Final
ENVIRONMENTAL ASSESSMENT

BARNEGAT INLET TO LITTLE EGG INLET (LONG BEACH ISLAND), NEW JERSEY

STORM DAMAGE REDUCTION PROJECT

Philadelphia District, U.S. Army Corps of Engineers

February 2014

BARNEGAT INLET TO LITTLE EGG INLET
STORM DAMAGE REDUCTION PROJECT
OCEAN COUNTY, NEW JERSEY

FINDING OF NO SIGNIFICANT IMPACT (FONSI)

In 1999, the United States Army Corps of Engineers, Philadelphia District, evaluated the environmental impacts associated with the construction of the Barnegat Inlet to Little Egg Inlet Storm Damage Reduction Project, and prepared a Final Environmental Impact Statement (FEIS). A Record of Decision (ROD) was signed in February 2001. The selected plan involves the placement of beachfill sand, which would be obtained from offshore sources to construct a berm and a dune for the purpose of storm damage reduction for the communities on Long Beach Island (LBI) from Seaview Drive, Loveladies to the terminal groin in Holgate, Long Beach Township, Ocean County, New Jersey. The initial plan called for approximately 4.95 million cubic yards (mcy) of sand for initial berm placement and 2.45 mcy for dune placement.

Although the design plan remains the same as described in the 1999 EIS, following Superstorm Sandy in 2012 existing conditions within the project area were re-evaluated to update quantity estimates. Beach nourishment to create a dune and beach berm of uniform cross section for the remaining unconstructed project municipalities entails a 125-foot wide beach berm at elevation +8.0 North American Vertical Datum (NAVD) and a dune at an elevation of +22 feet NAVD. The dune would be 30-feet wide at its crest and incorporate 347 acres of planted dune grasses and 540,000 linear feet of sand fencing. When initial construction is complete the total length of the dune/berm system would be approximately 16.9 miles long, and will require placement of approximately 7.8 mcy of sand fill. About 2 million cubic yards of sand would be required for periodic renourishment, on average, at 7-year intervals for a period of 50 years. For completion of initial construction of the project, approximately 2.9 mcy from Borrow Area D1 and approximately 4.9 mcy from Borrow Area D2 will be placed on the beach.

Initial construction has occurred along 4.5 miles of the LBI shoreline within some sections of the island (*i.e.* the municipalities of Surf City; Ship Bottom, Harvey Cedars; and the Brant Beach section of Long Beach Township). A 683-acre area (Borrow Area D1), centered approximately 2.5 miles off Harvey Cedars within state waters, has been utilized as the sand source. Additional sand sources are needed to complete initial construction. A 1034-acre area (Borrow Area D2) in Outer Continental Shelf (OCS) waters located directly east of Borrow Area D1, has been identified and evaluated. Since the Bureau of Ocean Energy Management (BOEM) has sole jurisdiction over OCS sand resources under the OCS Lands Act, and as such must authorize the use of the proposed borrow areas in the LBI project, BOEM is serving as a cooperating agency.

In compliance with the National Environmental Policy Act of 1969, as amended, and Council on Environmental Quality (CEQ) regulations, the Philadelphia District has prepared a draft Environmental Assessment (EA) to evaluate new information and proposed modified actions subsequent to the FEIS. The Draft EA for the project was forwarded to the U.S. Environmental

Protection Agency Region II, the U.S. Fish and Wildlife Service, the National Marine Fisheries Service, the New Jersey State Historic Preservation Office, the New Jersey Department of Environmental Protection (NJDEP), and all other known interested parties for comment.

The EA concludes that the proposed storm damage reduction project, if implemented, would not likely jeopardize the continued existence of any species or the critical habitat of any fish, wildlife or plant, which is designated as endangered or threatened pursuant to the Endangered Species Act of 1973 as amended by P.L. 96-159.

The EA also concludes that the project can be conducted in a manner, which should not violate New Jersey's Surface Water Quality Standards. Pursuant to Section 401 of the Clean Water Act, Water Quality Certification was provided from the NJDEP dated 15 June 2000 and 20 July 2006 (NJDEP Land Use Regulation File No. 1500-99-0001 1&2). Based on the information developed during preparation of the Environmental Assessment, and the application of appropriate measures to minimize project impacts, it was determined in accordance with Section 307(c) of the Coastal Zone Management Act of 1972 that the plan complies with and can be conducted in a manner that is consistent with the approved Coastal Zone Management Program of New Jersey. A Federal consistency determination for this project was provided by NJDEP in 2005 and 2006.

There are no known properties listed on, or eligible for listing on, the National Register of Historic Places that would be affected by the proposed activity. The proposed plan has been designed to avoid archaeologically sensitive areas, and concluded as having No Adverse Effect on historic properties potentially eligible for or listed on the National Register of Historic Places.

In accordance with the Clean Air Act, this project will comply with the General Conformity (GC) requirement (40CFR§90.153) through the following options that have been coordinated with the New Jersey Department of Environmental Protection (NJDEP); statutory exemption, emission reduction opportunities, use of the Joint Base McGuire/Lakehurst GC State Implementation Plan budget, and/or the purchase of Environmental Protection Agency (EPA) Clean Air Interstate Rule (CAIR) ozone season oxides of nitrogen (NOx) allowances. This project is not *de minimis* under 40CFR§90.153, therefore one or a combination of these options will be used to meet the GC requirements. The project specific option(s) for meeting GC are detailed in the Statement of Conformity (SOC), which is required under 40CFR§90.158.

The proposed Barnegat Inlet to Little Egg Inlet Storm Damage Reduction Project will not significantly affect the quality of the human environment; therefore a Supplemental Environmental Impact Statement is not required.

12 Feb 2014
Date

John C. Becking, P.E.
Lieutenant Colonel, Corps of Engineers
District Engineer

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1.0 PROJECT DESCRIPTION, PURPOSE, AND NEED

1.1 Introduction

The New Jersey Shore Protection Study addresses coastal erosion and water quality degradation along the ocean coast and back bays of the state of New Jersey (USACE 1990). The study provides recommendations for future beach nourishment and coastal restoration actions and programs to reduce storm damage and minimize the harmful effects of shoreline erosion; the plan also provides recommendations for coastal planners, engineers and resource agencies to reduce degradation of coastal lands and water quality.

Under the New Jersey Shore Protection Study, a Final Feasibility Report and Integrated Environmental Impact Statement (EIS) was completed by the U.S. Army Corps of Engineers Philadelphia District (PCOE) in 1999 for the Barnegat Inlet to Little Egg Inlet (Long Beach Island) reach of the New Jersey Atlantic Ocean coastline (Figure 1-1). The 50-year plan selected by the PCOE for restoring Long Beach Island (LBI) called for the placement of approximately 7.4 million cubic yards (mcy) of sand along approximately 17 miles of coastline from Barnegat Inlet to Little Egg Inlet, including 4.95 mcy for the initial berm placement and 2.45 mcy for dune placement. The berm and dune restoration extends from groin 4 (Seaview Drive, Loveladies) to the terminal groin (groin 98) in Holgate, Long Beach Township. The Barnegat Light area (northern end of the study area) is not included. The Feasibility Report estimated that approximately 1.9 mcy of sand would be needed for periodic nourishment every 7 years over the authorized 50-year period. Since 2006, the PCOE has constructed 4.5 miles of the LBI shoreline (*i.e*. within the municipalities of Surf City, Ship Bottom, Harvey Cedars, and the Brant Beach section of Long Beach Township).

Several borrow areas located within state waters off the New Jersey coast have been used to supply sand to beachfront communities; however, many of these sand sources have been deemed environmentally sensitive and are no longer available for use, whereas the sand in other borrow areas is not beach compatible or said borrow areas do not have sufficient volumetric capacity over the life of the project. Borrow Area D1, a 683-acre area centered approximately 2.5 miles off Harvey Cedars in state waters, has been utilized for past construction at LBI. There is an insufficient volume of sand remaining in D1 for continued project maintenance and/or full project construction. The PCOE previously identified two alternative borrow areas on the Outer Continental Shelf (OCS) that contain beach-compatible sediments for possible use in the LBI project: a 572 acre area directly east of Area D1, named D2, and a 542 acre area directly southeast named D3 (see Section 2.2 for a more detailed discussion of the proposed OCS borrow areas). Subsequent to geotechnical, biological, and cultural investigations, Area D2 and D3 underwent further geotechnical evaluation and were subsequently combined as one 1034 acre site referred to as Area D2. Combined, the area allows for more flexibility to avoid any areas of unsuitable material during dredging. The total acreage of the combined site is not additive, as the boundaries were modified to avoid areas of unsuitable material.

The purpose of this Environmental Assessment is to evaluate the PCOE's proposed use of expanded borrow area D2, as well as any new information that has become available since completion of the Final Feasibility Report and Integrated EIS in 1999. This EA tiers directly from the 1999 Final Feasibility Report and Integrated EIS; the effects analyses in that document are incorporated by reference and summarized herein and in the case where that information previously presented has changed, conditions or effects analyses are presented and updated herein. Since the Bureau of Ocean Energy Management (BOEM) has sole jurisdiction over OCS sand resources under the OCS Lands Act, and as such must authorize the use of the proposed borrow areas in the LBI project, BOEM is serving as a cooperating agency during the preparation of this EA.

Figure 1-1: Barnegat Inlet to Little Egg Inlet (Long Beach Island) project area, New Jersey.

1.2 Purpose and Need

Loss of sand from New Jersey coastal beaches and dunes is a serious problem that affects both the coastal environment and important public and private infrastructure (Figure 1-2). The U.S. Army Corps of Engineers (USACE) has selected beach nourishment as the most effective way to address the problem and previously constructed segments of the LBI project using sand from Borrow Area D1. The LBI project is needed to stem chronic coastal erosion and restore and enhance hurricane and storm damage protection provided by the beach and dune system. There is not sufficient volume of beach-compatible sand remaining in Borrow Area D1 to continue maintaining and complete the project. In addition, since the discovery of Discarded Military Munitions (DMM) within Borrow Area D1 during the initial LBI beachfill operation in March 2007, PCOE has been employing munitions screens on the dredging intake for subsequent beach nourishment projects to prevent DMM from being deposited on the beaches. The "sieved" method of pumping with screens renders less material in the borrow area available for beach placement.

Figure 1.2: Chronic erosion along Long Beach Island.

To construct the remaining segments of the LBI project and continue maintenance of the project as authorized, the PCOE must have access to a different borrow area to construct and maintain the beach and dune system. This EA provides an evaluation of the OCS Borrow Area D2 and updates the conditions and effects analyses of the project in support of the BOEM's related proposed action: authorizing use of OCS sand, in response to the PCOE's request for use of OCS sand under the authority granted to the Department of the Interior by the Outer Continental Shelf Lands Act (OCSLA). The proposed action is necessary because the Secretary of the Interior delegated the authority granted in the OCSLA to the BOEM to authorize the use of OCS sand resources for the purpose of shore protection and beach restoration.

1.3 Study and Project Authorities

1.3.1 New Jersey Shore Protection Study

The New Jersey Shore Protection Study was authorized under resolutions adopted by the Committee on Public Works and Transportation of the U.S. House of Representatives and the Committee on Environment and Public Works of the U.S. Senate in December 1987. The Senate resolution adopted by the Committee on Environment and Public Works on December 17, 1987 states:

> That the Board of Engineers for Rivers and Harbors, created under Section 3 of the Rivers and Harbors Act, approved June 13, 1902, be, and is hereby requested to review existing reports of the Chief of Engineers for the entire coast of New Jersey with a view to study, in cooperation with the State of New Jersey, its political subdivisions and agencies and instrumentality thereof, the changing coastal processes along the coast of New Jersey. Included in this study will be the development of a physical, environmental, and engineering database on coastal area changes and processes, including appropriate monitoring, as the basis for actions and programs to prevent the harmful effects of shoreline erosion and storm damage; and, in cooperation with the U.S. Environmental Protection Agency (USEPA) and other Federal agencies as appropriate, develop recommendations for actions and solutions needed to preclude further water quality degradation and coastal pollution from existing and anticipated uses of coastal waters affecting the New Jersey coast. Site specific studies for beach erosion control, hurricane protection, and related purposes should be undertaken in areas identified as having potential for a Federal project, action, or response.

The House resolution adopted by the Committee on Public Works and Transportation on 10 December 1987 states:

> That the Board of Engineers for Rivers and Harbors is hereby requested to review existing reports of the Chief of Engineers for the entire coast of New Jersey with a view to study, in cooperation with the State of New Jersey, its political subdivisions and agencies and instrumentality thereof, the changing coastal processes along the coast of New Jersey. Included in this study will be the development of a physical, environmental, and engineering database on coastal area changes and processes, including appropriate monitoring, as the basis for actions and programs to prevent the harmful effects of shoreline erosion and storm damage; and, in cooperation with the Environmental Protection Agency and other Federal agencies as appropriate, the development of recommendations for actions and solutions needed to preclude further water quality degradation and coastal pollution from existing and anticipated uses of coastal waters affecting the New Jersey Coast. Site specific studies for beach erosion control, hurricane protection, and related purposes should be undertaken in areas identified as having

potential for a Federal project, action, or response which is engineeringly, economically, and environmentally feasible.

1.3.2 Long Beach Island Coastal Storm Damage Reduction Project

The Long Beach Island Coastal Storm Damage Reduction Project was authorized by Congress for construction by Section 101 (a) (1) of the Water Resources Development Act of 2000 and cost-shared with the nonfederal sponsor, the New Jersey Department of Environmental Protection. The project is considered an ongoing construction project for purposes of PUBLIC LAW 113–2, issued 29 January 2013; The Disaster Relief Appropriations Act, 2013. PL 113-2, Chapter 4: for "repairs to projects that were under construction and damaged as a consequence of Hurricane Sandy" at full federal expense with respect to such funds.

1.3.3 BOEM Authority

Section 8(k) of the OCSLA grants BOEM the authority to convey, on a noncompetitive basis, the rights to OCS sand, gravel, or shell resources for shore protection, beach or wetlands restoration, or for use in construction projects funded in whole or part or authorized by the federal government. These resources fall under the purview of the Secretary of the Interior who oversees the use of OCS sand and gravel resources, and BOEM as the agency charged with this oversight by the Secretary.

1.4 Project Location

The barrier island between Barnegat Inlet to the north and Little Egg Inlet to the south is known as Long Beach Island in Ocean County, New Jersey. The island has a total length of 20.8 miles and has a general axis of orientation aligned in a north-northeast/south-southwest direction. The New Jersey coastline, including Long Beach Island, has a long history of severe erosion and is frequently subject to storm damage from wave attack and storm surge inundation. Along the shoreline, there are a total of 99 visible groin structures spaced at intervals that range from 750 to 1000 feet. The groins are constructed of timber, stone, or a combination of the two.

The island is separated from the mainland to the west by shallow, elongated backwaters with salt marshes: Barnegat Bay and Little Egg Harbor. Barnegat Inlet has been a Federally-maintained inlet since 1940 with the completion of rock jetties. Long Beach Island is comprised of the following municipalities: the Borough of Barnegat Light, Long Beach Township, the Borough of Harvey Cedars, the Borough of Surf City, the Borough of Ship Bottom, and the Borough of Beach Haven (Figure 1-1). It can be described as a developed urban area consisting of primarily residential homes and small businesses, with herbaceous shrub, beach, dune and tidal wetland perimeter areas. Seashore and water-oriented summer recreation is the predominant land-use including residential rentals and support services for commercial establishments.

Other than the municipalities there are also major State and Federal land holdings on Long Beach Island. Barnegat Inlet State Park, about 32 acres, is managed by New Jersey Department of Environmental Protection, Division of Parks and Forestry and bounds the north end of the island and borders Barnegat Inlet. The Holgate Unit of the Edwin B. Forsythe National Wildlife Refuge, nearly two miles of undeveloped beach, forms the southern tip of the island and borders Beach Haven Inlet. The U.S. Department of the Interior, U.S. Fish and Wildlife Service manages the refuge. The land use/cover type for the project area is typical of coastal barrier island and trapped bay conditions. Barnegat Bay, a 75-

square-mile estuary, is a crucial link in the Atlantic flyway for migratory waterfowl. These wetlands serve as the winter grounds for waterfowl as well as important nesting, feeding, and migratory habitat for hundreds of species of shorebirds and waterfowl. The Barnegat Bay system, located west of the proposed project area, includes contiguous streams and adjacent wetlands that provide nursery grounds for many coastal fish populations and supports large recreational and commercial fisheries for finfish and shellfish. These resources comprise the centerpiece of a thriving tourist industry and as such, are critical to the economic, as well as environmental health of southern New Jersey.

The project area also includes the diverse inner shelf habitat offshore of Long Beach Island, including the physically-dominated surf zone, sandy nearshore habitat, and offshore borrow areas that will be targeted for dredging for beach fill. The borrow areas D2 and D3 are described in more detail in Chapter 3.

1.5 Prior Related Studies and Reports

There exist numerous planned, completed, as well as ongoing shoreline erosion protection projects along the New Jersey ocean coast. Various groups, including the Federal government, the State of New Jersey, local municipalities, and private interests, have initiated this type of activity. The PCOE reports relevant to this project are presented below:

Project Information Report, Rehabilitation Effort for the New Jersey Shore Protection, Barnegat Inlet to Little Egg Inlet, NJ Hurricane/Shore Protection Project, 2012. Under the authority of 33 701n (Public law 84-99) this PIR was prepared to document damage to the project and serves on a nationwide basis to reduce loss of life and property damage under DOD, USACE, FEMA, and other agencies' authorities.

Project Information Report, Rehabilitation Effort for Surf City and Harvey Cedars Shore Protection, Barnegat Inlet to Little Egg Inlet, 2010. This report provides an overview of all pertinent regulations required for supplemental sand placement deemed necessary following severe erosion on the northern end of the project area due to a large number of coastal storms during the winter and spring.

Barnegat Inlet to Little Egg Inlet Feasibility Report and Integrated Environmental Impact Statement – 1999. This report presents the result of a feasibility phase study to determine the magnitude and effect of shoreline erosion problems and an implementable solution to the problems at Long Beach Island, New Jersey. The selected plan for hurricane and storm damage protection is berm and dune restorations utilizing sand obtained from offshore borrow sources, with periodic renourishment every 7 years for a 50-year period of analysis.

The Feasibility Report and EIS was prepared in accordance with ER 1105-2-100 (Civil Works Planning Guidance Notebook), ER 1110-2-1150 (Engineering & Design for Civil Works Projects), ER 1165-2-130 (Federal Participation in Shore Protection), and other applicable guidance and regulations. Preparation of the LBI EIS involved coordination with appropriate Federal and state resource agencies. During the public review of the EIS, a Water Quality Certificate, in accordance with Section 401 of the Clean Water Act, and a concurrence of Federal consistency with the New Jersey Coastal Zone Management program, in accordance with Section 307 (c) of the Coastal Zone Management Act, was granted by the New Jersey Department of Environmental Protection (NJDEP). A Section 404(b)(1) evaluation is included in the Final Feasibility Report and Integrated EIS. This evaluation concluded that the proposed action would not result in any significant environmental impacts relative to areas of concern under Section 404 of the Federal Clean Water Act. In accordance with the Fish and Wildlife Coordination Act (FWCA), a

Planning Aid Report was obtained from the U.S. Fish and Wildlife Service (1996) and a Section 2 (b) Report (1999). The Feasibility Report and Integrated EIS (1999) presented the results of the analysis of existing conditions, plan formulation, and design of the National Economic Development (NED) plan. The scope of work involved field data collection at both the proposed placement sites and proposed borrow areas, including hydrographic and topographic surveys, benthic organism utilization, economic, real estate and cultural resources studies.

Barnegat Inlet to Little Egg Inlet Reconnaissance Study – 1995. This study was the fifth site specific study conducted under the New Jersey Shore Protection Study. This first phase of the Corps's two-phase study planning process (the reconnaissance phase) addressed shoreline erosion and storm damage vulnerability of Long Beach Island, New Jersey. The study determined the potential for a Federal project, action and response which is engineeringly, economically, and environmentally feasible.

New Jersey Shore Protection Study – 1990. The Study was initiated in 1988 to investigate shoreline protection and water quality problems, which exist along the entire coast. Special interest focused on physical coastal processes, those mechanisms occurring in the coastal zone, which result in the movement of water, wind and littoral materials. Upon the conclusion that existing numerical data was insufficient to provide long-term solutions, future comprehensive studies were proposed. The Limited Reconnaissance Phase of the New Jersey Shore Protection Study identified and prioritized those coastal reaches which have potential Federal interest based on shore protection and water quality problems which can be addressed by the PCOE. Barnegat Inlet to Little Egg Inlet was one of the reaches identified to undergo the Corp's two-phase planning process.

Barnegat Inlet Phase I General Design Memorandum – ***1981.*** Phase II GDM - 1984. These design documents were prepared to finalize planning and policy for a modification to the Barnegat Inlet project. Ultimately it was decided to pursue as a correction for a design deficiency with the original inlet jetty configuration. The arrowhead design of 1939-40 did not provide for a sufficiently stable channel and safe navigation through Barnegat Inlet.

New Jersey Inlets and Beaches, Barnegat Inlet to Longport -1974. This recommended the following project for Long Beach Island: beach fill with a 75 ft berm at +10 MLW, construction of one additional groin, modification of seven groins, reimburse the state for recent construction of 14 groins, maintenance of all groins, and periodic nourishment for the beachfill. The project was authorized for PED in 1976 and for construction in 1986.

Miscellaneous Report No. 80-9 Beach Changes at Long Beach Island, New Jersey, 1962-73. Coastal Engineering Research Center (CERC) report 1980. This report documents beach changes during the period after the March 1962 storm and during the time of heavy groin construction until 1972.

Beach Erosion Control Report on Cooperative Study (Survey) of the New Jersey Coast, Barnegat Inlet to the Delaware Bay Entrance to the Cape May Canal - 1957. This report eventually became **House Document 86-208** (1959) "Shore of New Jersey -Barnegat Inlet to Cape May Canal, Beach Erosion Control Study" provided for Federal participation in the costs of constructing stone revetment, timber bulkhead, timber groins, extending stone groins, and beach nourishment.

2.0 ALTERNATIVES

This EA tiers directly from the 1999 Feasibility Report and Final EIS that previously considered a full suite of structural and non-structural alternatives to beach nourishment. The structural measures that were considered in the 1999 report included bulkheads, seawalls, revetments, offshore breakwaters, groins, beach restoration/nourishment, and beach sills. Nonstructural measures included flood insurance, development regulations, and land acquisition. Chapter 2 of the present EA describes the proposed action (selected plan), no action alternative, and borrow area alternatives that were subsequently considered following completion of the 1999 EIS.

Since the PCOE previously selected beach nourishment as the preferred alternative and the project was partially constructed from 2006-2013, this EA does not re-consider the full suite of alternatives previously evaluated during the initial planning process. The alternatives evaluated and compared in this EA include various sources of beach-quality sand with the purpose of identifying a new borrow area in support of the authorized beach nourishment project.

Section 2.1 summarizes the NED plan previously selected as the preferred alternative. Section 2.2 reviews borrow areas identified in the vicinity of LBI. Section 2.3 describes the alternatives evaluated for the current proposed action.

2.1 Selected Plan

In February 2001, the PCOE selected the NED plan for Barnegat Inlet to Little Egg Inlet, which included a combination of dune and berm restoration, with periodic nourishment every seven years for a 50 year project life. The National Economic Development (NED) plan is the plan which maximizes benefits to the Nation while meeting planning objectives. The NED objective is to increase the value of the Nation's output of goods and services and improve the national economic efficiency, consistent with protecting the Nation's environment pursuant to national environmental statutes, applicable executive orders and Federal planning requirements.

In the LBI Project, the PCOE proposed to place on various stretches of Long Beach Island in phases where the existing berm and dune profiles are below the minimum measurements of the design profile. The plan will provide for a dune with a slope of 1V:5H. This will produce a beach berm width of 125 feet from centerline of dune to the edge of the berm, with approximately 105 feet of dry beach from the seaward toe to mean high water (MHW). The dune elevation is 22 feet NAVD with a 30-foot wide crest and incorporates 347 acres of planted dune grasses and 540,000 linear feet of sand fencing. This plan was chosen because it provided the maximum net storm damage reduction benefits.

As described in the 1999 EIS, the plan required 4.95 million cubic yards of sand for initial berm placement and 2.45 million cubic yards for dune placement for the entire project area. Approximately 1.9 million cubic yards of sand would be needed for periodic nourishment every 7 years over a 50-year period of analysis. The Barnegat Light (northern end of the study area) is not included in the project because it has little long-term erosion and adequate dune and berm profiles. In the southern uninhabitated portion of the study area, the U.S. Fish and Wildlife Service has stated that the Holgate Unit of the Edwin B. Forsythe National Wildlife Refuge will remain in its natural state, therefore it also is excluded from the project.

Although the design plan remains the same as described in the 1999 EIS, following Superstorm Sandy in 2012 existing conditions within the project area were re-evaluated to update quantity estimates. Beach nourishment to create a dune and beach berm of uniform cross section for the remaining unconstructed project municipalities entails placement of approximately 7.8 mcy of sand fill. About 1.9 million cubic yards of sand would be required for periodic renourishment, on average, at 7-year intervals for a period of 50 years. For completion of initial construction of the project, approximately 2.9 mcy from Borrow Area D1 and approximately 4.9 mcy, with a 20-25% contingency quantity, will be dredged from Borrow Area D2. When initial construction is complete the total length of the dune/berm system would be approximately 16.9 miles long.

Beach access during and after construction includes natural beach walkover paths, up and over the dunes at a skewed angle and delineated by sand fencing. Vehicular access will be provided at existing vehicular access points. The plan also included planting 337 acres of dune grass and 509,700 linear feet of dune fencing.

A protective dune/berm with periodic nourishment represents the least environmentally damaging structural method of reducing potential storm damages at a reasonable cost. It is generally considered socially acceptable, proven to work in high-energy environments, and is the only engineered shore protection alternative that directly addresses the problem of a sand budget deficit (National Research Council, 1995). The somewhat transient nature of beach nourishment is actually advantageous. Beach fill is dynamic, and adjusts to changing conditions until equilibrium can again be achieved. Despite begin structurally flexible, the created beach can effectively dissipate high storm energies, although at its own expense. Costly rigid structures like seawalls and breakwaters utilize large amounts of material foreign to the existing environment to absorb the force of waves. Beach nourishment uses material typical of existing area sand to buffer the shoreline structures against storm damage. Consequently, beach nourishment is more aesthetically pleasing as it represents the smallest departure from existing conditions in a visual and physical sense, unlike groins.

2.1.1 Project History

Initial construction of three sections of the Barnegat Inlet to Little Egg Inlet project has been completed using Borrow Area D1. Figure 2-1 shows the typical landside beachfill operation during construction. For each of the three initial construction sections, the beach fill material was placed into the general construction template depicted on Figure 2-5.

1. In 2006-2007 approximately 886,000 cubic yards (cy) of sand was placed on 8,100 linear feet of beach between North 25th Street in Surf City to South 5th Street in the northern five blocks of Ship Bottom.
2. In 2010 approximately 3,000,000 cy of sand was placed on 10,450 linear feet of beach between 86th street and 500 feet south of Bergen Avenue in Harvey Cedars.
3. In 2012, approximately 1,200,000 cy of sand was placed on 5,200 linear feet in the Brant Beach section of Long Beach Township, between 32nd and 57th Streets.

In addition to the initial construction of the three segments, two emergency repair actions have been conducted in response to a number of severe coastal storms that caused damage to the completed project sections:

1. In 2011 an additional 300,000 cy was placed between North 25th and North 10th Streets in Surf City in response to severe Nor'easter storms that caused severe erosion during the prior two winters.
2. In 2013, the PCOE conducted emergency repairs along the completed sections of Long Beach Island, placing approximately 880,000 cy was placed in Brant Beach, approximately 280,000 cy of beachfill in Surf City, and approximately 840,000 cy of beachfill in Harvey Cedars. The borrow area was D1.

As explained in the 1999 EIS, there is a long and complex history of state sponsored beach nourishment projects along LBI dating to the 1950s (refer to Table 1-2, 1999 EIS).

Figure 2-1: Beachfill along Brant Beach, Long Beach Island in 2012.

2.2 Alternative Borrow Areas

There are no economically viable land sources of sand for the large quantities of beach fill required. Inlet, nearshore, and offshore sand sources are the only economically viable borrow areas alternatives. Barnegat Inlet, a Federally-maintained channel, is dredged three times a year by the dredge Currituck with approximately 100,000 cubic yards removed each time. The median grain size of this material is adequate for beach purposes along LBI but quantities limit the cost effectiveness of using the inlet as a sand source. The quantities of sand dredged at any one time for maintenance is very small in comparison to the quantity needed for beach renourishment.

Potential nearshore and offshore borrow areas A-G were originally identified by Meisburger and Williams in the 1982 USACE Coastal Engineering Research Center (CERC) report entitled "Sand Resources on the Inner Continental Shelf off the Central New Jersey Coast". Borrow Area G was determined to have incompatible material based on the 1982 report, and thus, was not considered any further during feasbility. Seven offshore borrow areas were identified in the 1999 Feasibility Report and EIS including borrow areas A, B, C, D, E, F and Barnegat Light Inlet. Borrow area D included areas D1 and D2, the latter of which extended onto the OCS. Borrow Area C and F were not considered further due to the interference of AT&T submarine telecommunication cables. Borrow areas A, B, D and E, located within three miles of the Long Beach Island coast, were determined to be the most feasible and cost-effective sources of sand (Figure 2-2):

Borrow Area "A". Site A is an ebb shoal located 0.25 statute miles offshore from Barnegat Inlet and is about 845 acres. This site is approximately 3.0 miles long by 1.5 miles wide. Borrow area A is considered a back-up source of material due to its moderate compatibility with the beach material. This site has an estimated 2,200,000 cubic yards (cy) of suitable material.

Borrow Area "B". Site B is about 272 acres and centered off Loveladies at a distance of about 1.7 statute miles. It is approximately 2.2 miles long with a width of 0.8 miles. This site has approximately 3,640,000 cy of suitable material for the proposed beach fill.

Borrow Area "D" (now referred to as D1). Site D was initially identified as 567 acres and most recently as a 683-acre site centered approximately 2.5 miles off Harvey Cedars and has a length of 1.3 miles and width of 0.6 mile (the shape of D1 was adjusted slightly before initial construction due to additional subsurface information). This site is currently estimated to have approximately 2,900,000 cy of suitable material.

Borrow Area "E" is 400 acres in size and centered off Ship Bottom at a distance of about 1.0 statute mile and has an approximate length of 2.5 miles and width of 0.3 mile. This site has approximately 9,350,000 cy of suitable material for the proposed beach fill.

In 1999, the selected plan for LBI proposed to use Borrow Areas A, B, D1 and E for initial construction and periodic nourishment. In general, subsurface investigations indicated that shoals contained the proper grain size material that was compatible with the sand material on the beaches (USACE/Alpine 1996; Duffield Associates 1998). Subsurface investigations in 1982, 1996, and 1998 indicated that finer material existed outside of the shoals. Nine vibracores were collected in 1998 east of Barnegat Inlet, Harvey Cedars, and Beach Haven Crest (Duffield Associates, 1998). Predominantely granular materials were encountered in a majority of the vibracores obtained, with some fine-grained materials in two vibracores. In 2002, another 19 vibracores were taken at locations offshore of Harvey Cedars in Borrow Areas D1 and in Borrow Area D2, ranging in distance from two to six miles from the coast (Duffield Associates, 2002). D2 was a northeast extension of the D1 borrow area, extending on to the OCS (Figure 2-2). The majority of the vibracore samples had significant quantities of granular materials in the initial 10 feet below the mudline. Two core locations located closest to shore were observed to contain relatively thin layers of fine-grained materials in the uppermost 2 feet of material obtained in the core. While the thickness of the fine-grained stratum is relatively thin, the areal extent of these materials is unknown. The northwestern, or shoreward boundary of Area D1 may not offer material suitably coarse-grained for beachfill material.

Only Borrow Area D1 has been used in the partial construction of the LBI project to date. Borrow Areas A, B, D1, and E, located 0.25 to 2.5 miles offshore, offer varying available quantities and compatibility characteristics, but no longer meet the design quantities needed and/or dredging these areas is not considered environmentally acceptable. Area A has been eliminated because of its moderate grain size compatibility and the greater likelihood for more severe environmental impacts associated with repeat dredging in a productive inlet system. Moreover, dredging Borrow Area A may interrupt the longshore sediment transport and sediment bypassing that has developed around the ebb tidal delta. The PCOE expected to use Borrow Areas B and E during the 42-year renourishment cycle following initial construction. The PCOE proposed to use Area B every seven years after initial construction, dredging approximately 167,000 cy each. In comparison, Area E was expected to contribute 379,000 cy for initial construction and 794,000 cy every 7 years until depleted. Borrow Areas B and E have been effectively eliminated over environmental impacts concerns, resulting in the reduction of available sand source by approximately 12 million cy. Area B and E were ruled out as they are located partially in areas that have been identified by the New Jersey Department of Environmental Protection as Prime Fishing Areas, as defined by the Rules on Coastal Zone Management N.J.A.C. 7:7E, as amended July 18, 1994.

While telecommunication cables also pass through Borrow Area D1, the majority of the Borrow Area D1 could still be utilized, except those areas where finer grained material was sampled. In 2006, PCOE pumped approximately 880,000 cy of sand onto Surf City. Unknown at the time, the D1 Borrow Area contained significant quantities of discarded military munitions. Over 1,150 munitions items were recovered by PCOE or turned in by citizens from the Surf City beach. The PCOE entered into an agreement with the NJDEP (nonfederal sponsor) to use munitions screening on all beach nourishment dredging projects, regardless of the source location of the material. Munitions screening on both the dredge intake and discharge points screen out substrate particles larger than the screen openings, thereby reducing available quantities for placement. PCOE typically limits the depth of dredging to 5-10 feet below current surface to minimize impacts to the bottom habitat. Three previous initial construction placements combined with recent post-storm emergency repair and restoration renourishment actions have reduced the remaining capacity of Borrow Area D1. Capacity is insufficient to complete initial construction of the remaining portions of the project. The PCOE determined that additional sand sources would be necessary as D1 alone could not provide sufficient volume.

As previously mentioned, a 572 acre area directly east of D1, designated D2, was identified and sampled in 2001, 2002 and 2009 (Duffield Assoc. 2002; Cox, 2001; Scott and Bruce, 2001). Thereafter, D3, a 542 acre area directly southeast of D2, was delineated (CH2MHill, 2009; Cox, 2012; Scott, 2012). Borrow Areas D2 and D3, now collectively referred to as D2, are both located outside state waters (Figure 2-3 and Figure 2-4). Duffield Associates subcontracted Alpine Ocean Seismic Survey, Inc. in 2009 to conduct vibracore sampling in areas D2 and D3. Twelve additional vibracores were taken, including 5 in Area D2 and 7 in Area D3, after munitions were discovered. The majority of samples possessed more than 96% sand and determined to be beach compatible.

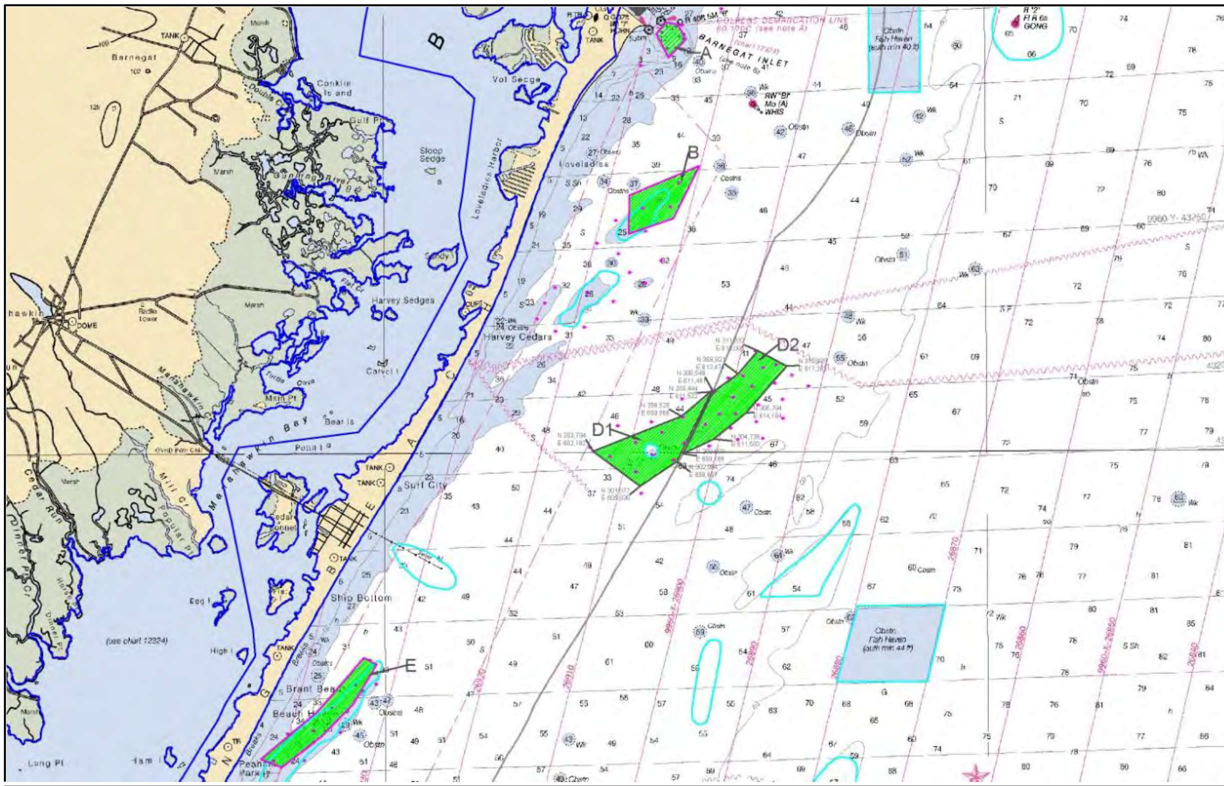

Figure 2-2: Original proposed borrow areas. The original proposed Area D2 was included in 1999 EIS.

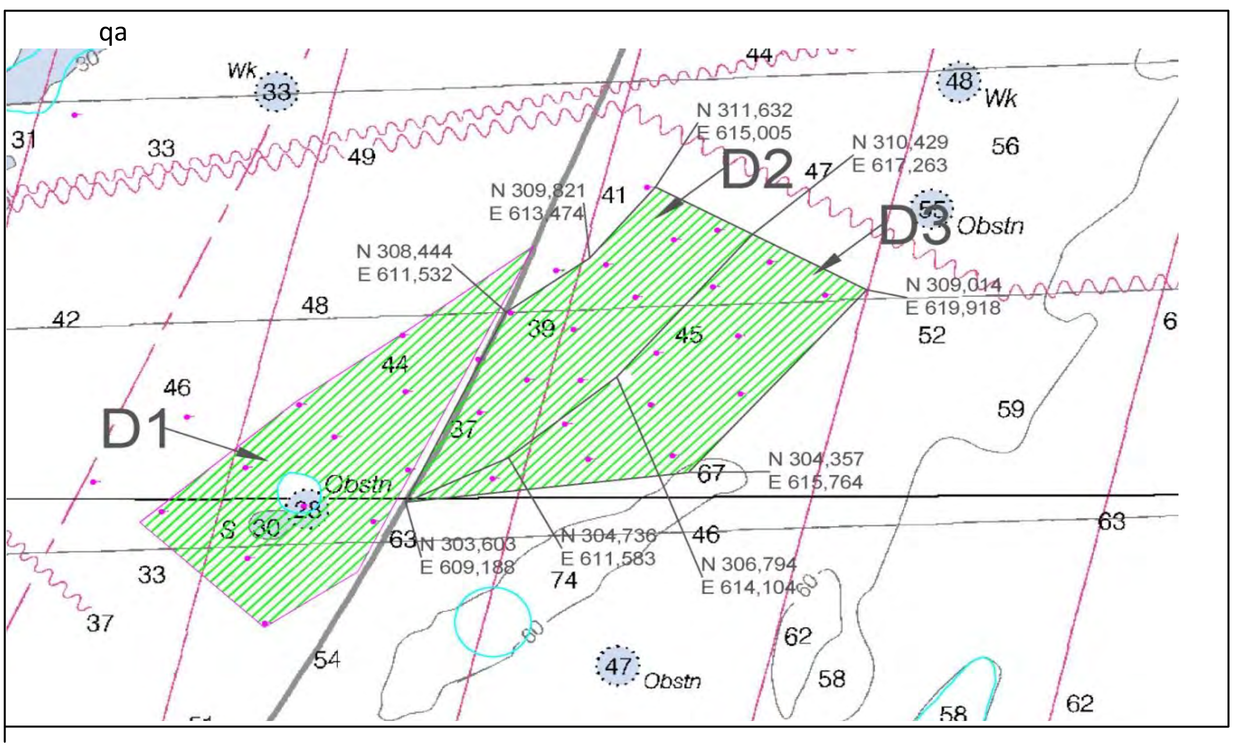

Figure 2-3: Proposed Borrow Areas D2 and D3 analyzed in 2011 and 2012.

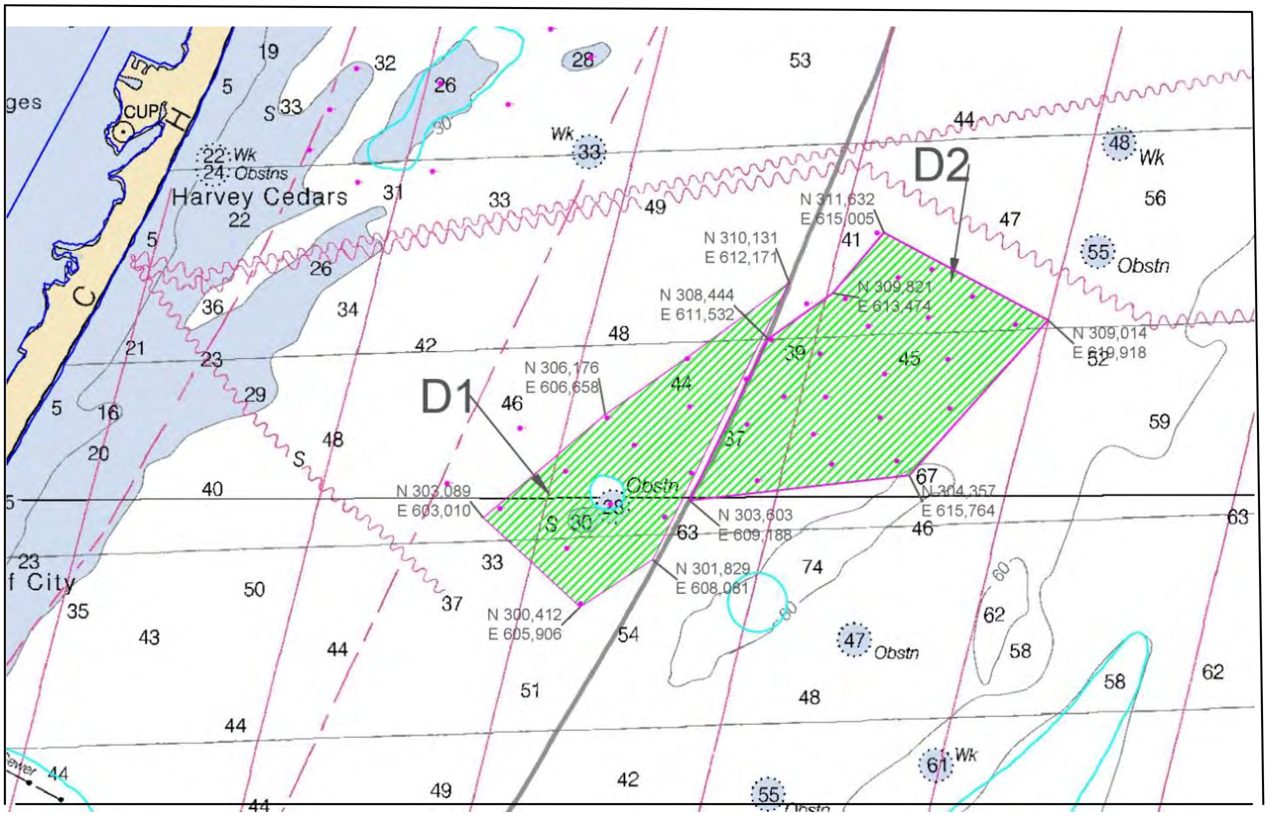

Figure 2-4: Redesignated Area D2 (modified original Areas D2 and D3 combined).

2.3 Alternative Plans

2.3.1 No Action

Project construction was initiated in 2006. Initial construction of the beach berm and dune has been completed to date in Harvey Cedars, Brant Beach, and Surf City, comprising approximately 26% of the total project. Beach nourishment projects serve to protect coastal infrastructure because their template is designed to offer sufficient elevation and length of a beach berm and vegetated dune system to function in a naturalized state. The No Action Alternative will leave the project partially constructed with a remaining quantity of only 2.9 mcy in Borrow Area D1. The impacts to resources of the No Action Alternative are presented in the EIS (USACE, 1999) and for purposes of brevity, are not included herein. With respect to the current proposal to complete project construction, the impacts to resources under the No Action alternative would be the same as those described in the 1999 EIS. The No Action Alternative would render the partially completed project incapable of providing the intended storm protection and undermines the resiliency and integrity of the constructed portions of the project.

The New Jersey coast also serves the added benefit as a recreational resource, generating a tourism industry in addition to providing major shipping and commercial fishing industries. Decades of coastal developments have interrupted the natural and necessary movement of sediment and interfered with coastal processes, and combined with sea level rise, erode protective sand dunes. With the No Action alternative, coastal communities will continue to be vulnerable to winds and high waves, and ultimately, flooding.

2.3.2 Beach Nourishment using Borrow Area D1

For the reasons presented in Section 2.2, Borrow Area D1 became the most viable borrow area for the LBI project construction and has been used solely, thus far, for those portions of the project that have been constructed to date. Due to several storms, initial construction quantities and post-storm emergency renourishment quantities reduced the remaining capacity in D1 to approximately 2.9 mcy. The total volume need estimated in the Feasibility Study (USACE, 1999) was approximately 21 mcy over the 50 year life of the project. The use of Borrow Area D1 alone was dismissed as it was concluded to be infeasible.

2.3.3 Preferred Plan: Beach Nourishment using Borrow Areas D1 and D2

As previously presented in Section 1.1**,** several borrow areas located within state waters off the New Jersey coast have been used to supply sand to beachfront communities; however, many of these sand sources have been deemed environmentally sensitive and are no longer available for use, whereas the sand in other borrow areas is not beach compatible or said borrow areas do not have sufficient volumetric capacity over the life of the project. Borrow Area D1, a 683-acre area centered approximately 2.5 miles off Harvey Cedars in state waters, has been utilized for past construction at LBI. There is an insufficient volume of sand remaining in D1 for continued project maintenance and/or full project construction. The PCOE previously identified two alternative borrow areas on the Outer Continental Shelf (OCS) that contain beach-compatible sediments for possible use in the LBI project: a 572 acre area directly east of Area D1, named D2, and a 542 acre area directly southeast named D3 (see Section 3.3 for a more detailed discussion of the proposed OCS borrow areas). Subsequent to geotechnical, biological, and cultural investigations, Area D2 and D3 underwent further geotechnical evaluation and were combined and identified as one 1034 acre site, referred to as Area D2. The combined site allows for more flexibility to avoid any areas of unsuitable material during dredging. The total acreage of the combined site is not additive as the boundaries were modified to avoid areas of unsuitable material.

Although the design plan remains the same as described in the 1999 EIS, following Superstorm Sandy existing conditions within the project area were re-evaluated to update quantity estimates. Beach nourishment to create a dune and beach berm of uniform cross section for the remaining unconstructed project municipalities entails a 125-foot wide beach berm at elevation +8.0 North American Vertical Datum (NAVD) and a dune at an elevation of +22 feet NAVD. The dune would be 30-feet wide at its crest and incorporate 347 acres of planted dune grasses and 540,000 linear feet of sand fencing. When initial construction is complete the total length of the dune/berm system would be approximately 16.9 miles long, and will require placement of approximately 7.8 million cubic yards (mcy) of sand fill. About 1.9 mcy of sand would be required for periodic renourishment, on average, at 7-year intervals for a period of 50 years. For completion of initial construction of the project, approximately 2.9 mcy from Borrow Area D1 and approximately 4.9 mcy from Borrow Area D2 will be dredged. An estimated additional 20-25% may be dredged from Area D2 to account for potential losses during the dredging operation due to sediment characteristic variability, shoreline change prior to construction, and settlement/erosion due to storms during construction.

Approximately 4 miles of the 16.9 mile project has been constructed. Three separate contracts have been completed based on the appropriations made available to date. Initial construction has been completed in Harvey Cedars (2 mi), Surf City (1 mi), and the Brant Beach section of Long Beach Township (1 mi). The municipalities that still require initial construction include Long Beach Township, the Borough of Ship Bottom, and the Borough of Beach Haven.

Dredging of sand from within the limits of D1 and D2 shall be accomplished by either a cutter suction or trailing suction hopper dredge. Cutter suction or hydraulic dredges are floating platforms equipped with a rotating cutter that excavates the sea floor, feeding the loosened material into a pipe (generally 30" diameter) and pump system that transports the material and water slurry up to typical distances of five miles. Transport distances can be extended by the addition of booster pumps in the pipeline route. These booster pumps are within New Jersey state waters.

Trailing suction hopper dredges are designed to vacuum material from the sea floor through drag arms that load the material into the hold of the vessel (3,600 CY to 6,500 CY). The cargo of sand is then sailed to a pump-out location within New Jersey state waters where the material is pumped ashore by the ship (or the pump-out station). Both dragheads and cutterheads will be screened on intakes and baskets. The hole size on the intake screens is 1 ¼” while the mesh on the baskets is ¾”. The screening device on the dredge intake or in-pipeline section prevents the passage of any material greater than 1 ¼”in diameter. The maximum allowable opening is 1-1/4” x 6 “.

Current depths in Borrow Area D1 range between -35 and -65 feet NAVD88 and between -40 and -60 feet NAVD88 in Borrow Area D2. Dredge cut depths can vary greatly depending on the type of dredge plant utilized. For each drag arm of a hopper dredge, cuts typically are about 4 feet wide and 3 feet deep. Hydraulic cutter suction dredges can cut lanes approximately 200 feet wide and about 5 feet deep with each pass. To allow flexibility for the dredge to most efficiently remove the required volume of sand, the dredger is permitted to access the entire extent of the delineated borrow area but typically does not impact the entire site. Maximum cut depths are restricted to 5-10 feet deeper than surrounding bathymetry. The only operation within BOEM regulated waters for trailing suction hopper dredges is the dredging process itself.

Once material is on the beach, earth work equipment is used to spread the sand to meet line and grade (dune, berm, fore slope, *etc.*) as required by contract (Figures 2-5, 2-6). Initial construction is anticipated to take approximately 4-6 months of dredging and 6 months of berm construction (*i.e*. bulldozing), crossover construction, dune grass planting, sand-fence installation. There will be one staging area within each community that will be utilized for construction materials, such as dune fencing. These areas are typically 50 x 100 feet in size and generally located in the public works yard of each municipality. All other staging of equipment will be done on the beach.

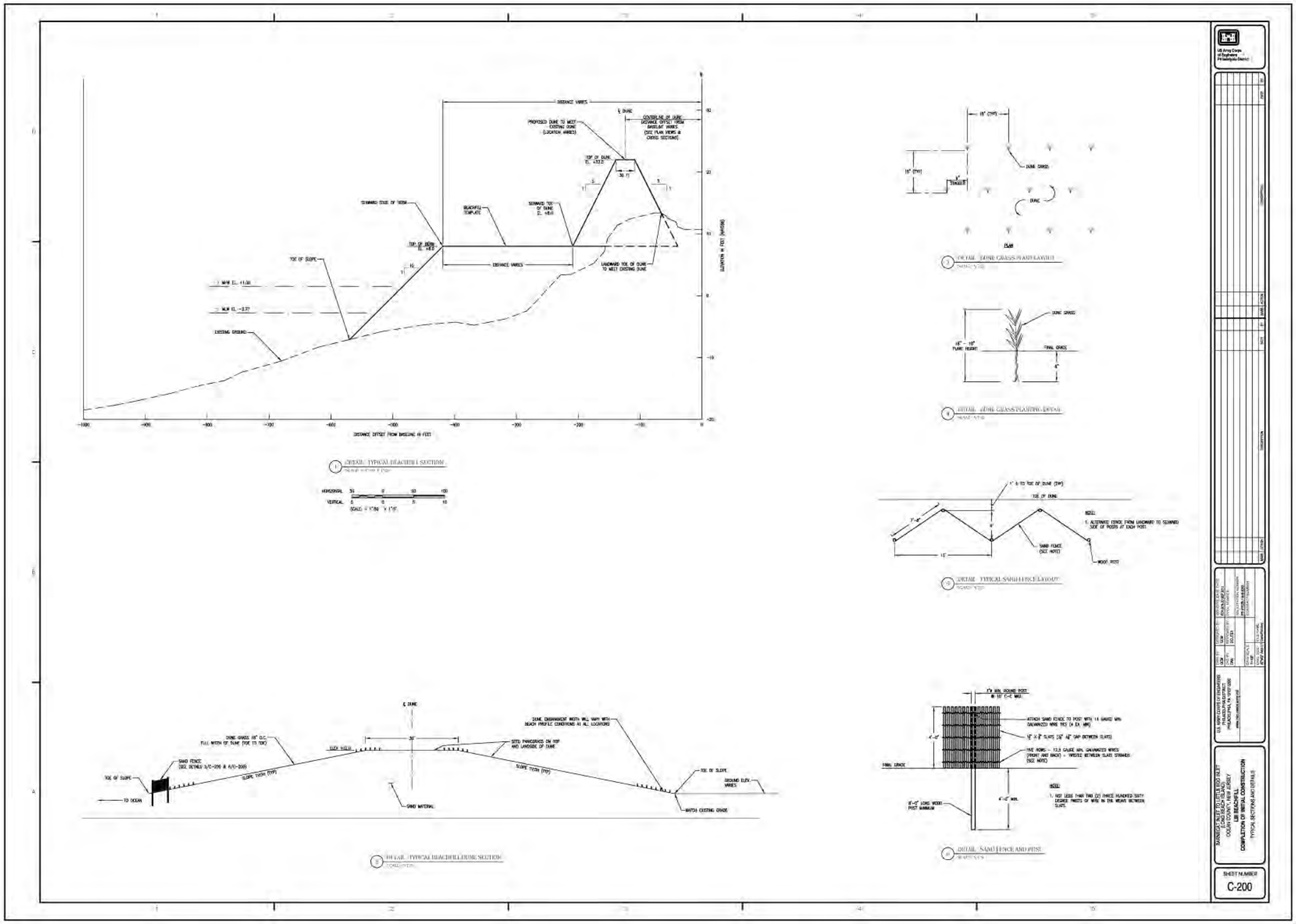
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Figure 2-5: Typical cross-sectional profile of the proposed beachfill.

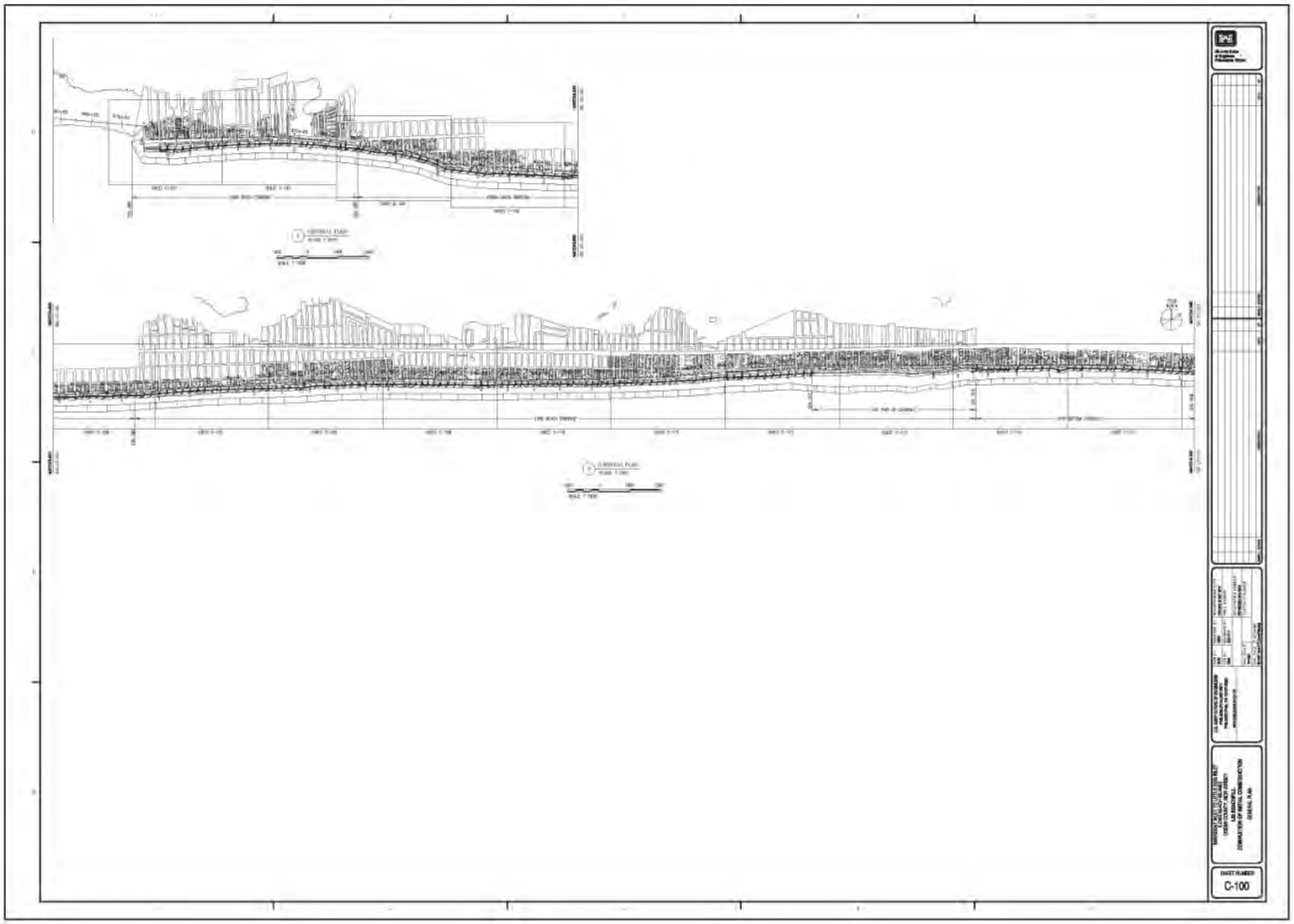

Figure 2-6: Plan Lay-out.

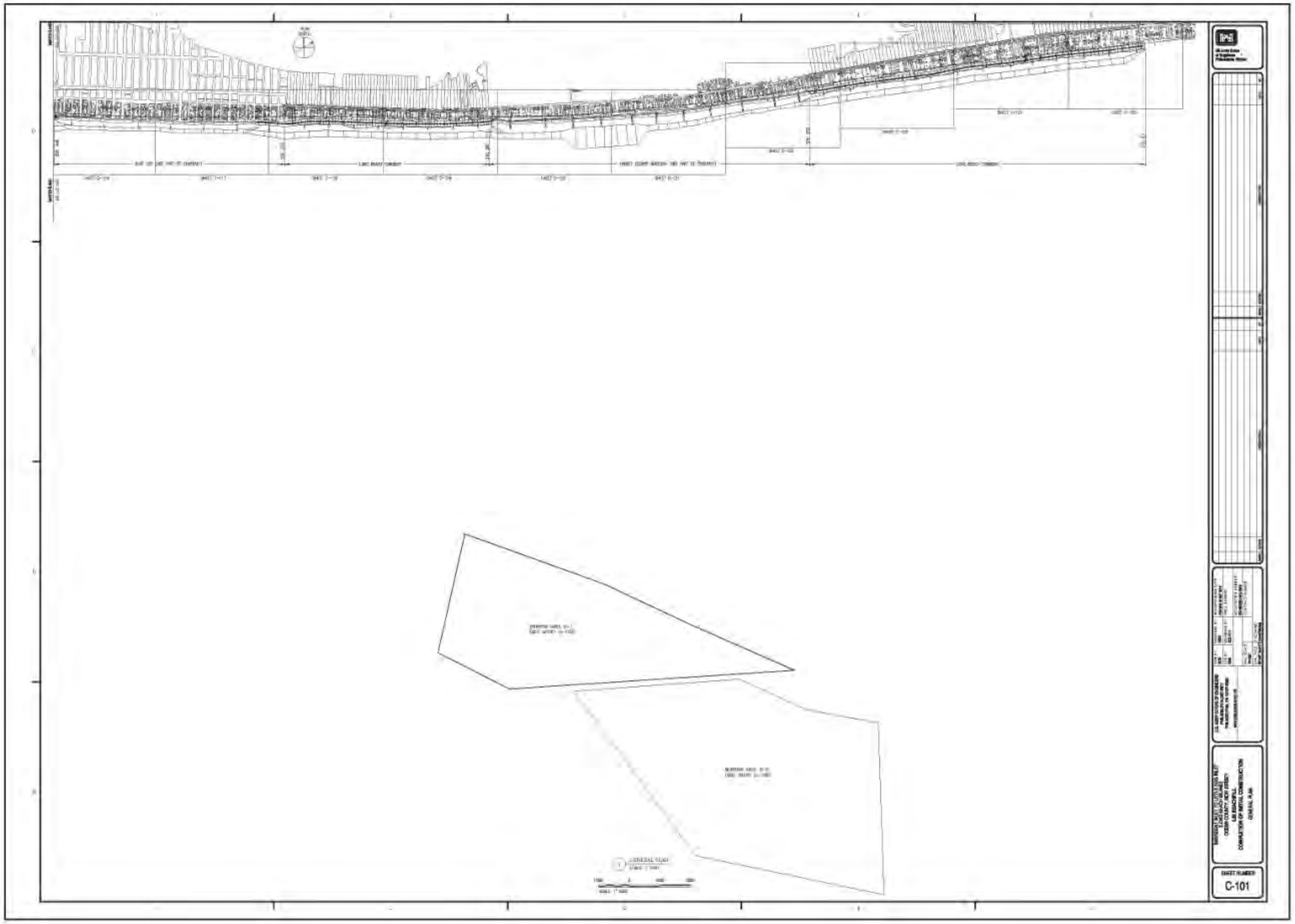

Figure 2-6: Plan Lay-Out (cont.)

3.0 AFFECTED ENVIRONMENT

The affected environment for this EA includes the beach, the nearshore zone within which project related activities (*i.e.*, dredge pump-out) would occur, and the offshore borrow areas identified as sources of beach fill material. Given that there is a complete description of all project related resource areas in the 1999 EIS except the proposed borrow area, only those environmental resources that have measurably changed or would be notably affected are discussed in detail; otherwise the description of the affected environment is incorporated by reference and summarized.

Resources Carried Forward for Detailed Analysis-Table 3-1 presents the results of the process of identifying resources to be analyzed in this EA. The general organization of resource areas is consistent with the EIS, however some have been grouped and/or renamed for clarity.

Resources Considered but Eliminated from Detailed Analysis - Numerous resources were considered in the EIS, but warrant no further examination in this EA. USACE and BOEM's rationale for eliminating resource areas from detailed study is presented in Table 3-1.

Table 3-1 – Resources Considered for Analysis in this EA

Resource	Analyzed in Detail in this EA?	If *Yes,* EA Section If *No*, Rationale for Elimination
Water Quality	Yes	Section 3.2.1; 4.2.1
Sound	Yes	Section 3.2.2; 4.2.2
Beach and Dune Habitat	Yes	Sections 3.1.1; 4.1.1
Intertidal and Nearshore Zone	Yes	Section 3.2.3; 3.2.4; 4.2.3; 4.2.4
Offshore Sand Habitat	Yes	Section 3.2.4; 4.2.4
Finfish	Yes	Sections 3.2.4.3; 4.2.4.3
Wildlife	Yes	Sections 3.1.3; 4.1.3
Birds	Yes	Sections 3.1.2; 3.3; 4.1.2
Threatened and Endangered Species	Yes	Section 3.3; 4.3
Visual	No	Negligible impacts identified in the EIS
Air Quality	Yes	Section 3.5; 4.5
Recreation	No	Negligible adverse impacts. positive impacts in EIS
Cultural Resources	Yes	Section 3.4; 4.4
Essential Fish Habitat	Yes	Section 3.2.4.4; 4.2.4.4
Cumulative Effects	Yes	Section 4.14

3.1 Terrestrial

3.1.1 Dunes and Nearshore Habitat

New Jersey Atlantic beaches and nearshore waters provide a dynamic environment heavily influenced by the tidal flows and long-shore currents. Beaches and dunes are linked together to form the "littoral active zone". Even though there is active sand exchange occurring between them, the two systems are quite distinct. The beach/surf zone being a marine, wave-driven system, and the dune field a primarily wind-driven terrestrial ecosystem. The intertidal zone has shifting sands and pounding surf dominating the habitat. Organisms within this zone have evolved to have special locomotory, respiratory, and morphological adaptations that enable them to survive in this extreme habitat. They are agile, mobile and capable of resisting long periods of environmental stress. These organisms tend to be rapid burrowers with high rates of reproduction and short (1 to 2 years) life spans (Hurme and Pullen, 1988). Dominant marine intertidal species are presented in Section 3.2.4.2 Benthic Invertebrates.

Coastal dune fauna is generally not indigenous but displays high diversity. In typical undisturbed beach profiles along the Atlantic Coast of New Jersey, the primary dune is the first dune landward from the beach. The flora of the primary dune are adapted to the harsh conditions present such as low fertility, heat, and high energy from the ocean and wind. The dominant plant on these dunes is American beachgrass (*Ammophila breviligulata*), which is tolerant of salt spray, shifting sands and temperature extremes. American beachgrass is a rapid colonizer that can spread by horizontal rhizomes, and also has fibrous roots that can descend to depths of 3 feet to reach moisture. Beachgrass is instrumental in the development of dune stability, which opens up the dune to further colonization with more species like seaside goldenrod (*Solidago sempervirens*), sea-rocket (*Cakile edentula*) and beach cocklebur (*Xanthium echinatum*).

The secondary dunes lie landward of the primary dunes, and tend to be more stable resulting from the protection provided by the primary dunes. The increased stability also allows an increase in plant species diversity. Some of the plant species in this zone include: beach heather (*Hudsonia tomentosa*), coastal panic grass (*Panicum amarum*), saltmeadow hay (*Spartina patens*), broom sedge (*Andropogon virginicus*), beach plum (*Pnmus maritima*), seabeach evening primrose (*Oenothera humifisa*), sand spur (*Cenchrus tribuloides*), seaside spurge (*Ephorbia polygonifolia*), joint-weed (*Polygonella articulata*), slender-leaved goldenrod (*Solidago tenuifolia*), and prickly pear (*Opuntia humifusa*).

3.1.2 Birds

Migratory shorebirds are a Federal trust resource responsibility of the U. S. Fish and Wildlife Service. Many species of shorebirds inhabit the beach during the spring and fall migrations, although most are even more likely to be found on protected wetland areas located around the perimeter of the proposed project area on Long Beach Island. Shorebirds feed on small individuals of the resident infauna and other small organisms brought in with waves. Common shorebird species include clapper rail (*Rallus longirostris*), sanderling (*Calidris alba*), dunlin (*C. alpina*). semipalmated sandpiper (*C. pusilla*), western sandpiper (*C. mauri*), least tern (*Sterna antillarum*), American bittern (*Botaurus lentiginosus*), and least bittern (*Ixobrychus exilis*),and willet (*Catoptrophomus semipalmatus*). The Holgate Unit of the Edwin B. Forsythe National Wildlife Refuge, on the southern end of Long Beach Island, provides important resting and feeding areas for migrating shore birds. Sanderling, dunlin, and western sandpiper also occur on the beach throughout the winter. Colonial nesting shorebird habitat is increasingly under pressure from development and human disturbance along New Jersey's Atlantic beaches. Nesting birds such as common tern (*Sterna hirundo*), least tern (*Sterna antillarum*), black skimmer (*Rynchops niger*), and American oystercatcher (*Haematopus palliatus*) are frequent spring and summer inhabitants on unvegetated dunes and upper beaches within the study area. For a comprehensive list of colonial nesting waterbirds, raptors, and migratory songbirds that visit the barrier island and surrounding marshes in Barnegat Bay, Manahawkin Bay, and Little Egg Harbor adjacent to Long Beach Island, please refer to the EIS (USACE, 1999).

Several species of gulls are common along New Jersey's shores, and are attracted to forage on components of the beach wrack such as carrion and plant parts. These gulls include the laughing gull (*Larus atricilla*), herring gull (*L. argentatus*), and ring-billed gull (*L. delawarensis*).

3.1.3 Wildlife

Due to the developed nature of the project site, most of the terrestrial wildlife that can be found in the area would be either transient in nature or very adaptable to human intervention. Common species include American toad (B*ufo americanus*), common snapping turtle (*Chelydra serpentine*), eastern diamondback terrapin (*Malaclemys terrapin terrapin*), raccoon (*Procyon lotor*), white-footed mouse (*Peromyscus leucopus*), house mouse (*Mus musculus*), and eastern cottontail (*Sylvilagus floridanus*). A more extensive listing of amphibian, reptilian, and mammalian species is provided in Section 2.3 of the EIS (USACE, 1999).

3.2 Aquatic

3.2.1 Water Quality

Section 2.2 of the 1999 EIS reviews nearshore and offshore water quality in more detail, only a brief summary is included here. Water quality in Barnegat Inlet, the Atlantic Ocean, and other surface waters in the study area are generally good. Exceptions are occasional waste discharges or offshore oil spills. Intentional overboard discharge of solid waste and sewage from recreational boats may degrade water quality in the Bay. The discharge of this contamination makes water unsanitary for swimming and may cause closure of shellfish beds. The state of New Jersey has classified the water along the ocean side of Long Beach Island as approved for the harvest of oysters, clams and mussels, except for one mile of beach off of Surf City that is rated prohibited. It is expected that the primary cause of non-point source pollution be related to development on land and/or the activities that result from land development. Sources might include run-off of petroleum products, fertilizers and animal wastes from roadways and lawns. When it is generated on land, such non-point source pollution is carried by rainwater, which can drain to surface or ground water and ultimately reach the ocean.

The proposed borrow areas are found within the Mid-Atlantic Bight (MAB), one of the four subregions of The Northeast Continental Shelf. Each subregion reflects different underlying oceanographic conditions and fishery management boundaries with varying water temperature and salinity. In the MAB, temperature stratification varies greatly between summer and winter. The water column is vertically well-mixed, with surface water temperatures of 14°C (57°F) at the surface and 11°C (52°F) at depth in the winter. During the summer, the water is generally 25°C (77°F) near the surface and 10°C (50°F) at depths greater than 656 feet (Paquette *et al*., 1995). The pH of the marine seawater is relatively stable due to the presence of the CO_2- carbonate equilibrium system which maintains a pH between 7.5 and 8.5. The major chemical parameters of marine water quality include pH, dissolved oxygen, and nutrient concentrations. Salinity in the MAB generally ranges from 28 to 36 parts per thousand (ppt) over the continental shelf. Lower salinities are found near the coast and the highest salinities found near the continental shelf break. Marine seawater salinity is generally highest during the winter and lowest in the spring.

3.2.2 Sound

Predominant noises in the proposed placement site consist of crashing waves, gulls, and tourists. In a recent study done on in-water noise of a beach nourishment dredging project at Wallops Island, VA, background sound pressure levels (SPLs) averaged 117 decibels (dB) across all sampling days, sites, water depths and weather conditions. Minimum measured sound levels ranged from 91 dB to 107 dB depending on sampling location and water depth; maximum levels ranged from approximately 128 dB to just under 148 dB (Reine *et al*. in prep). Highest SPLs were found at frequencies of less than 200 hertz. The authors note that sea state and the associated sounds generated by waves interacting with the survey vessel likely contributed to the elevated readings.

3.2.3 Upper Marine Intertidal

The upper marine intertidal zone is also primarily barren, however, more biological activity is present in comparison to the upper beach. Organic inputs are derived primarily from the ocean in the form of beach wrack, which is composed of drying seaweed, tidal marsh plant debris, decaying marine animals, and miscellaneous debris that washed up and deposited on the beach. The beach wrack provides a cooler, moist microhabitat suitable to crustaceans such as the amphipods *Orchestia* spp. and *Talorchestia* spp., which are also known as beach fleas. Beach fleas are important prey to ghost crabs. Various foraging birds and some mammals are attracted to the beach fleas, ghost crabs, carrion and plant parts that are commonly found in beach wrack. The birds include gulls, shorebirds, fish crows, and grackles.

3.2.4 Nearshore and Offshore

The following paragraphs discuss geomorphology and biological resources associated with New Jersey coastal waters which overlap nearshore waters with offshore waters. The term “nearshore” refers to all intertidal and marine waters located within the coastal zone that extends out to sea 3 nautical miles (approximately 3.3 statute miles) from the New Jersey shoreline, otherwise referred to as the Inner Continental Shelf (ICS). The term “offshore” refers to marine waters lying seaward of state coastal waters under Federal jurisdiction (BOEM), otherwise known as the Outer Continental Shelf (OCS).

3.2.4.1. Offshore Geomorphology

An evaluation of the offshore sand shoal was conducted by the New Jersey Geology and Water Survey (NJGWS, 2013, pers. comm.) in OCS waters off the New Jersey coast where Borrow Area D2 is located. The entire shoal was calculated by the NJGWS to contain approximately 64.2 mcy of sand and extends nearly 4 times the size of the proposed offshore borrow area. Figure 2-7 (prepared by NJGWS) shows the original Borrow Areas D2 and D3 (now combined), overlain in gray scale on the entire sand shoal and comprises approximately 18.5 mcy of sand. The plan proposes to dredge approximately 4.9 mcy, less than 8% of the sand identified by NJGWS that comprises the shoal.

The sand resource shoal identified by NJGWS is a shore-detached ridge, formed through a combination of eustatic and hydrodynamic factors. The evolution of these continental shelf sand bodies is characteristic of transgressive episodes in sea-level cycles (Snedden *et al*., 1994; McBride and Moslow, 1991; Figueiredo, 1984). Short-term along-shore inlet shifting due to longshore currents and other factors, combined with longer term landward inlet migration due to sea level rise, result in ebb-tidal delta sediments being cut off from inlet sediment sources. In the New Jersey offshore, they are subsequently reshaped by longshore currents into ridges typically oriented 10 degrees to 30 degrees oblique to the shoreline (Uptegrove *et al*., 2012). Currents and waves reshape the sand body, carving swales that may cut below the base of the former delta, adding relief to the shoal feature and transforming a shore-attached ridge into a shore-detached ridge (Snedden *et al*., 1994).

The sand ridges typically have a convex upper surface and a flat lower surface (Snedden *et al*., 1994). The flat lower surface is typically floored by a gravel layer that was formed during the last glacial maximum (LGM), when sea level was approximately 125 m (~400 ft) lower than it is today. Leading up to and during the LGM, the surface was subaerial, as indicated by extensive oxidation of the sand and gravel (in the vibracore samples). The convex upper surface has a smooth shape, due in part to the unconsolidated and texturally more homogeneous sands which typically comprise the upper sections of these ridges. In addition to the Pleistocene gravel at the base of the shoal features, some may contain an interbedded sand/clay unit of variable thickness overlying the gravel (Smith, 1996). The interbedded section is interpreted to be estuarine sediments of the Holocene transgression, buried by advancing barrier sands and related shore ridges as Holocene sea-level continued to rise (Smith, 1996).

The shore-detached shoal feature in Area D2 lies on the southern edge of the ebb-tidal shoal complex of present-day Barnegat Inlet (see Uptegrove *et al*., 2012, 2013). It is possible that there were shore-attached/shore-detached ridges that formed around an earlier inlet seaward of present-day Harvey Cedars or present-day Ship Bottom. The D2 site would fit the model for a shore-detached ridge associated with a former inlet offshore present-day Ship Bottom. This most likely occurred prior to modern times, when sea level was 50-60 feet lower, and the inlets between barrier islands were several miles seaward of their present locations.

From a limited review of existing seismic and shallow core data, the ebb-tidal delta of the present-day Barnegat Inlet is comprised of a more aerially extensive, moderate-relief sand body and smaller sand ridges extending approximately 5 miles beyond the inlet. It appears that the prevailing southerly long-shore drift in this area has transported sediment to the south, resulting in more extensive accumulation and preservation of sand to the south and east of Barnegat Inlet than to the north. However these currents do not supply significant sediment to the sand resource shoal. The proximity of the ebb-tidal delta to the north may be a buffer for the sand resource shoal against erosion by currents from the north. But at the same time, the delta feature is not supplying significant sediment to the relict sand ridge, however submarine currents continue to sculpt these features, as noted by Snedden et al. (1994).

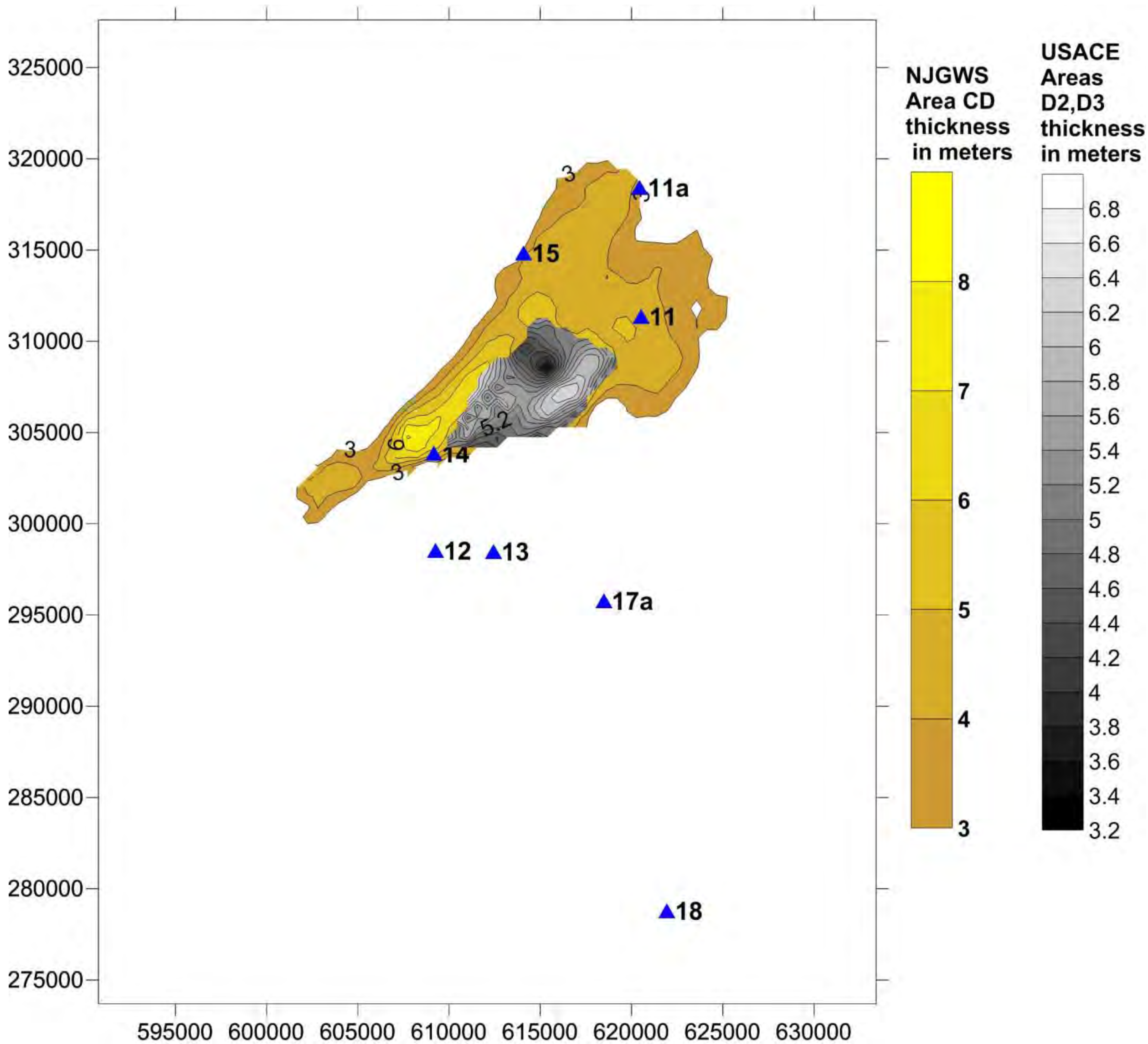

Figure 2-7: Sand resource map of Shoal CD (NJGWS, 2009). Map units are NJ State Plane feet. Map scale for contour plots in meters thickness of sand. Blue triangles are locations of NJGWS cores. Sand volume of entire Area CD shoal (in tan/brown): approximately 64.2 mcy. Sand volume of USACE combined borrow areas (D2 and D3) in Federal waters (in gray): 18.5 mcy.

3.2.4.2. Benthic Invertebrates

Typical invertebrate infauna of the beach intertidal zone that have evolved to survive in high energy, disruptive habitat include the mole crab (*Emerita talpolida*), haustorid amphipods (*Haustorius* spp.), coquina clam (*Donax variablilis*), and spionid worm (*Scolelepis squamata*) (Scott and Bruce, 1999). The epifaunal blue crab (*Callinectes sapidus*), and lady crab (*Ovalipes ocellatus*) are also found in the intertidal zone. These invertebrates are prey to various shore birds and nearshore fishes.

Long Beach Island has groins that represent an artificial rocky intertidal zone. Some typical algae found growing on the groins are sea lettuce (*Ulva lactuca*), hollow green weeds (*Enteromorpha* spp.), rockweeds (*Fucus* spp.), and laver (*Porphyra* spp.). In addition to providing a hard substrate for the attachment of benthic macroalgae, the groins also contain suitable habitat for a number of aquatic and avian species. Typical invertebrates that might be attached to these groins are blue mussel (*Mytilus edulis*), skeleton shrimp (*Caprella* spp.), little gray barnacle (*Chthamalus fragilis*), northern rock barnacle (*Balanus balanoides*), and striped anemone (*Haliplanella luciae*). If the groin is made of wood the following wood boring species might be found: gribble worm (*Limnoria tripunctata*), and shipworm (*Teredo navalis*). These structures are also used by various finfish for feeding and shelter.

The benthic community composition of the four LBI nearshore borrow areas and an LBI reference area were evaluated in 1998 and found to be similar (Scott and Kelley, 1998). For comparative purposes with OCS benthic resources, the full benthic evaluation report can be found in the Environmental Appendix of the EIS (USACE, 1999). Polychaete worms, followed by molluscs and arthropods (specifically crustaceans) dominated the areas. Oligochaete worms also contributed substantially to the faunal composition of these areas. The mean abundance of the top 10 dominant taxa of each borrow area contributed from 69% of the total mean abundance at Area B to more than 88% at Area E. In general, the dominant polychaetes were small, surface dwelling organisms. The small bristle worm *Polygordius* spp. was either the first or the second most dominant polychaete in each area.

Other dominant polychaetes included the small capitellid *Mediomastus ambiseta* and the small syllid *Parapionosyllis longicirrata*. The dominant crustacean was the very small (<5 mm as an adult) tanaid *Tanaissus psammophilus*. The majority of the molluscs were also dominated by the small bivalves *Donax variabilis*, *Petricola pholadiformi,s* and *Tellina agilis*. Another dominant bivalve the surf clam *Spisula solidissima* had some clams that reached lengths greater than 2 cm in all four areas. Diversity indices, as measured by the Shannon Wiener Index and the Simpson's Dominance Index, indicate a relatively diverse, evenly distributed community structure within the four LBI borrow areas evaluated (Borrow Areas A,B,D, and E) . Shannon Wiener Diversity Index (H), which includes a measure of taxa evenness, ranged from a low of 2.6 at Area E to a high of 3.4 at Area D (Scott and Kelley, 1998).

Simpson's Dominance Index (*D*) followed the same pattern as *H,* where the lowest value 0.70 occurred at Area E and the highest value 0.86, occurred at Area D. The macrobenthic assemblages present in the LBI inshore borrow areas were similar to the assemblages of the LBI reference area and other regional studies. More than 80% of the taxa present in the four borrow areas were also present in at least one of the LBI reference or regional areas. This indicates that none of the proposed inshore borrow areas contain a unique or rare benthic assemblage and the faunal assemblage of the borrow areas is common to the New Jersey coast.

The Atlantic surf clam, *Spisula solidissima*, was collected from all the LBI borrow areas using both a Young grab sampler and the hydraulic clam dredge. Juvenile and small adult surf clams were collected in more than 92% of the stations in the nearshore borrow areas using a Young grab device. Mean abundance of surf clams collected ranged from 183/m2 at Area D1 to 568/m2 at Area A. The abundance of clams greater than 2 cm in length also varied by borrow area. Biomass followed the same pattern as number of larger clams, in that Area A had the greatest mean biomass (29g/m2) and Area D1 had the lowest (0.9g/m2).

Densities of surf clams ranged from 65.6 clams/100 ft2 at Area E to 0.4 clams/100 ft2 in Area B. The total surf clam stock ranged from 12.0 million clams in Area A to 0.05 million clams in Area B. The average number of bushels collected from the four nearshore borrow areas were variable relative to the regional surveys conducted by the New Jersey Department of Environmental Protection (NJDEP, 1995). The average number of bushels for Area A, which had the greatest average number of bushels collected per tow, was about 70% greater than the regional average.

The average number of bushels collected from Areas B and D1 were less than a third of the regional average. Borrow Area E most closely approximated the regional average of about 12 bushels collected/tow. Surf clams of the four nearshore borrow areas were of comparable size relative to those of the regional Atlantic coast. Ten additional mega and macroinvertebrate taxa were collected by the clam dredge tows. The most frequently collected invertebrate was the moon snail, which was present in 70% of all tows. All other invertebrates were collected at frequencies less than 40% for all tows.

A study (Scott and Bruce, 2008) was conducted to assess baseline macrobenthic and surf clam resources in the offshore Borrow Area D2, and entailed 17 sampling stations within the borrow area and 6 stations outside of the borrow area (reference sites) . This 2008 study employed the same field and laboratory methods as was used to assess the four nearshore borrow areas (A, B, D1, and E) in the Scott and Kelly (1998) study to allow for statistical comparison. The benthic community was found to be similar to other offshore sand areas in the mid-Atlantic with dominant taxa common to Areas A, B, D1 and E sampled in 1998. The majority of the benthic community in D2 was dominated by small organisms with opportunistic life histories, with one exception: the sand dollar (*Echinarachnius parma*), which was the second most abundant species.

Surfclam surveys were completed at 12 stations within Borrow Area D2 (Scott and Bruce, 2008). Bivalves, such as surf clams, were not very abundant compared to samples taken from the previously sampled borrow areas (A, B, D1, and E). The surf clam survey suggests that Area D2 currently supports a limited clam population. Adult densities were estimated to be about 0.7 clams per square foot, which was substantially less than estimates for nearshore Borrow Areas A, D1, and E sampled in 1997. The density is also less than the population density estimated by NJDEP in an area ranging from Barnegat Inlet to Absecon Inlet.

Borrow Areas D1 and D2 were again evaluated (Scott, 2012) for benthic macroinvertebrates after D1 was used in 2008 and 2010 for beach renourishment to assess dredging impacts. A comparison of surface sediment components at stations in Area D1 sampled both prior to and after dredging operations suggest that a slight shift in the surface sediment habitat occurred since the first sampling in 1997. Prior to dredging, the five stations contained mainly a mix of coarse sand to gravel type sediments. Subsequent to these dredging events, these sites were classified as having a fine-medium sand mix. Changes in the corresponding benthic community appear to be more highly associated with sampling year than to slight variances in sand percentages. Benthic data are inherently highly variable with many factors contributing to distribution patterns.

In the Scott (2012) benthic study, Area D3 was also sampled. Results suggest that the benthic community within the expansion Area D3 is not unique or uncommon to the Long Beach Island region. Most of the species collected were smaller species with adults reaching sizes less than 2 cm in length and have life history characteristics that will allow for quick recovery after a dredging disturbance. The dominant epifauna species were the small sessile, tunicate, Ascidiacea, and the small *Spirorbis corrugates*, both of which attach themselves to coarse sand particles. The dominant infauna taxa were also small, fast growing species including the polychaete worm *Polygordius* spp., the syllid worm

Parapionosyllis longicirrata, oligochaete worms, and the small tanaid crustacean *Tannaissus psammophilus*.

The NJDEP Department of Shellfisheries has conducted annual stratified random surf clam sampling along the New Jersey coast out to the three mile territorial limit offshore from Shark River Inlet south to Cape May since 1988. Typical sampling years collected from 250 to 330 stations. Versar (2008) was contracted by PCOE to compile the NJDEP surf clam data to enable the PCOE to select potential sand borrow sites in areas that would minimize impacts to surf clams. Versar (2008) compared surf clam densities in three strata. Average surf clam densities were consistently lower in the outermost strata (2-3 miles offshore) relative to the middle strata (1-2 miles offshore) and were generally highest in the inshore strata (0-1 mile offshore). Densities of the adult surf clam have been declining since 1997 in all three strata, as documented by the NJDEP adult surf clam surveys, but appear to drop off precipitously in the outermost sampling zone. However, juvenile-sized clams were collected from the borrow areas, indicating that this region continues to contain a habitat conducive to surf clam recruitment. In Area D3, the majority of juvenile clams were collected at stations located along the southern end of the borrow area. The Scott (2012) study showed that recruitment of clams in dredged areas continues to be similar to areas that are not dredged. Juvenile surf clams collected from the dredged area D1 were similar to Area D2 which has not been dredged.

Benthic community differences detected by cluster analysis results were associated with sediment microhabitat differences detected within the region. Although all of the stations sampled were classified as sand stations, differences in the size of sand particles were detected amongst the stations. Some stations within Area D1, D2, and D3 contained a higher percentage of coarse to gravel sized particles, some had more of a mix of medium to coarse sand, while others had a predominance of fine sand sediments. Although these differences are important for documentation of benthic community composition, the differences detected within these sediment habitats are not unique to the area.

3.2.4.3 Finfish

Important recreational and commercial fish in the nearshore and offshore project area include: American eel (*Anguilla rostrata*), white perch (*Morone americana*), blueback herring (*Alosa aestivalis*), alewife (*Alosa pseudoharengus*), fluke (*Paralichthys dentatus*), bluefish (*Pomatomus saltatrix)*, spot (*Leiostomus xanthurus*), summer flounder (*Paralichthys dentatus*), northern puffer (*Sphoeroides maculatus*), weakfish (*Cynscion regalis*), Atlantic menhaden (*Brevoortia tyranus*), scup (*Stenotomus chrysops*), striped bass (*Monroe saxatilis*), spiny dogfish (*Squalus acanthias*), and winter flounder (*Pseudopleuronectes americanus*). Other fish found within the area, many which are important forage fish, include bay anchovy (*Anchoa mitchilli*), Atlantic silverside (*Menidia menidia*), three spine stickleback (*Gasterosteus aculeatus*), northern pipefish (*Syngnathus fuscus*), winter skate (*Raja ocellata*), clearnose skate (*Raja eglanteria*), southern stingray (*Dasyatis americana*), and northern kingfish (*Menticirrhus saxatilis*).

Nearshore and offshore areas along the Atlantic coast provide a migratory pathway and spawning, feeding and nursery area for many fish sought by sport fishermen common to the Mid-Atlantic region including black sea bass (*Centropristis striata*), striped bass, summer flounder, winter flounder, bluefish, Atlantic mackerel (*Scomber japonicus*), tautog (*Tautoga onitis*), scup, Atlantic menhaden, weakfish, and American shad (*Alosa sapidissma*). In addition, shipwrecks and artificial reefs along the coast provide habitat for a variety of fish including: Atlantic cod (*Gadus morhua*), red hake (*Urophycis chuss*), spotted hake (*Urophycis regia*), white hake (*Urophycis tenuis*), black sea bass, pollock (*Pollachius virens*), mackerel, and bluefish. Shoal areas along the Atlantic coast are very productive areas for finfish. Such bathymetric contours provide important structure and feeding areas for finfish (Nairn *et al*., 2007; Slacum *et al*., 2006). Groins also provide structure within nearshore shallows that provide sites for attachment of sessile organisms on which finfish feed.

There are highly migratory pelagic species of finfish of the high seas that dwell in the OCS region of the Mid-Atlantic. The Magnuson-Stevens Fishery Conservation and Management Act (Public Law 94-265), and amended as a Reauthorization Act (P.L. 109-479), have established Regional Fishery Management Councils to exercise sound judgment in the stewardship of fishery resources and develop Fishery Management Plans (FMPs). Highly migratory fish species include such species as the bigeye tuna (*Thunnus obesus*), bluefin tuna (*Thunnus thynnus*), sailfish (*Istiophorus albicans*), skipjack tuna (*Katsuwonus pelamis*), yellowfin tuna (*Thunnus albacares*) and white marlin (*Tetrapturus albidus*).

3.2.4.4 Essential Fish Habitat

Section 2.2 of the 1999 EIS reviews nearshore and offshore Essential Fish Habitat (EFH) in more detail, only a brief summary is included here and updates species information. In accordance with provisions of the Magnuson-Stevens Fishery Conservation and Management Act of 1976 (MSA) and the 1996 Sustainable Fisheries Act, federal agencies are required to consult with NMFS regarding actions that may adversely affect EFH. EFH is defined as "*those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity*." *Waters* consist of aquatic areas and their associated physical, chemical, and biological properties that are currently utilized by fishes and may include areas historically used. *Substrate* is defined as sediment, hardbottom, structures beneath the waters, and any associated biological communities. *Necessary* means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem. *Spawning, breeding, feeding*, or *growth to maturity* includes all habitat types used by a species throughout its life cycle. Only species managed under a Federal FMPs are protected under the MSA (50 Code of Federal Regulations [CFR] 600). The act requires federal agencies to consult on activities that may adversely influence EFH designated in the FMPs.

The use of nearshore and offshore borrow areas for beach nourishment on Long Beach Island may have an effect on EFH for the following species or species groups (Table 3-2): northeast multispecies (groundfish such as cod, haddock, flounders), Atlantic scallops, sea herring, monk fish, Atlantic salmon, summer flounder, scup, black sea bass, bluefish, squid, mackerel, butterfish, surf clams, ocean quahogs, dogfish, tilefish, highly migratory species (tuna, sharks), Atlantic billfishes, red drum, Spanish mackerel, king mackerel and golden crab, and skates. The Atlantic Fishery Management Council and the National Marine Fisheries Service have identified EFH for these species and the Corps has included an impact assessment in Section 5.9 of the EIS (1999). Any species additions following release of the 1999 EIS are included in the EFH assessment herein.

Shoals attract many different fish species, including some of species and species groups that fall under EFH. The Atlantic OCS region provides habitat that supports a wealth of species including commercially and recreationally important fish and shellfish and endangered and threatened species. Regional Fishery Management Councils are required to describe, identify, conserve and enhance areas designated as EFH. In addition, the councils must minimize adverse effects of fishing on EFH. These actions taken by the councils are to be informed by recommendations from NMFS. EFH descriptions currently exist for species in the proposed project area where offshore Borrow Areas D2 and D3 are located. In 2003, NMFS issued an Amendment to the Fish Management Plans (FMP) for Atlantic tunas, billfish, and sharks which may travel through the proposed project area.

Table 3-2 provides a summary of EFH designation for the 10 x 10 minute square for the location of the combined Borrow Area D2/D3. This square is defined as follows:

> Waters within the square east within the Atlantic Ocean and west within Barnegat Bay, affecting from just north of Surf City , NJ., north along the northern part of Long Beach past Harvey Cedars, NJ., Loveladies Harbor, NJ., Barnegat Light and Barnegat Inlet, the Sedge Islands to Island Beach including waters affecting Clam Island, Vol Sledge and High Bar, and along with the entrance to the Forked River on the mainland, Slope Sedge, Sandy Island, eastern Carvel Island and eastern Harvey Sedges.

Table 3-2 Summary of Essential Fish Habitat (EFH) Designation

10' x 10' Square Coordinates:

Boundary	North	East	South	West
Coordinate	39° 50.0' N	74° 00.0' W	39° 40.0' N	74° 10.0' W

Species	Eggs	Larvae	Juveniles	Adults
Atlantic cod *(Gadus morhua)*				X
haddock *(Melanogrammus aeglefinus)*				
pollock *(Pollachius virens)*				
whiting *(Merluccius bilinearis)*				
offshore hake *(Merluccius albidus)*				
red hake *(Urophycis chuss)*	X	X	X	
white hake *(Urophycis tenuis)*				
redfish *(Sebastes fasciatus)*	n/a			
witch flounder *(Glyptocephalus cynoglossus)*	X			
winter flounder *(Pseudopleuronectes americanus)*	X	X	X	X
yellowtail flounder *(Limanda ferruginea)*	X	X		
windowpane flounder *(Scophthalmus aquosus)*	X	X	X	X

American plaice *(Hippoglossoides platessoides)*				
ocean pout *(Macrozoarces americanus)*				
Atlantic halibut *(Hippoglossus hippoglossus)*				
Atlantic sea scallop *(Placopecten magellanicus)*				
Atlantic sea herring *(Clupea harengus)*			X	X
monkfish *(Lophius americanus)*	X	X		
bluefish *(Pomatomus saltatrix)*			X	X
long finned squid *(Loligo pealeii)*	n/a	n/a		
short finned squid *(Illex illecebrosus)*	n/a	n/a		
Atlantic butterfish *(Peprilus triacanthus)*			X	
Atlantic mackerel *(Scomber scombrus)*				
summer flounder *(Paralichthys dentatus)*		X	X	X
scup *(Stenotomus chrysops)*	n/a	n/a	X	X
black sea bass *(Centropristis striata)*	n/a		X	X
surf clam *(Spisula solidissima)*	n/a	n/a	X	X
ocean quahog *(Artica islandica)*	n/a	n/a		
spiny dogfish *(Squalus acanthias)*	n/a	n/a		
tilefish *(Lopholatilus chamaeleonticeps)*				
king mackerel *(Scomberomorus cavalla)*	X	X	X	X
Spanish mackerel *(Scomberomorus maculatus)*	X	X	X	X
cobia *(Rachycentron canadum)*	X	X	X	X
tiger shark *(Galeocerdo cuvieri)*		X		
dusky shark *(Carcharhinus obscurus)*		X		
sandbar shark *(Carcharhinus plumbeus)*		X	X	X

clearnose skate (*Raja eglanteria)*			X	X
little skate (*Raja erinacea)*			X	X
winter skate			X	X

Eight species considered as Coastal Migratory Pelagics by the NMFS Essential Fish Habitat Mapper (www.habitat.noaa.gov/protectin/efh/efhmapper/index.html) were identified for the project area. Those that are not included within the NMFS EFH Designation 10'x10' square for the project area provided above are the following: Atlantic bluefin tuna (*Thunnus thynnus*), scalloped hammerhead (*Sphyrna lewini*), shortfin mako (*Isurus oxyrinchus*), smooth dogfish (*Mustelus canis*), and white shark (*Carcharodon carcharias*). A description of the life history requirements and distribution of the managed species identified above, relative to the study area, is included in Appendix A.

3.3 Threatened and Endangered Species

Endangered species are those whose prospects for survival are in immediate danger because of a loss or change of habitat, over-exploitation, predation, competition or disease. Threatened species are those that may become endangered if conditions surrounding the species begin or continue to deteriorate. Species may be classified on a Federal or State basis. There are several listed or notable species of special concern that can be found along the New Jersey coast; most of these are transient in the area. The Federally-listed seabeach amaranth (*Amaranthus pumilus Rafinesque*) was listed as threatened throughout its range in 1993 (58 FR 18035 18042). Historically, this species occurred on coastal barrier island beaches from Massachusetts to South Carolina. Extant populations are currently known from South Carolina, North Carolina, Virginia, Delaware, Maryland, New Jersey, and New York. The number of plants and populations has increased in all states since it was listed in 1993; however, in North Carolina have generally been increasing since 2002. Primary habitats include overwash flats on the accreting ends of islands, lower foredunes, and the upper strand on non-eroding beaches. Seabeach amaranth is an annual, meaning that the presence of plants in any given year is dependent on seed production and dispersal during previous years. Seeds germinate from April through July. Flowering begins as early as June and seed production begins in July or August. Seeds are dispersed by wind and water. Seabeach amaranth is intolerant of competition; consequently, its survival depends on the continuous creation of newly disturbed habitats. Prolific seed production and dispersal enable the colonization of new habitats as they become available. A continuous supply of newly created habitats is dependent on dynamic and naturally functioning barrier island beaches and inlets (USFWS 1996b).

The piping plover (*Charadrius melodus*) is a Federally-listed endangered small pale shorebird on sandy beaches along the Atlantic and Gulf coasts, including areas within the vicinity of the project location. The roseate tern (*Sterna dougallii*) is a medium-sized tern and primarily tropical but breeds in scattered coastal localities in the northern Atlantic temperate zone. It is Federally-listed as endangered in the northeast region, including New Jersey, but has not been observed within the vicinity of the project area since the 1970s (Holgate).

There are five Federally-listed threatened or endangered sea turtles that can occur off the coast of New Jersey's ocean coast. The endangered Kemp's ridley turtle (*Lepidochelys kempii*), leatherback turtle (*Dermochelys coriacea*) and hawksbill turtle (*Eretmochelys imbricata*), and the threatened green turtle (*Chelonia mydas*) and loggerhead turtle *(Caretta caretta*). With the exception of the loggerhead these species breed further south from Florida through the Caribbean and the Gulf of Mexico. The loggerhead may have historically nested on coastal barrier beaches. No known nesting sites are within the project area. All five species of sea turtles are listed in the State of New Jersey.

There are six Federally-listed species of endangered whales that have been observed along the New Jersey Atlantic coast. The North Atlantic right (*Eubalaena* glacialis) , fin whale (*Balaenoptera physalus*), and humpback whale (*Megapter novaeangliae*) are found seasonally in waters off New Jersey. The sperm whale (*Physeter catodon*), Sei (*Balaenoptera borealis),* and blue whale *(Balaenoptera musculus*) may be present in deeper offshore waters. These are migratory animals that travel north and south along the Atlantic coast. All six species of whales are listed in the State of New Jersey. There are no areas within the project area designated as critical habitat for marine mammals.

The shortnose sturgeon (*Acipenser brevirostrum*) is a Federally-listed endangered species of fish that is also state listed in New Jersey. The shortnose sturgeon is an anadromous species that inhabits marine and estuarine waters, but spawns in freshwater. Shortnose sturgeon occur primarily in the Delaware River but may occur in the nearshore ocean waters (Brundage and Meadows, 1982).

In April 2012, NMFS added the Atlantic sturgeon (*Acipenser oxyrinchus*) to the Federally endangered list. Atlantic sturgeon has been recommended for endangered status listing in New Jersey. Atlantic sturgeon spawn in the freshwater regions of the Delaware River. By the end of their first summer the majority of young-of-the-year Atlantic sturgeon remain in their natal river while older subadults begin to migrate to the lower Delaware Bay or nearshore Atlantic Ocean. An acoustic tagging study conducted between 2008-2011 (Brundage and O'Heron, in press) found a few subadults, tagged within the Delaware River, in the Hudson River, Potomac River and off Cape Hatteras in the second year of the study. Older subadult Atlantic sturgeon are known to undertake extensive marine migrations, returning to their natal river in the late spring, summer, and early fall months (Dovel and Berggren, 1983).

The bald eagle (*Haliaeetus leucocephalus*) was listed as a Federally endangered species throughout the United States in 1978. Most bald eagle nests are located in large wooded areas associated with marshes and other water bodies. Based on improvements in bald eagle population figures for the contiguous United States, the U.S. Fish and Wildlife Service removed the bald eagle from the Endangered Species list in June 2007. The New Jersey Department of Environmental Protection reported that there were more than 100 pairs of bald eagles within the state in 2011. Although the bald eagle has been removed from the Endangered Species list, the bird is still protected by the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act. These laws prohibit killing, selling or otherwise harming eagles, their nests, or eggs. The bald eagle has remained a state-listed species in New Jersey.

Pergrine falcons (*Falco peregrinus*) were placed on the Endangered Species list as endangered in 1984, however, like the bald eagle, their numbers in the Northeast region have been steadily increasing (Steidl *et al*., 1991). The peregrine falcon was removed from the Endangered Species list in August 1999. The bird continues to be protected by the Migratory Bird Treaty Act, which prohibits the taking, killing, possession, transportation, and importation of migratory birds, their eggs, parts, and nests except when specifically authorized by the Interior Department. The peregrine falcon remains a state-listed species in New Jersey. The peregrine falcon is known to nest on the Barnegat Division of Edwin B. Forsythe National Wildlife Refuge in Stafford Township, Ocean County, New Jersey, however the refuge is not a proposed placement site for sand nourishment.

There are currently 34 bird species state-listed as endangered or threatened species in New Jersey. A few of these, such as the black skimmer (*Rynchops niger*), the least tern (*Sternula antillarum*), and the roseate tern (*Stena dougallii*) are likely to occur along the beaches of Long Beach Island (NJDEP, 2012). The piping plover and roseate tern are state-listed endangered species that have the potential to occur in the vicinity of the project areal. Several raptors occur in the vicinity of the project area include the state-listed endangered northern harrier (*Circus cyaneus*), short eared owl (*Asio flammeus*), osprey (*Pandion haliaetus*), and barred owl (*Strix varia*).

Although primarily found within the Delaware Bay shoreline and not the ocean coast, the red knot (*Calidris canutus*) is currently proposed for listing under Endangered Species Act protection by the U.S. Fish and Wildlife Service. The New Jersey Department of Environmental Protection reports that both horseshoe crabs and red knots numbers have declined by over 75 percent since the early 1990's. The state listed threatened black rail (*Laterallus* jamaicensis) nests in emergent tidal marshes in the surrounding area.

The harbor porpoise (*Phocoena phocoena*) and the bottlenose dolphin (*Tursiops truncatus*) are New Jersey species of special concern. These species, as are all marine mammals, are protected under the Marine Mammal Protection Act. While mid-Atlantic waters are the southern extreme of their distribution, stranding data indicate a strong presence of harbor porpoise off the coast of New Jersey, predominately during spring. The northern diamondback terrapin (*Malaclemys terrapin terrapin*), considered a "species of special concern", is known to occupy Barnegat Bay. The diamondback terrapin occupies brackish tidal marshes and nests on sandy bay beaches.

For more information concerning existing conditions in the project area, refer to the Barnegat Inlet to Little Egg Inlet Final Feasibility Report and Integrated Final Environmental Impact Statement (USACE, 1999).

3.4 Cultural Resources

In preparing the EIS, the Corps consulted with the New Jersey State Historic Preservation Office (NJ SHPO) and other interested parties to identify and evaluate historic properties in the project area in order to fulfill its cultural resources responsibilities under the National Historic Preservation Act of 1966, as amended, and it's implementing regulations, 36 CFR Part 800. As part of this work, a cultural resources investigation was conducted in the project area. The results of this investigation are presented in the draft report entitled *Phase I Submerged and Shoreline Cultural Resources Investigations and Hydrographic Survey, Long Beach Island, Ocean County, New Jersey* (Hunter Research, Inc. *et al.*, 1998).

The following brief discussion has been taken directly from the above referenced report and summarized. For more detailed information on the history of Long Beach Island, please refer to the report and to other studies listed in the reference section of the EIS. Previous cultural resource surveys have been completed in and close to the project area. In 1977 an archeological survey was conducted by R. Allen Mounier in conjunction with a proposed waste water collection facility for the town of Manahawkin and vicinity. As part of this investigation, Bonnet Island, a small body of land located in Manahawkin Bay, was subjected to a program of background research, field inspection and limited subsurface testing. Several historic cultural resources were identified on the mainland, however, none were located on Bonnet Island or within the general vicinity of the project area (Mounier 1977).

In 1990, A. K. Mounier completed a second investigation along a proposed transatlantic telecommunications cable alignment which was to cut across Manahawkin Bay and traverse Long Beach Island along Bergen Avenue in North Beach. No cultural resources of interest were found within the project corridor. Mounier noted severely disturbed landscapes on Long Beach Island from the ocean to the bay (Mounier 1990).

A statewide survey of archeological resources conducted in the early part of this century (Skinner and Schrabisch, 1913) and more recent cultural resource investigations have not identified any prehistoric sites either within the tidal zone of the current project area or on Long Beach Island itself. However, prehistoric artifacts have occasionally been recovered from the floor of Manahawkin Bay and many prehistoric sites are known to exist nearby on the mainland. No potentially significant historical archeological resources have been previously documented along the tidal shoreline and tidal zone of the current project area. Numerous shipwrecks, however, are known to have occurred along the beaches of Long Beach Island. A list of documented shipwrecks in the Long Beach Island vicinity is provided in Appendix A in Hunter's report (Hunter Research, Inc. *et al*., 1998).

Examination of maps and files of the New Jersey Historic Preservation Office indicate that there are several historic resources in the project vicinity currently listed in the State and National Registers of Historic Places. These are the Barnegat City Public School (now the Barnegat Light Museum), Barnegat Lighthouse, the Beach Haven Historic District, Converse Cottage, Sherbourne Farm and the Dr. Edward H. Williams House. The last four properties are all included within the Beach Haven Multiple Resource Area. In 1981, the New Jersey Historic Sites Survey inventoried the historic resources of Long Beach Island and generated an additional list of potentially eligible properties (see Table 1.1 in Hunter Research, Inc. *et al*., 1998). Of these previously identified historic properties, the only ones located in close proximity to the present study area are the Barnegat Lighthouse, the Ship Bottom Historic District and Aunt Hill.

The Barnegat Lighthouse is a mid-19th century 150-foot tall lighthouse located at the extreme northern tip of the island. The light keeper's house at 7 East 5th Street in Barnegat is a typical example of a late 19th century Long Beach Island cottage. The Ship Bottom Historic District is a district composed primarily of late 19th-century and early 20th-century summer cottages which on its east abuts the beach front. Aunt Hill is another late 19th-century cottage and is notable for being one of the oldest buildings in Spray Beach. Of these resources, only the Barnegat Lighthouse is actually listed in either the State or National Registers, and none are located directly on the beach or in the tidal zone.

As part of the 1999 feasibility study, a Phase I submerged and shoreline cultural resources investigation was conducted in four segments of the tidal and nearshore zone within the project area along an 18-mile stretch of the Atlantic coastline between Barnegat Inlet and Little Egg Inlet and totaling 10.5 miles and adjacent nearshore underwater acres totally 320 acres(Hunter Research, Inc. *et al.*, 1998). In addition, three potential sand borrow areas totaling approximately 1,055 acres were also investigated (Borrow Areas B, D and E). The fieldwork involved visual inspection and remote sensing. Visual inspection and magnetic survey were conducted within the four, shoreline areas at low tide. Comprehensive magnetic, acoustic and bathymetric remote sensing and hydrographic surveys were conducted within the four near-shore sand placement areas, as well as within the three proposed offshore sand borrow areas.

Five magnetic targets identified within the tidal zone may represent potentially significant cultural resources; however, placement of additional sand on the beach will protect the source of these magnetic targets and no further study was recommended. One magnetic target located during the Phase I submerged survey demonstrated characteristics of a possible shipwreck. Additional survey was recommended for this target, designated as Target 7:614.

In 2003, Hunter Research Inc. conducted near-shore and on-shore cultural resources investigations in the project area to assess for both submerged and shoreline terrestrial resources. Additionally, six submerged magnetic targets of potential interest were located both onshore and near shore during the 2003 investigations. The proposed beach nourishment will not impact these targets, but will serve to aid in their preservation. A two-part underwater archaeological investigation was conducted in the Atlantic Ocean offshore of Long Beach Island and included a Phase I level remote sensing survey conducted at the offshore borrow area D2 (Dolan Research, 2001). Analysis of the remote sensing data confirms that no potentially significant targets were identified within Borrow Area D2 and no additional investigations were recommended.

Phase 1 underwater archaeological investigations were also performed by Dolan Research at Offshore Borrow Area D3 in 2012. Tasks performed included: limited background and documentary research; magnetic and acoustic remote sensing with follow-up target analysis; and analysis of assembled research and field data into a technical report. The goal of the investigation was to identify targets suggestive of submerged and shoreline cultural resources that might be impacted by sand borrowing activities. Analysis of fieldwork data confirmed the presence of no magnetic and five sonar targets in the project area. However, none of the five target signatures is considered suggestive of a submerged cultural resource. No additional underwater archaeological investigations were recommended for Borrow Area D3.

3.5 Air Quality

Air quality is determined by the number and quantity of air toxics emitted from many types of sources: point, area, and mobile sources. The U.S. Environmental Protection Agency (EPA) prepared a comprehensive list of air toxics emissions for the entire country in 1999: the National-Scale Air Toxics Assessment (NATA). A summary of the emissions inventory for the state of New Jersey, based on the NATA, gives an indication of which may be the most important sources and areas of highest air toxic emissions. Broken down by county, areas in New Jersey with the largest air toxic emissions are generally those with the largest populations in the smallest space. Higher levels of air toxic emissions are directly related to high levels of vehicle use, solvent use, and other population-related types of activities. The immediate project placement area is residential and a prominent recreational tourism area. The air quality is relatively good since there are no major sources of emissions in the area.

NJDEP evaluates EPA's NATA air toxic emissions concentrations to chemical-specific health benchmarks to determine a risk ratio to assess which toxic emissions pose a potential human health problem within the state. If the risk ration for a specific chemical is greater than one, it may be of concern. There are 181 air toxics that EPA included in their 2005 NATA (http://www.state.nj.us/dep/airtoxics/nataest05.htm). One-third of these do not have toxicity values or corresponding health benchmarks. For those that do, NJDEP's state and county average air toxics concentrations indicate that 22 of the pollutants are "of concern", 21 of these are cancer-causing chemicals and one (acrolein) is evaluated as a noncarcinogen. Predicted concentrations of these pollutants vary around the state, depending on the type of sources that emit them. In Ocean County 13 of the 22 pollutants of concern have a risk ration higher than 1, including some risk ratios based on noncarcinogenic effects (http://www.state.nj.us/dep/airtoxics/oceanavg05.htm).

3.5.1 General Conformity Rule

The Clean Air Act, and its subsequent amendments, established the National Ambient Air Quality Standards (NAAQS) for seven common pollutants: particulate matter, ground-level ozone, carbon monoxide, sulfur oxides, nitrogen oxides, and lead. These air pollutants are referred to as "criteria pollutants" by the EPA because they are regulated for permissible levels based on human health and environmentally based guidelines. The General Conformity Rule, under the Clean Air Act, applies to all Federal actions that are taken in designated nonattainment areas, with three exceptions: 1) actions covered by the transportation conformity rule; 2) actions associated with emissions below specified *de minimis* levels, and 3) other actions which are either exempt or presumed to conform.

The states have the primary responsibility to attain and maintain those standards. Through the State Implementation Plan (SIP), the New Jersey Department of Environmental Protection – Division of Air Quality manages and monitors air quality within the state. The goal of the SIP is to meet and enforce the primary and secondary national ambient air quality standards for pollutants. New Jersey air quality has improved significantly over the last 40 years, but exceeds the current standards for ozone (O_3) throughout the state and fine particles (PM_{10} or $PM_{2.5)}$ in many urban areas. New Jersey has attained the sulfur dioxide (SO_2) (except for a portion of Warren County), lead (Pb), and nitrogen dioxide (NO_2) and Carbon Monoxide (CO) standards (http://www.state.nj.us/dep/daq)

The Clean Air Act requires that all areas of the country be evaluated and then classified as attainment or non-attainment areas for each of the National Ambient Air Quality Standards. Areas can also be found to be "unclassifiable" under certain circumstances. The 1990 amendments to the act required that areas be further classified based on the severity of non-attainment. The classifications range from "Marginal" to "Extreme" and are based on "design values". The design value is the value that actually determines whether an area meets the standard. For the 8-hour ozone standard for example, the design value is the average of the fourth highest daily maximum 8-hour average concentration recorded each year for three years. Ground-level ozone is created when nitrogen oxides (NOx) and volatile organic compounds (VOCs) react in the presence of sunlight. NOx is primarily emitted by motor vehicles, power plants, and other sources of combustion. VOCs are emitted from sources such as motor vehicles, chemical plants, factories, consumer and commercial products, and even natural sources such as trees. Ozone and the pollutants that form ozone (precursor pollutants) can also be transported into an area from sources hundreds of miles upwind. The study area falls within the Northern New Jersey/New York City/Long Island Area (New Jersey Portion). The entire state of New Jersey is in non-attainment and is classified as being "Marginal." A "Marginal" classification is applied when an area has a design value of 0.085 ppm up to but not including 0.092 ppm (NJDEP, 2012 Ozone Summary).

4.0 ENVIRONMENTAL EFFECTS

4.1. Terrestrial

4.1.1 Dunes and Nearshore Habitat

Minimal adverse impacts are expected to occur at the placement site as there is little structure on the sand beaches. The dune, the active berm beach, and the offshore zone are dynamic high-energy areas, subject to the forces of wind and waves. Sand normally moves offshore in the winter and returns on-shore in the spring and summer. During beach nourishment, sand can be placed in any one, or all of these areas, and will redistribute to a more stable profile (NRC, 1995). Following sand placement, there are notable physical changes to a nourished beach. For example, sand is more compacted along a nourished beach, sometimes three to four times higher, which has been shown to increase over time for some beaches (Ryder, 1991).

Other physical changes from placement of sand include increased shear resistance (sand permeability), altered dry density, change in moisture content, different grain size and shape, silt/clay composition changes, and altered placement of sand grains throughout the nourished area (Parr *et al.,* 1978; Reilly and Bellis, 1978, 1983; Nelson and Dickerson, 1988; Ryder, 1991). Such sediment may cause changes in the hydrodynamic patterns in the intertidal zone. Deposition of material high in clay or silt content may cause temporary elevated turbidity in the immediate placement area. One positive impact is to down-drift beaches receiving sand moving alongshore from the nourished beach.

The use of earth-moving equipment to spread deposited sand on the beach can alter sedimentology, compaction, and the nature of the sands along the primary dune (Wells and McNinch, 1991). Wind is one of the major forces that form dunes, and sorts sediments according to grain size. Lindquist and Manning (2001) found that bulldozed dunes contain sediment that is more poorly sorted and has a higher percentage of coarse sands and gravel-sized particles.

4.1.2 Birds

Beach nourishment operations should have minimal effect on birds as the area is seasonally heavily used by people for recreation. Most birds in the area are either transient in nature or very adaptable to human activity. Since birds are highly mobile, they avoid the construction area due to the noise of construction activity, and on occasion, co-occupy the area with people. Other than gulls, and migratory shorebirds in early spring, not many avian species use the beach berm regularly.

Birds that use the target beach for nesting and breeding are more likely to be affected by beach nourishment than those species that use the area for feeding and resting during migration (USDOI/MMS, 1999). Birds may be displaced by dredges, pipelines, and other equipment along the beach, or may avoid foraging along the shore if they are aurally affected (Peterson *et al*., 2001). Sand that is placed on the beach has the potential to crush eggs, hatchlings, and adult birds (USDOI/MMS, 1999). If the sediment is too coarse or high in shell content it can inhibit the birds' ability to extract food particles in the sand. Fine sediment that reduces water clarity can also decrease feeding efficiency of birds (Peterson *et al*., 2001).

4.1.3 Wildlife

Placement of sand on the beach should have minimal effect on wildlife as the area is seasonally heavily used by humans. Most wildlife in the area is either transient in nature or very adaptable. Most wildlife would avoid the construction area due to the noise of construction activity, but would return after construction ends. Not many wildlife species use the berm part of the beach regularly. The increased berm size and planted dune grass would provide more habitat for beach nesting shorebirds.

4.2 Aquatic

4.2.1 Water Quality

The selected plan poses a short-term effect on water turbidity during berm placement and excavation at the borrow area. Dissolved oxygen (DO), pH, and temperature all influence the welfare of living organisms in water; without an appreciable level of DO, many kinds of aquatic organisms cannot exist (Priest, 1981). Elevated levels of particulate concentrations at the discharge location will dissipate after a short period in ocean currents. The borrow material, given its large grain size, is not expected to be chemically contaminated. Generally, the larger the grain sizes the smaller the area of impact. Turbidity resulting from resuspension of the sediments into the water column at the placement site is expected to be localized and temporary in nature. Dredging operations within the borrow area cause sediment to be suspended in the water column as well. Studies of past projects indicate that the extent of the sediment plume is generally limited to between 1,640-4,000 feet from the dredge (hopper) and that elevated turbidity levels are generally short-lived, on the order of an hour or less (Barnard, 1978; USACE, 1983; Hitchcock *et al*., 1999; MMS, 19999; Anchor Environmental, 2003; Wilber *et al*., 2006).

The length and shape of the plume depend on the hydrodynamics of the water column and the sediment grain size. Given that the dominant substrate at the borrow sites is sand, it is expected to settle rapidly and cause less turbidity and oxygen demand than finer-grained sediments. No appreciable effects on DO, pH, or temperature are anticipated because the dredge material has low levels of organics and low biological oxygen demand. Additionally, dredging activities would occur within the open ocean where the hydrodynamics of the water column are subject to mixing and exchange with oxygen rich surface waters. Any resultant water column turbidity would be short term (*i.e.* present for approximately 1 hour) and would not be expected to extend more than several thousand feet from the dredging operation. Accordingly, it is anticipated that the project would have only minor impacts on marine waters at the offshore borrow area.

The USEPA has stated that the preliminary results of the Biological Monitoring Plan (BMP) of the U.S. Army Corps of Engineers (COE)-New York District's Beach Erosion Control Project, which extended from the Asbury Park to Manasquan Section Beach, provided relevant insight into the impact arising from turbidity and suspended sediments generated by the beach fill. "The impact is limited to a relatively narrow swath of beach front and the observed concentrations decayed rapidly with dispersal through the surf zone. Moreover, the maximum Nephelometric turbidity units (NTUs) measured near the fill operations did not appear to be outside the range that organisms would be exposed to during periods of high wave energy."

4.2.2 Sound

Project-related noise at the placement site during construction will consist of the sound of dredged material passing through the pipe and discharging in a plume of water. Earth-moving equipment, such as bulldozers, will shape the newly deposited dredged material and produce engine noise in the nearby vicinity. Utilizing heavy machinery fitted with approved muffling apparatus reduces noise, and vibration will reduce noise impacts.

At the offshore borrow areas, hydraulic suction dredging involves raising loosened material to the sea surface by way of a pipe and centrifugal pump along with large quantities of water. Suction dredgers produce a combination of sounds from relatively continuous sources including engine and propeller noise from the operating vessel and pumps and the sound of the drag head moving across the substrate. Based upon data collected by Reine *et al*. (in prep.), sediment removal and the transition from transit to pump-out would be expected to produce the highest sound levels as an estimated source level (SL) of 172 decibels (dB) at 3 feet. The two quietest activities would be seawater pump-out (flushing pipes) and transiting (unloaded) to the borrow site, with expected SLs of approximately 159 and 163 dB at 3 feet, respectively. Based upon attenuation rates observed by Reine *et al*. (in prep.), it would be expected that at distances approximately 1.6-1.9 miles from the source, underwater sounds generated by the dredges would attenuate to background levels. However, similar to in-air sounds, wind (and corresponding sea-state) would play a role in dictating the distance to which project-related underwater sounds would be above ambient levels and potentially audible to nearby receptors.

Robinson *et al.* (2011) carried out an extensive study of the noise generated by a number of trailing suction hopper dredgers during marine aggregate extraction. Source levels at frequencies below 500 hertz (Hz) were generally in line with those expected for a cargo ship travelling at modest speed. The dredging process is interspersed with quieter periods when the dragheads are raised to allow the dredge to change positions. Clarke *et al*. (2003) evaluated sound levels produced by a hopper dredge during its "fill" cycle working in a sandy substrate. They found that most of the sound energy produced fell within the 70 to 1,000 Hz range, with peak pressure levels in the 120 to 140 dB range at 40 meters from the dredge. These data correlate well with a study conducted in the United Kingdom which found trailing suction hopper dredge sounds to be predominately in the low frequency range (below 500 Hz), with peak spectral levels at approximately 122 dB at a range of 56 meters (DEFRA, 2003).

In a review by Southall *et.al.* (2007) several studies showed altered behavior or avoidance by dolphins to increased sound related to increased boat traffic. Clarke *et al.* (2004) found that cutterhead dredging operations are relatively quiet compared to other sounds in aquatic environments, whereas hopper dredges produce somewhat more intense sounds. Thomsen *et al.* (2009) conducted a field study to better understand if and how dredge-related noise is likely to disturb marine fauna. This study found that the low-frequency dredge noise would potentially affect low- and mid-frequency cetaceans, such as bottlenose dolphins. Noise in the marine environment has also been responsible for displacement from critical feeding and breeding grounds in several other marine mammal species (Weilgart, 2007). Noise has also been documented to influence fish behavior (Thomsen *et al*., 2009). Fish detect and respond to sound utilizing cues to hunt for prey, avoid predators, and for social interaction (LFR, 2004). High intensity sounds can also permanently damage fish hearing (Nightingale and Simenstad, 2001). It is likely that at close distances to the dredge vessel, the noise may produce a behavioral response in mobile marine species, with individuals moving away from the disturbance, thereby reducing the risk of physical or physiological damage. Accordingly, any resulting effects would be negligible.

4.2.3 Upper Marine Intertidal

Infaunal organisms within the placement zone will be impacted by burial. Most of the organisms inhabiting these dynamic zones are highly mobile and respond to stress by displaying large diurnal, tidal, and seasonal fluctuations in population densities (Reilly *et al*., 1983). Despite the resiliency of intertidal benthic fauna, the initial effect of beachfill will result in some mortalities of existing benthic organisms. The ability of a nourished area to recover depends heavily on grain size compatibility of the material pumped on the beach (Parr *et al*., 1978). Macrofaunal recovery is usually rapid after pumping operations cease. Recovery of the macrofaunal community may occur within one or two seasons if borrow material grain sizes are compatible with natural beach sediments. Results obtained from the intertidal and surf zone of Folly Beach, South Carolina indicated that beach nourishment had a very brief effect on the infaunal abundance and number of species in the benthic communities (Lynch, 1994). Recolonizing infauna was observed in substantial numbers one day after nourishment. The abundances and species assemblages were generally not different from pre-nourishment samples after three months. Recolonization depends on the availability of larvae, suitable conditions for settlement, mobile organisms from nearby beaches, vertical migration of organisms through the placed material, and mortality. The benthic community can, however, be somewhat different from the original community. The seven year nourishment cycle provides sufficient recovery time.

4.2.4 Nearshore and Offshore

4.2.4.1 Offshore Geomorphology

Established dredging procedures limit dredge cuts to no more than 5-10 feet below current elevations to minimize geomorphological impacts to the ocean floor. Dredge cut depths can vary greatly depending on the type of dredge plant utilized. For each drag arm of a hopper dredge, cuts typically are about 4 feet wide and 3 feet deep. Hydraulic cutter suction dredges can cut lanes approximately 200 feet wide and about 5 feet deep with each pass. Seabed filling typically occurs following dredging events due to natural current processes and storms. Post-dredging bathymetric surveys typically demonstrate no substantial changes in borrow area sediment relative to pre-dredging conditions.

4.2.4.2 Benthic Resources

The primary ecological impacts of dredging a sand borrow site is the removal of existing benthic community organisms. This has an immediate localized effect on the benthic macroinvertebrate community. Survival of organisms during dredging varies widely (USACE, 1983). Mechanical disturbance of the substrate may generate suspended sediments and increase turbidity near the dredging operation and result in reduced light penetration temporarily. In addition to the physical disruption of the habitat, recolonization of the benthic community can be rapid, typically taking from a few months to a few years (Brooks *et al*., 2006; Maurer *et al*., 1981a,b; 1982, Maurer *et al., 1986*; Saloman *et al*., 1982; Van Dolah *et al*., 1984). Recovery of infaunal communities after dredging has been shown to occur through larval transport, along with juvenile and adult settlement, but can vary based on several factors including seasonality, habitat type, size of disturbance, and species' life history characteristics (*e.g*., larval development mode, sediment depth distribution) (Shull, 1997; Thrush *et al*., 1996; Zajac and Whitlatch, 1991). Initial recolonization is dominated by opportunistic taxa whose reproductive capacity is high, and flexible environmental requirements allow them to occupy disturbed areas (Boesch and Rosenberg, 1981; McCall, 1977). Highly mobile organisms, such as amphipods, can escape to the water column and can directly resettle after dredging operations are completed (Conner and Simon, 1979). Mobile polychaetes are intermediate of amphipods and bivalves in their capacity to resettle directly after dredging. Bivalves are the least mobile organisms, although pelagic larvae of these species can result in high recruitment. Larval recruitment and horizontal migration from adjacent, unaffected areas initially recolonize the disturbed area (Van Dolah *et al*., 1984; Oliver *et al*., 1977).

Most studies indicate that dredging had only temporary effects on the infaunal community, and in some studies, differences in infaunal communities were attributed to seasonal variability or to hurricanes rather than to dredging (Posey and Alphin, 2002). Within months to years, and if environmental conditions permit, the initial surface-dwelling opportunistic species would be replaced by benthic species that represent a more mature community (Bonsdorff, 1983). Scott (2012) resampled undredged areas within Borrow Area D2 as well as resampled Borrow Area D1 (dredged both in 2008 and 2010). D2's expansion area (formerly referred to as Borrow Area D3) was initially sampled. The benthic community in Area D3 was not unique, containing typical east coast fast-growing, opportunistic epifaunal and infaunal species, and similar to other communities in and along the New Jersey coast. Cluster analyses detected benthic population groups associated with the surface sediments collected from each station. These same patterns between benthic community composition and sediment type existed at revisited sampling sites in Borrow Area D1 and D2. The overall benthic community composition, even within these sub-habitats, consists of species that can easily recruit after dredging disturbances.

Dredging may uncover sediments that are different in structure and changes in sediment characteristics can cause a shift in the corresponding benthic community. Five stations resampled in Area D1, which was subjected to two dredging events, suggested a slight shift in surface sediment habitat (*i.e.* coarse sand/gravel to fine/medium sand mix). The benthic community inhabiting these 5 sites in 2012 clustered separately from these same 5 sites sampled in 1997. However, these differences detected are also influenced by time. Stations sampled in nearby un-dredged Area D2 also had differing benthic communities in 2000 compared to 2011 (Scott, 2012). This suggests that although differences in benthic communities occur due to sediment variations, temporal variations in substrate are more likely the greater contributor to differences detected in the benthic community.

The PCOE has conducted living resource evaluations at inlets, nearshore and offshore regions of the New Jersey Atlantic Ocean coast for over 20 years (Stone and Webster, 1991; Kropp, 1995; Chaillou and Scott, 1997; Scott and Kelly, 1998; Scott, 2004; Scott, 2005; Scott 2007). The majority of abundant taxa found in these benthic communities have opportunistic life history strategies with fast-growing, short life-cycles of one year or less, allowing these organisms to recover rapidly and recruit into areas disturbed by dredging. Cluster analyses showed groups influenced more by station proximity and sediment type with no apparent influence from dredging operations occurring from two or more years previous, where dredging does not result in any significant changes to substrate type. For example, two stations sampled in 2005, collected from within an area at Great Egg Harbor Inlet dredged in 2003, closely grouped with nearby stations sampled in 1997 and 2003 that were undisturbed (Scott, 2007). Additionally, a reanalysis of the 2003 data collected specifically from dredged and undisturbed areas substantiated the conclusion that the benthic community did not display impacts 2-years post-dredging (Scott, 2004).

Similar results were found in these studies with respect to surf clam recruitment. The adult clams sampled in 1997 and 1998 were consistent with nearby areas and clams reaching adult sizes. When juvenile clam abundances collected since 1995 were mapped, the high recruitment ability of the clams was apparent within the Great Egg region. Areas of high recruitment and low recruitment were apparent but did not appear to be affected by previous sand dredging. The area of highest clam recruitment over the 10-year database was in the southwest corner of the borrow area where two past dredging operations had occurred.

The NJDEP's longterm annual stratified random surf clam sampling program demonstrates this as well. Versar's (2009) compilation of the NJDEP longterm data compared surf clam densities in three strata. Average surfclam densities were consistently lower in the outermost strata (2-3 miles offshore) where Borrow Areas D1 and D2 are located, relative to the middle strata (1-2 miles offshore) and were generally highest in the inshore strata (0-1 mile offshore). Densities of the adult surf clam have been declining since 1997 in all three strata, as documented by the NJDEP adult surf clam surveys, but appear to drop off significantly in the outermost sampling zone. The Scott (2012) study described in Section 3.2.4.1 showed that recruitment of clams in dredged areas continues to be similar to areas that are undredged. Juvenile surf clams collected from the dredged area D1 were similar to Area D2 which has not been dredged.

Dredging operations can mitigate impacts by creating ridges as opposed to large depressions, which allow for quicker benthic community recovery due to recruitment from neighboring unimpacted areas. Based on the existing benthic community found occurring within the offshore areas, it is expected that these organisms will recover quickly after dredging operations cease, provided the sediment substrate is not significantly altered and benthic studies conducted in these areas both prior to and after two dredging events demonstrated subtle changes in sediment characteristics with a slight shift in corresponding benthic community composition. No long term effects are expected as the benthic community that naturally exists in the area is dominated by species with opportunistic life histories and exhibit rapid recruitment capabilities.

4.2.4.2 Finfish

Beach placement of sand in shallow inshore waters as well as at the sand borrow area have limited and short-term impacts on finfish. With the exception of some small finfish and early developmental stages, most bottom dwelling and pelagic fishes are highly mobile and should be capable of avoiding turbidity impacts of dredging and placement. Due to suspension of food particles in the water column, some finfish are attracted to the turbidity plume. Few studies have addressed the effects of beach nourishment on surf zone fishes (Van Dolah *et al.*, 1994). The effects in the intertidal and nearshore zones may be similar, although on a smaller scale, to the effects of storms (Hackney *et al*., 1996). Even though fishes regularly occurring in the surf zone are adapted to high energy environments, rapid changes in habitat can cause mortality. Storms, and in particular, hurricanes have caused large changes in shore fish community structure and massive fish kills in Florida (Robins, 1957; Breder, 1962). Although the literature offers contradictory results and the effects of turbidity on surf zone fishes is unclear, elevated turbidity is implicated (Hayes *et al*., 1992).

The primary impact to fisheries is the disturbance of benthic and epibenthic communities. As mentioned above, the loss of benthos smothered during berm construction and removed during the borrow dredging activity temporarily disrupts food resources in the impact areas (Hackney *et al*., 1996). This effect is expected to be temporary, as noted above, due to the documented rapid recolonization that can occur in these highly dynamic environments. Depending on the time of year, benthos food resources can recolonize from dredged areas rather quickly (*e.g.* within a year) via larval recruitment as well as from immigration of adults from adjacent, undisturbed areas (Burlas *et al*., 2001); Posey and Alphin, 2002; Byrnes *et al*., 2004). Recovery should be most rapid if dredging is completed before seasonal increases in larval abundance and adult activity in the spring and early summer (Herbich, 2000). Opportunistic benthic species are adapted to exploit suitable habitat when it becomes available post-dredging.

4.2.4.3 Essential Fish Habitat

Essential Fish Habitat (EFH) is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" and covers all habitat types utilized by a species throughout its life cycle. The Magnuson-Stevens Fishery Conservation and Management Act (Public Law 104-267) requires all Federal agencies to consult with National Marine Fisheries Service (NMFS) on all actions, or proposed actions, permitted, funded, or undertaken by the agency, that may adversely affect EFH.

The selected borrow source plan was revised during the draft report comment period to eliminate borrow areas B and subsequently E to avoid impacts to EFH, as recommended by the state of New Jersey, USFWS, and NMFS. These revisions instigated a need to investigate additional sand borrow sources offshore (Area D2) in deeper waters. Modification of the selected plan conforms to Corps policy which states that damages to fish and wildlife resources will be prevented to the extent practicable thorough planning and design and incorporation CEQ mitigation principles (ER 1165-2-1 and ER 1105-2-100). The modified selected plan proposes to utilize borrow areas D1 and D2 for the life of the project.

Dredging within the offshore borrow area has the potential to impact EFH several ways: by direct entrainment of eggs and larvae; the creation of higher suspended sediment levels in the water column, reduce feeding success for site-feeding fish; and reduce water oxygen levels. All of these impacts are temporary in nature, during the actual dredging period. Substrate conditions typically return to preconstruction conditions and the benthic community recovers through recolonization. Impacts to fish species with designated EFH occurs primarily within inlets and estuaries (*i.e.*inshore) as a variety of fish species migrate in and out of inlets, such as summer flounder. Area D2 encompasses approximately 1034 acres in deep water (30-45 feet). Only a small fraction of the offshore borrow area bottom would be impacted by the dredge cutterhead in any given dredging operation and beach nourishment operations do not typically occur every year, thereby allowing benthic recovery in the smaller dredging zone. Dredging within the borrow site will not diminish topographic variability and will not create deep pits that allow for anoxia or siltation, environments unsuitable for recolonization.

A review of EFH designations and the corresponding 10' x 10' squares, which encompass the Barnegat Inlet to Little Egg Inlet study area was completed. The following is an evaluation of the potential effects associated with this project on EFH species:

Atlantic cod: no adverse effect is anticipated as adult fish are anticipated to avoid the project area during the temporary period when turbidity is high and feeding habitat is disrupted.
Atlantic butterfish: no adverse impacts are anticipated. All life history stages are pelagic and construction activities will take place on the bottom. Elevated turbidity effects are temporary.

Atlantic sea herring: no adverse effect is anticipated as adults and juveniles can move away from the project area during the temporary construction period.
Black sea bass: no adverse effect is anticipated on juveniles and adults as this species occurs primarily in areas with structure and they can avoid temporary impacts to the water column and prey species during the dredging period.
Bluefin tuna: no adverse effect is anticipated on eggs and larvae as these stages are pelagic in surface waters in the Gulf of Mexico and the Mediterranean, and juveniles and adults are anticipated to move out of the project impact area during dredging.
Bluefish: no adverse effect on juveniles and adults is anticipated because these life history stages can move away from the project area during the temporary construction period.
Clearnose skate: habitat for juveniles and adults is generally shallow soft bottoms or rocky, gravelly bottoms. Adults tend to move from shallow shores to deeper water in winter. Impacts may occur to larvae through entrainment. Juveniles and adults are highly mobile. Temporary disruption of benthic food prey organisms may occur.
Cobia: no adverse effect is anticipated for all life stages as they are all pelagic and construction activities will take place on the bottom.
Dusky shark: neonates and early juveniles inhabit shallow coastal waters and not likely to be present in the offshore borrow areas. No adverse impact is anticipated for neonates, juveniles or adults as these stages are expected to move out of the beach placement area during the temporary construction period. Pumping will occur above the high water line on the beach and proceed in sections to minimize turbidity impacts to surrounding areas.
King mackerel: no adverse effect on all life stages is anticipated as all life stages of this species are pelagic and construction activities will take place on the bottom.
Little skate: habitat consists of shallow coastal water over sand or gravel and up to 80 fathoms. Juveniles and adults are highly mobile. Larvae may be impacted through entrainment. A temporary disruption to benthic food prey organism may occur.
Monkfish: no adverse effect on eggs and larvae is anticipated because these life history stages are pelagic and work will be completed on the bottom during the temporary construction period.
Red hake: no adverse effect is anticipated on eggs and larvae because these life history stages are pelagic in surface waters and juveniles are anticipated to move away from the project area during the temporary construction period.
Sandbar shark: neonates and early juveniles are found in shallow coastal waters and not likely to be present in the offshore borrow areas. No adverse impact is anticipated for juveniles or adults as these stages are expected to move out of the construction area during the temporary construction period. Sand is pumped onto the beach above the mean high water line to minimize turbidity at the construction site.
Scalloped Hammerhead: Juveniles occur offshore of New Jersey and are highly pelagic and not likely to be impacted by dredging operations at the bottom.
Scup: no adverse effect on juvenile and adults is anticipated because they typically occur in estuaries and bays. No adverse impacts anticipated on adults in offshore demersal waters as they tend to migrate to coastal waters in summer and would be expected to avoid the immediate dredging area during temporary construction during winter. The disturbance within the offshore borrow area habitat could adversely impact scup feeding or migration. No anticipated impacts in shallow water at the placement site as any increase in turbidity at the placement site is minimal with pumping above the mean high water line.

Shortfin Mako: At this time, insufficient data is available to differentiate EFH impacts by size classess. The species is highly pelagic and not likely to be impacted by dredging operations on the bottom offshore.
Smooth dogfish: At this time, insufficient data is available for neonates and young-of-year, juveniles, and adult life stages. It is anticipated that this coastal shallow water species would not be impacted by placement operations as pumping of material onto the beach will occur above the mean high water line and thereby minimize turbidity and disruption of prey species composition.
Spanish mackerel: no adverse effect is anticipated for all life stages as they are all pelagic and not associated with bottom habitats and construction activities will take place on the bottom.
Summer flounder: no adverse effect is anticipated on eggs and larvae because they are pelagic and work will be conducted on the bottom during the temporary construction period.
No adverse effect is anticipated on juveniles and adults because they would be expected to move out of the dredging area. Impacts within the placement area are minimized due to pumping of material onto the beach above the mean high water line and reducing turbidity. Impacts to prey species in the intertidal zone will be temporary. The predominant benthic community composition consists of dominant small taxa, such as polychates and small bivalves, species with fast recruitment rates.
Surf clam: surf clams are found on the continental shelf out to approximately 25 miles. Dredging from an offshore borrow source area may impact juvenile and adult surf clams through direct removal and larval surf clams by the generation of turbidity, causing reduced light penetration which can in turn effect settlement and subject the larvae to increased predation. This impact is considered to be temporary as benthic studies have demonstrated recolonization of benthic communities following dredging operations within 13 months to two years. The proposed borrow areas were selected to minimize destruction of the benthic community by choosing areas where the surrounding macroinvertebrate community was similar to the borrow sites so that recruitment recolonization would be rapid. Surf clam populations are not expected to be high in the proposed offshore borrow area. The predominant benthic community composition consists of dominant small taxa, such as polychates and small bivalves, species with fast recruitment rates.
Tiger shark: Although it is possible that there may be tiger shark neonates, juveniles or adults in the offshore borrow area, it is unlikely that they would experience significant effects as a highly mobile species that would leave the area of temporary disturbance. Likewise in the placement site on the beach where turbidity will be minimized by positioning of the dredge pump out pipe abobve mean high water on the beach.
White shark: Although it is possible that there may be white shark neonates, juveniles or adults in the offshore borrow area, it is unlikely that they would experience significant effects as a highly mobile species that would leave the area of temporary disturbance. White shark life stages are not expected to occur in the intertidal zone where beach berm placement will occur.
Windowpane flounder: no adverse effect is anticipated on eggs and larvae as they are pelagic and work will be conducted on the bottom during the temporary construction period offshore. No adverse effect on juveniles and adults is anticipated in bottom habitats of the berm placement site as these life stages are anticipated to move away from the placement disturbance area during the temporary construction period. Pumping of material onto the beach will occur above the mean high water line and thereby minimize turbidity and disruption of prey species composition.
Winter flounder: no adverse effect is anticipated on adult and juveniles because both stages can move away from the project impact area during construction. Minimal adverse effect is expected on eggs and larvae. Although they are demersal at these life stages, impacts are minimal because dredge material is pumped onto the beach berm above the mean high water line. This also serves to minimize turbidity in the intertidal zone and reduce the impact to prey items.

Winter skate: habitat consists of shallow coastal water over sand or gravel and up to 80 fathoms. Juveniles and adults are highly mobile. Larvae may be impacted through entrainment. A temporary disruption to benthic food prey organism may occur.
Witch flounder: no adverse effect is anticipated on eggs because they are pelagic and rise in the water column as they develop. There is the potential to affect juvenile and adult demersal life stages and prefer deep water. It is likely that adults and juveniles would leave the immediate area of disturbance during dredging in the offshore borrow site.
Yellowtail flounder: no adverse effect is anticipated on eggs and larvae because they are pelagic and usually found in deep surface waters.

In conclusion, of the species identified with Fishery Management Plans, and highly migratory pelagic known to occur in the vicinity, the potential for adverse impacts to EFH is considered temporary and minimal. The proposed project could impact surf clams although the numbers that occur in the offshore borrow areas and placement zone are very low. The egg and larval stages of winter flounder, which occur predominantly in inlets, are less likely to be impacted in offshore deep water where the proposed borrow areas occur. The neonate stages of several shark species are predominately located in shallower coastal waters, not offshore deep water where the proposed borrow areas are located.

The effect on surfclams and other benthic organisms (that include food prey items) in the borrow areas is considered to be temporary as benthic studies have demonstrated recolonization following dredging operations within 13 months to 2 years. In addition, the dredging operation is designed to mitigate impacts by not only enhancing bottom topography by creating ridges as opposed to a large hole but also allowing for quicker recruitment from the immediately adjacent ridges where the benthic community is left intact. This is in contrast to the extended time period required for recruitment of benthic organisms in deep holes that alter hydrographic characteristics of the habitat. Elevation differences are also minimized with the creation of ridges as opposed to one large depression. The total impact to EFH is considered minimal due to the fact that only approximately 1,600 acres (to be used over a 50 year period in portions) of sandy bottom habitat is proposed for utilization of this shore protection project, as compared to the total quantity of similar offshore habitat (grain size and depth) off the New Jersey coast. Along the 22-mile coastline of Long Beach Island alone, there is more than ten times the quantity of sandy bottom habitat available, adjacent to the project area. Similar bottom habitat also exists offshore of Little Egg Inlet and Brigantine Inlet.

At the beach placement site (nearshore zone), the slurry of dredged material and water pumped onto the beach typically results in an increase in localized turbidity. The Atlantic States Marine Fisheries Commission (Greene, 2002) review of the biological and physical impacts of beach nourishment cites several studies on turbidity plumes and elevated suspended solids that drop off rapidly seaward of the sand placement operation. Other studies support this finding that turbidity plumes and elevated TSS levels are typically limited to a narrow area of the swash zone downcurrent of the discharge pipe (Burlas *et al*., 2001). Fish eggs and larvae are the most vulnerable to increased sediment in the water column and are subject to burial and suffocation. Given the location of the placement site (ocean coast as opposed to inlets) impacts to eggs and/or larvae is considered minimal. Juvenile fish and adults are capable of avoiding sediment plumes. Increased turbidity due to placement operations will temporarily affect fish foraging behavior and concentrations of food sources are expected to return to the nearshore zone once placement operations cease due to the dynamic nature of nearshore benthic communities (Burlas *et al*., 2001). Turbidity impacts are anticipated to be minimized by the placement of the dredge pipe above the mean high water line during pump-out and development of the raised beach berm moving along the shoreline. Most shallow water coastal species will leave the area of disturbance at the immediate placement site.

4.3 Threatened and Endangered Species

There is the potential for short-term impact to threatened and endangered species during construction. This temporary impact would be limited to avoidance of the area, with the individuals returning after placement of sand ends. Piping plovers presently nest at three locations in the vicinity of the study area (Barnegat Light, between Harvey Cedars and Loveladies, and within the Holgate Unit of the Edwin B. Forsythe National Wildlife Refuge, including Little Beach, an uninhabited barrier island that is part of the Refuge. Both the Barnegat Light area and the Holgate Unit have been removed from the project area. In accordance with Section 7 of the Endangered Species Act (87 Stat. 884 as amended, 16 U.S.C. 1531 et seq.) the Philadelphia District prepared a Biological Assessment (BA) for piping plovers. The recommendations developed in the BA will be followed for this project. Additionally, each township that receives beach nourishment must submit a Beach Management Plan to the U.S. Fish and Wildlife Service for approval and adhere to the post-construction procedures as outlined in the plan.

In accordance with the procedures outlined in the Biological Opinion on the *Effects of Federal Beach Nourishment Activities Along the Atlantic Coast of New Jersey Within the U.S. Army Corps of Engineers, Philadelphia District (2005)*, the USACE consults with the US Fish and Wildlife Service (USFWS) and the NJ Department of Environmental Protection, Division of Fish and Wildlife (NJDEP DFW) prior to any beach nourishment operations. Following Hurricane Sandy, the PCOE requested streamlined Tier 2 formal consultation with the USFWS for approved beach nourishment activities at the constructed beaches Harvey Cedars, Surf City and Brant Beach. This Tier 2 (28 February 2013) follows the USFWS's 2005 Programmatic Tier 1 Biological Opinion (BO) stated above. Upon approval of the 2013 Public Law 113-2 Disaster Relief Appropriations Act, the PCOE has coordinated with USFWS for Tier 2 consultation for the remaining portions of the LBI beach nourishment project in need of beachfill (*i.e.* Long Beach Township, Ship Bottom Borough, and Beach Haven Borough).

To minimize impacts to piping plovers associated with beach nourishment, the USFWS suggests seasonal restrictions and further consultation prior to initial nourishment and all subsequent renourishment activities. The District will comply with the Service's *Guidelines for Managing Recreational Activities in Piping Plover Breeding Habitat on the U.S. Atlantic Coast to Avoid Take Under Section 9 of the Endangered Species Act*, dated April 15, 1994. Several state-listed species of birds are found in the project vicinity, and may be temporally displaced from the construction area for alternate feeding sites. The black skimmer and least tern occur along beaches in the project area. Birds are transient in nature and construction activities should have limited impact on them. The roseate tern (*Sterna dougallii*) is a Federally-listed endangered species in the northeast region (includes New Jersey) but has not been observed in the project area, and like the black skimmer and least tern, is transient, wintering off the coast of South America. However, use of seasonal dredging restrictions and implementation of a comprehensive beach nesting bird management plan, coordinated with USFWS and NJDEP Endangered and Non-Game Species Program, will minimize impacts to these seasonal visitors.

Between June and November, New Jersey's Coastal waters may be inhabited by transient sea turtles, especially the loggerhead, green, leatherback, and the Kemp's ridley. Sea turtles can be adversely impacted during dredging operations. Coordination with NMFS, in accordance with Section 7 of the Endangered Species Act, has been undertaken on all Philadelphia District Corps of Engineers dredging projects. A Biological Assessment that discusses Philadelphia District hopper dredging activities and potential effects on Federally threatened or endangered species of sea turtles was prepared and formally submitted to the NMFS. If a hopper dredge is used for the project, the November 1996 Biological Opinion provided by NMFS included an incidental take statement requiring monitoring of all hopper dredge operations in areas where sea turtles are present between June and November by trained endangered species observers. Adherence to the findings of the Biological Opinion (BO) would insure compliance with Section 7 of the Endangered Species Act. Other measures that have subsequently been implemented and eliminated the need for onboard endangered species observers is the use of rigid drag-arm deflectors and screens, serving the dual purpose of functioning to prevent unexploded ordnance from being pumped onto beaches as well as preventing sea turtle mortalities.

Shortnose sturgeon are included in the 1996 BO. At present, PCOE is conducting consultations with the NMFS on a project-by-project basis for the newly listed Atlantic sturgeon until completion of the formal Programmatic Biological Assessment (see Memorandum in Appendix C). Since implementation of NMFS's original Biological Opinion for dredging within the Philadelphia District in 1996, no sea turtles, whales or sturgeon have been taken during dredging in offshore and inlet borrow areas along the Atlantic Coast. Prior to the implementation of the UXO screening, all hopper dredging from June through November included turtle monitoring, which equates to approximately 15 years worth of monitoring in these areas with no takes.

Marine mammals would be expected to avoid the dredging operation. Section 7 of the Endangered Species Act of 1973 (ESA), as amended, requires federal agencies to consult with the NMFS to ensure that the action carried out is not likely to jeopardize the continued existence of any endangered species or threatened species or adversely modify or destroy designated critical habitat. The PCOE has initiated coordination with NMFS's Protected Resources Division (PRD) on this project and is in the process of preparing a programmatic biological assessment to cover beach nourishment projects along the New Jersey Atlantic coast. The impact to them should be minimal and operations are not expected to impact migratory pathways. There may be a temporary reduction in prey species in the area.

The diamondback terrapin inhabits marshes, tidal flats, and beaches associated with saltmarsh systems. The terrapin breeds in sandy substrate above the levels of normal high tides. It is expected that this species would not directly benefit from a beach berm restoration project; however, efforts to minimize erosion of beach habitat in areas where terrapin' breed can be considered an indirect benefit to the species. Berm restoration would not adversely impact the diamondback terrapin.

Although not present at the project placement area, the possibility exists that the Federally-listed plant species seabeach amaranth (*Amaranthus pumilus*) could become established subsequent to construction (Arroyo, 1994). To minimize the potential for impacts to future seabeach amaranth plants associated with beach nourishment and renourishment activities, the USFWS and local municipalities have established Beach Management Plans which requires townships to adhere to in the event that annual surveys result in the discovery of seabeach amaranth, and include the establishment of protective zones around the plants.

4.4 Cultural Resources

Proposed project construction has the potential to impact cultural resources in two areas. These are the existing beach area, including the underwater nearshore sand placement areas, and the underwater offshore borrow areas. In the beach and nearshore sand placement areas, potential impacts to cultural resources could be associated with the placement and compaction of sand during berm and dune construction.

Dredging activities in offshore borrow areas could impact unknown submerged cultural resources. Federal undertakings will comply with the Archaeological and Historical Preservation Act of 1974 (16 USC 469-469c), the Abandoned Shipwreck Act of 1987 (PL 100-298; 43 USC 21012106), The National Historic Preservation Act of 1966, as amended (16 USC 470) and the Advisory Council on Historic Preservation's implementing regulations 36CFR800 (protection of Historic Properties). Section 106 of the National Historic Preservation Act requires Federal agencies to provide the State Historic Preservation Officer (SHPO) (as agent to the Advisory Council on Historic Preservation) reasonable opportunity to evaluate and comment on any Federal undertaking.

As summarized in Section 3.6, a Phase I submerged and shoreline cultural resource investigation was conducted on four segments (Areas A, B, C, D) of the tidal (beach) and near shore zone (submerged) within the project area along with three proposed offshore sand borrow areas (areas B, D, and E) in 1999. Six beach anomalies were located, five submerged anomalies were identified and one anomaly was located within Borrow Area D. The six beach and five submerged anomalies identified may represent potentially significant cultural resources; however, the placement of additional sand on the beach will protect the anomalies and no further study was recommended. Additional survey was recommended for the anomaly located in Borrow Area D, designated as Target 7:614.

In 2001, Dolan Research Inc. performed a two part underwater investigation within the project area which included a Phase I survey at borrow area D2 and a Phase I b/II investigation at the six previously recorded beach anomalies and five previously recorded submerged anomalies. Analysis of the remote sensing data confirmed that no potentially significant anomalies were identified within borrow area D2 and no additional investigations were recommended. Five of the six beach anomalies investigated resulted in a lack of sustained magnetic signatures and did not require additional investigation. The sixth beach anomaly, MA-4, proved to be a buried telecommunications cable. Two of the five submerged anomalies proved to be shipwreck sites potentially eligible for listing on the National Register of Historic Places (NRHP): Targets 4:735 and 9:643. A 200-foot radius buffer zone will be observed around the centroid of each shipwreck, as was previously coordinated with the SHPO. Target 7:614, located in Borrow Area D was not assessed during this investigation.

In 2003, Hunter Research Inc., conducted a cultural resource investigation with three main components: 1) remote sensing survey of Borrow Area A; 2) a Phase II investigation on Target 7:614, previously located in Borrow Area D; and, 3) a submerged and shoreline survey for sections of the project area that were not previously assessed during the 1999 survey, thus completing the 18-mile length of the project area. For Borrow Area A, no anomalies indicative of potential shipwrecks were found and no further work was recommended. Target 7:614 was found to be a bell buoy and not eligible for the NRHP. Four beach anomalies were located during the survey. The proposed beach nourishment will not impact these anomalies, but will serve to aid in their preservation. The only submerged anomaly of significance found was Target 9:643, which was discovered in a previous investigation.
In 2012, Dolan Research, Inc. performed a Phase I submerged cultural resource investigation of borrow area D3. No magnetic or sonar anomalies demonstrated characteristics of a possible shipwreck; therefore, no additional investigations were recommended for borrow area D3.

In conclusion, there are no historic properties eligible for inclusion in the NRHP in Borrow Areas A, B, D1, D2, D3 and E; four unevaluated beach anomalies will not be impacted by the beach nourishment project, but will instead be preserved in place; and, two submerged anomalies will be buffered by a 200-foot radius in order to ensure no impact to potentially significant historic properties by dredging, pipe placement, mooring or anchoring.

Since the proposed project will not be impacting any new areas, but will be utilizing previously surveyed and coordinated areas, the proposed emergency beach nourishment activities will have no effect to historic properties. The New Jersey SHPO concurred in a letter dated 22 January 2004 (Appendix C) and again 24 December 2013.

4.5 Air Quality

Emissions of criteria pollutants, greenhouse gases, and other hazardous air pollutants would result from operation of the dredge pumps and coupled pump-out equipment, dredge propulsion engines, and tugs, barges, and support vessels used in the placement and relocation of mooring buoys. In addition, air emissions would result from bulldozers, trucks, and other heavy equipment used in the construction of the berm, beach, and dunes. Carbon monoxide and particulate emissions at the project site, during construction, may be considered offensive; but are generally not considered far-reaching. Exhaust from the construction equipment will have an effect on the immediate air quality around the construction operation but should not impact areas away from the construction area. These emissions will subside upon cessation of operation of heavy equipment.

4.5.1. General Conformity Review and Emissions Inventory

The 1990 Clean Air Act Amendments include the provision of Federal Conformity, which is a regulation that ensures that Federal Actions conform to a nonattainment area's State Implementation Plan (SIP) thus not adversely impacting the area's progress toward attaining the National Ambient Air Quality Standards (NAAQS). In the case of the proposed project on Long Beach Island, the Federal action is to construct a berm and dune restoration project utilizing beachfill sand dredged from offshore sand sources in an area classified as marginal nonattainment for ozone (oxides of nitrogen [NOx].

There are two types of Federal Conformity: Transportation Conformity and General Conformity (GC). Transportation Conformity does not apply to this project because the project would not be funded with Federal Highway Administration money and it does not impact the on-road transportation system. However, GC is applicable to this project. Therefore, the total direct and indirect emissions associated with project construction must be compared to the GC trigger levels. Criteria pollutant emissions are estimated from power requirements, duration of operations, and emission factors for the various equipment types (See Appendix B).

Criteria pollutant emissions are dominated by NOx (which represents the sum of Nitric Oxide (NO) and Nitrogen dioxide (NO_2) emissions) with relatively small amounts of other criteria pollutants. Results indicate that the dredge plant is the major source of emissions from the project. Since the Federal OCS waters attainment status is unclassified, there is no provision for any classification under the Clean Air Act for waters outside of the boundaries of state waters. Calculating the increase in emissions that may occur within the state limits was done by subtracting out the dredging-related emissions within Borrow Area D2 since those activities would take place entirely on the OCS. Table 4-1 provides subtotals for

NOx emissions inside and outside of the State of New Jersey territorial limits (pers. comm. New York District USACE). Projected emissions of NOx are in excess of the *de minimis* emission threshold (100 tons/year) specified for a marginal ozone nonattainment area, requiring preparation of a general conformity determination per the requirements of 40 CFR 93 (Appendix B). Emissions estimated for other pollutants were below the *de minimus* thresholds.

The Barnegat Inlet to Little Egg Inlet Storm Damage Reduction Project will comply with the General Conformity (GC) requirement (40CFR§90.153) through the following options that have been coordinated with the New Jersey Department of Environmental Protection (NJDEP): statutory exemption, use of the Joint Base McGuire/Lakehurst GC State Implementation Plan budget, and /or the purchase of Environmental Protection Agency (EPA) Clean Air Interstate Rule (CAIR) ozone season oxides of nitrogen (NOx) allowances. This project is not *de minimis* under 40CFR§90.153, therefore one or a combination of these options will be used to meet GC requirements. The project-specific option(s) for meeting GC will be detailed in the Statement of Conformity (SOC), required under 40CFR§90.158, which will be issued prior to construction. Detailed analytical assumptions are provided in Appendix B. Operational data from similar nourishment projects were used to estimate power, loading, and duration for each phase of activity.

Table 4-1: General Conformity Emission Estimates.

Cubic Yards	**NOx Emissions in State Waters, tons per year***		
	2014	**2015**	**Total**
7,800,000	454.4	519.3	973.7
Out of state NOx emissions, tons per year*			
	103.6	118.5	222.1
Cubic Yards	**NOx Emissions in State Waters per construction year, tons per ozone season (1 May – 30 September)**		
	2014	**2015**	**Total**
7,800,000	259.7	259.7	519.4

(Starcrest Consulting Group, LLC)

***These estimates assume steady work flow each month of the project's duration, with no environmental window (12 months work in full calendar year). Unanticipated periods of down-time or schedule make-up time may change the annual emissions. Actual equipment chosen by the dredging contractor and the final volumes of dredged material will also affect the magnitude of emissions.**

In general, the total increases in emissions are relatively minor in context of the existing point and nonpoint and mobile source emissions in Ocean County. Projected emissions from the proposed action would not adversely impact air quality beyond the immediate construction area or for a sustained period of time given the relatively low level of emissions, relatively short duration of the project spanning more than one construction year, and the likelihood for prevailing offshore winds to disperse the pollutants. Annual emissions monitoring will be performed during construction. Emissions calculations for the proposed project and a General Conformity Statement are provided in Appendix B.

4.6 Hazardous, Toxic, and Radioactive Waste

Borrow area and beach nourishment activities are not expected to result in the identification and/or disturbance of HTRW, as it has been found that coarse-grained material in a high-energy area is unlikely to be contaminated with HTRW (USACE, 1994). Since small caliber UXO may be encountered in the borrow areas during dredging operations, as a safety precaution, the Corps requires that a screen be placed over the drag head to effectively prevent any of the UXO from entering the hopper and/or being subsequently placed on the beach; the screen will be made of vertical metal bars with a gap of no more than 1.5 inches. The magnetometer survey conducted of the borrow area identified a number of items to avoid; the contractor will not be permitted to dredge within a 200-foot radius of these items. In the event that ordnance is encountered in the borrow area, the screening and/or magnetometer sweeping will all but eliminate the possibility of any ordnance remaining on the new beach after construction.

The contractor would be responsible for proper storage and disposal of any hazardous material such as oils and fuels used during the dredging and beach nourishment operations. The U.S. EPA and U.S. Coast Guard regulations require the treatment of waste (*e.g.*, sewage, gray water) from dredge plants and tender/service vessels and prohibit the disposal of debris into the marine environment. The dredge contractor will be required to implement a marine pollution control plan to minimize any direct impacts to water quality from construction activity.

4.7 Aesthetics

During dredging operations, equipment used for dredging would be visible several miles offshore, resulting in a temporary reduction in the aesthetic value for some; other beachgoers enjoy watching the operation in progress. During dredging, the use of the immediate area surrounding the dredge plant would be restricted due to public safety. These restrictions are of short duration and typically offseason with minimal impacts to recreational boaters and anglers. Resort towns in the study area draw on the high aesthetic values of the seashore environment (*i.e*. sandy beaches, dunes, ocean views, *etc*.). Adverse impacts to beachgoers at the placement site are temporary. Dredging contractors constructing beaches typically cordon off areas approximately 1,000 feet wide at a time, working about a week or less as they pump and shape the beach. The effects of beach nourishment to restore the beach berm and dunes lost due to storms are considered positive in that the aesthetic value of the seashore environment is restored for recreational users.

4.8 Environmental Regulations

The Barnegat Inlet to Little Egg Inlet Shore Protection Project has adhered to the following environmental quality protection statutes and other environmental review requirements.

Archeological Resources Protection Act of 1979, as amended	Full
Clean Air Act, as amended	Full
Clean Water Act of 1977	pending
Safe Drinking Water Act	Full
Coastal Zone Management Act of 1972, as amended	pending

Endangered Species Act of 1973, as amended	Full
Estuary Protection Act	Full
Federal Water Project Recreation Act, as amended	N/A
Fish and Wildlife Coordination Act	Full
Land and Water Conservation Fund Act, as amended	N/A
Magnuson-Stevenson Act, Essential Fish Habitat	Full
Marine Mammal Protection Act	Full
Marine Protection, Research and Sanctuaries Act	Full
Migratory Bird Treaty Act	Full
National Historic Preservation Act of 1966	Full
National Environmental Policy Act, as amended	Full
Rivers and Harbors Act	Full
Watershed Protection and Flood Prevention Act	N/A
Wild and Scenic Rivers Act	N/A
Coastal Barrier Resources Act	Full
EO 11988, Floodplain Management	Full
EO 11990, Protection of Wetlands	Full
EO 12114, Environmental Effects of Major Federal Actions	Full
EO 12898, Environmental Justice	Full
EO 13186, Protection of Migratory Birds	Full

4.9 Areas of Concern

This project would have temporary adverse impacts on water quality and on aquatic organisms. Dredging would increase suspended solids and turbidity at the point of dredging and at the berm and dune restoration site. The area to be dredged and the area where the material would be deposited would be subject to extreme disturbance. Many existing benthic organisms will be covered at the berm restoration site. Dredging would result in the temporary complete loss of the benthic community in the borrow area. These disruptions are expected to be of short duration and of minor significance if rapid recolonization by the benthic community occurs.

Dredging would consequently temporarily displace a food source for some finfish. Scott and Kelley (1998) and Scott (2012) showed that benthic organisms in this area rapidly recover (*i.e*. within two years) after multiple dredging areas in borrow areas along the New Jersey Coastline Seven offshore borrow areas were identified for this study (A, B, C, D, E, F and Barnegat Light Inlet). Areas C, F and Barnegat Light Inlet were eliminated due to inadequate material grain size, limited quantities and proximity to submerged cables. The four offshore borrow sites considered for further evaluation were A, B, D, and E. Surveys conducted at the borrow sites has shown that the benthic organisms in the sites are similar to those in the surrounding areas.

The New Jersey Department of Environmental Protection has identified two of the borrow areas as Prime Fishing Areas, as defined by the Rules on Coastal Zone Management N.J.A.C. 7:7E as amended July 18, 1994. The New Jersey CZM rules also state that development within surf clam areas is conditionally acceptable only if the development is of national security interest and no prudent and feasible alternative sites exist. The USFWS recommends avoidance of the use of Borrow Areas B and E, and reevaluating alternative borrow areas. The Service also suggests limiting hydraulic dredging during the period of lowest biological activity and rotational dredging of borrow areas. As a consequence of coordination with natural resource agencies, borrow areas B and E were eliminated and Area D was expanded to include offshore former Areas D2 and D3. Areas D2 and D3 underwent further geotechnical evaluations and were subsequently revised to incorporate one 1034 acre site referred to as D2.

To minimize impacts to the Federally-listed piping plover, the USFWS recommends seasonal restrictions of dredging be applied to the maximum extent possible; further consultation prior to initial nourishment and all subsequent renourishment activities; monitoring, and compliance with the Services Guidelines for Managing Recreational Activities in Piping Plover Breeding Habitat on the U.S. Atlantic Coast to Avoid Take Under Section 9 of the Endangered Species Act", dated April 15, 1994. To minimize impacts to the Federally-listed threatened seabeach amaranth, the U.S. Fish and Wildlife Service suggest conducting surveys prior to construction activities. If seabeach amaranth is identified in the project area, a protective zone should be established around the plants (Arroyo, 1999).

Concerns regarding the potential impacts of dredging on Federally-listed threatened and endangered species (sea turtles and whales) were raised with respect to this project. Based on coordination with the National Marine Fisheries Service (NMFS), the PCOE would continue to employ measures more recently used (*i.e*. draghead/cutterhead) to reduce the likelihood of negatively impacting marine species. These and any other measures would be fully coordinated with NMFS prior to dredging. Coordination with NMFS with respect to the newly listed Atlantic sturgeon is ongoing.

State listed species of birds, such as the black skimmer, roseate tern, and least tern may occur along beaches in the project area. The District will coordinate with the NJ Endangered and Nongame Species Program prior to construction to develop and implement a comprehensive and beach nesting bird management plan.

The non-Federal sponsor for the Feasibility study is the New Jersey Department of Environmental Protection (NJDEP), and authorized by Congress for construction by Section 101(a)(1) of the Water Resources Development Act of 2000 and cost-shared with the nonfederal sponsor. The project is considered an ongoing construction project for purposes of PUBLIC LAW 113–2, issued 29 January 2013; The Disaster Relief Appropriations Act, 2013. PL 113-2, Chapter 4: for "repairs to projects that were under construction and damaged as a consequence of Hurricane Sandy" at full federal expense with respect to such funds.

4.10 Environmental Constraints

Appropriate measures must be taken to ensure that any resulting projects are consistent with local, regional, state, and Federal regulations. The proposed project will not have a disproportionately high adverse effect on minority or low income populations and is in compliance with EO 12898. The project would generally have beneficial social and economic effects and would generally affect all persons equally.

It must be evident that all necessary permits and approvals are issued by the regulatory agencies. Further environmental constraints relate to the protection and maintenance or control of flora and fauna species found within the ecosystem that may be affected by a project. This includes areas of prime fishing habitat, essential fish habitat and significant commercially harvestable surf clam areas. The following environmental and social well-being criteria were considered in the formulation of alternative plans:

a. Consideration should be given to public health, safety, and social well being, including possible loss of life.

b. Wherever possible, provide an aesthetically balanced and consistent appearance.

c. Avoid detrimental environmental and social effects, specifically eliminating or minimizing the following where applicable:

i. Air, noise and water pollution;

ii. Destruction or disruption of man-made and natural resources, aesthetic and cultural values, community cohesion, and the availability of public facilities and services;

iii. Adverse effects upon employment as well as the tax base and property values;

iv. Displacement of people, businesses, and livelihoods; and,

v. Disruption of normal and anticipated community and regional growth.

d. Maintain, preserve, and, where possible and applicable, enhance the following in the study area:

i. Water quality;

ii. The beach and dune system together with its attendant fauna and flora;

iii. Wetlands and other emergent coastal habitats;

iv. Commercially important aquatic species and their habitats;

v. Nesting sites for colonial nesting birds;

vi. Habitat for endangered and threatened species.

4.11 Unavoidable Adverse Environmental Impacts

The unavoidable adverse impact of the no-action alternative of obtaining offshore sand borrow sources due to insufficient suitable nearshore sand borrow sources would be continued erosion of the existing beach, which would result in loss of habitat and eventually damage to structures. Increased flooding would occur as beach loss continues. As the risk of storm damage increases, property values would decrease. The unavoidable adverse impact of both berm and dune restoration, as well as to offshore sand borrow areas, is a temporary decrease in benthic community standing stocks, which would be effected during dredging and placement operations. It is anticipated that these communities would recover in time and the displacement of benthic invertebrates is temporary. Visual, noise and air quality impacts that may occur during dredging operations are temporary and will cease upon completion of the dredging operation.

4.12 Short-term Uses of the Environment and Long-term Productivity

The use of available offshore sand when insufficient quantities are available for use in beach nourishment purposes will positively affect the economy of the project area by maintaining recreational beaches and further storm protection to the communities and natural beach and dune habitat over a 50-year period of analysis. Adverse impacts to the placement area, as well as the nearshore and offshore borrow areas, is short-term as the area fauna re-establishes through recolonization.

4.13 Irreversible and Irretrievable Commitments of Resources

Berm and dune restoration involves the utilization of time and fossil fuels, which are irreversible and irretrievable. Impacts to the benthic community would not be irreversible, as benthic communities would reestablish with cessation of placement activities.

4.14 Cumulative Effects

Cumulative impacts, as defined by CEQ regulations, is the "impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. Before 1930, the Federal government's involvement in shore erosion was limited to protection of public property. With the enactment of the River and Harbor Act of 1930 (Public Law 71-520, Section 2), the Chief of Engineers was authorized to make studies of the erosion problem, in cooperation with municipal and state governments, in efforts to prevent further erosion. Until 1946, the Federal aid was limited to studies and technical advice. In 1946 and 1956, the law was amended to provide Federal participation in the cost of a project and allowed limited contribution to the protection of privately owned shores which would benefit the public.

There are several Federal navigation projects in inlets and beachfill projects along the New Jersey ocean coast, as well as some at the State and municipal levels that utilize shoals or offshore areas. As previously mentioned in Section 2.1 (Selected Plan), portions of the Barnegat Inlet to Little Egg Inlet (Long Beach Island) beach nourishment project have been constructed to date. These include beachfront in Surf City and Ship Bottom (2007, 2011), Harvey Cedars (2010), and Brant Beach (2012).

Since November of 2012, several of the authorized and constructed projects within the Philadelphia District have had beachfill placement to offset sand losses incurred during storm Sandy. These projects include portions of Long Beach Island, Brigantine Island, Absecon Island (Atlantic City and Ventnor), Townsends Inlet to Hereford Inlet (Avalon and Stone Harbor), and Cape May City. The Ocean City – Peck Beach (northern Ocean City) project and Lower Cape May Meadows project were scheduled for renourishment at the time Hurricane Sandy struck, and that work has been completed. The remaining authorized, but uncompleted Federal projects are Long Beach Island, Absecon Island (Margate & Longport), Great Egg Harbor Inlet to Townsends Inlet (southern Ocean City, Strathmere (part of Upper Township), and Sea Isle City), and Manasquan Inlet to Barnegat Inlet (Point Pleasant Beach, Bay Head, Mantoloking, Brick Township, Toms River Township, Lavallette, Seaside Heights, Seaside Park, and Berkeley Township).

These projects have all used either inlet borrow sites or offshore sites, which have impacted over 3,000 acres of marine habitat. The proposed Federal projects combined with the existing project would affect approximately 68 miles of beach along the New Jersey coast (south of Manasquan Inlet). This represents nearly 71% of beaches along this segment of coast.

In recent years, the New Jersey Coast has been affected by catastrophic coastal storms, most notably Hurricane Sandy in October 2012. In response to the devastation of the Atlantic coastal communities in New Jersey from Hurricane Sandy, the USACE and the Federal Emergency Management Agency (through aid to State and local municipalities) have undertaken unprecedented measures to repair and/or restore the affected beaches under P.L. 84-99 Flood Control and Coastal Emergencies (FCCE) and P.L. 113-2: Disaster Relief Appropriations Act. P.L. 84-99 allows for the repair of beaches with active Federal projects to pre-storm conditions and P.L. 113-2 allows for the restoration of affected beaches to full template that have existing active Federal projects. Also, as part of P.L. 113-2, there is the funding to complete authorized, but unconstructed projects, which include the Great Egg Harbor Inlet to Townsends Inlet and the Manasquan Inlet to Barnegat Inlet projects. Figure 4-1 portrays the status of these projects along the New Jersey ocean coast.

Although nearly 71% of the beaches along the N.J. coast south of Manasquan Inlet could potentially be impacted by beachfill placement activities, the cumulative effect of these combined activities is expected to be temporary and minor on resources of concern such as benthic species, beach dwelling flora and fauna, water quality and essential fish habitat. This is due to the fact that flora and fauna associated with beaches, intertidal zones and nearshore zones are adapted to and resilient to frequent disturbance as is normally encountered in these highly dynamic and often harsh environments. Among the existing and proposed projects along this stretch of coast, renourishment cycles vary from two to seven years, which would likely preclude all of the beachfill areas from being impacted at one time.

Figure 4-1: Superstorm Sandy recovery projects along the New Jersey and Delaware Coastlines.

The majority of impacts associated with all these projects are related to the temporary disturbance to the benthic community, and do not represent a permanent loss of marine benthic habitat. The borrow areas for each project would be impacted incrementally over the 50-year project life with each periodic nourishment cycle. It is anticipated that the benthic community in offshore borrow areas would be recovered within several years after disturbance. For the Barnegat Inlet to Little Egg Inlet project, recovery is expected to occur more quickly due to the dynamic nature of the beach borrow area (2.5 to 3 miles offshore).

Cumulative adverse impacts of past and proposed future coastal erosion control projects typically result from the effect these projects have on the borrow areas: 1) the benthic resource community and 2) the creation of hypoxic conditions by dredging deep holes. Impacts to the nourishment sites themselves are temporary displacement of benthic resources in the short-term and positive impacts to the beach ecosystem in the long-term (enhanced storm protection and increased habitat). Since the current project was designed to minimize adverse environmental effects of all types the project should not culminate in adverse cumulative impacts on ecological and socioeconomic resources, and should result in an overall improvement of the beach environment. Proposed offshore Borrow Areas D2 has not been previously utilized and there are no future plans to utilize the site as a sand source for other New Jersey beach nourishment projects. NJGWS calculated that the entire shoal contains approximately 64.2 mcy of sand and extends nearly 4 times the size of the proposed offshore borrow area (see Figure 2-7). The placement of 4.9 mcy from Area D2 constitutes less than 8% of sand identified in this shoal complex.

The cumulative impacts on Essential Fish Habitat (EFH) are not considered significant. Like the benthic environment, the impacts to EFH are temporary in nature and do not result in a permanent loss in EFH. The borrow site proposed for this project does not contain prominent shoal habitat features, wrecks and reefs, or any known hard bottom features that could be permanently lost due to the impacts from dredging. Some minor and temporary impacts would result in a loss of food source in the affected areas.

Projects of a restorative nature using beachfill are becoming increasingly common in coastal areas of high development as they become more susceptible to erosive forces. Numerous beach nourishment projects have been studied along the Atlantic Ocean coast of New Jersey since the 1960s by local, State, and Federal interests. Depending on site-specific circumstances, such as the methods utilized to alleviate coastal erosion and ensuing storm damages and the existing ecological and socioeconomic conditions, it is difficult to gauge the net cumulative effects of these actions. The scientific literature generally supports beachfill projects over structural alternatives, if properly planned, are short-term, and have minor ecological effects.

5.0 EVALUATION OF 404(b)(1) GUIDELINES

I. Project Description
A. Location
The proposed project site includes the communities of Long Beach Township, Barnegat Light, Harvey Cedars, Surf City, Ship Bottom, and Beach Haven. The site is located in Ocean County, New Jersey. The project would use nearshore and offshore sand borrow areas.

B. General Description
The purpose of the proposed project is to reduce impacts from Hurricanes and Storm damage, which results in erosion, inundation and wave attack along the oceanfront of Long Beach Island. The berm and dune restoration extends from groin 4 (Seaview Drive, Loveladies) to the terminal groin (groin 98) in Long Beach Township, approximately 17 miles. The Barnegat Light (northern end of the study area) area is not included in the nourishment aspect of the project because of minimal erosion and substantial dune/berm complex. The US Fish and Wildlife Service (USFWS, 1996) states that they do not consider beach nourishment on the Holgate Unit of the Edwin B. Forsythe National Wildlife Refuge necessary. Hence, the Holgate Unit (southern end of study area) was also not included in the project.

Due to the fact that both ends of the project terminate at a groin, no tapers would be needed. The template for the plan is a dune at elevation of +22 ft NAVD, with a 30 foot dune crest width, 1V:5H slopes from dune crest down to a berm at elevation +8 ft NAVD, a berm width of 125 feet from centerline of dune (105 feet of dry beach from the seaward toe of dune to MHW), 1V:10H slopes from the berm to MLW, and maintenance of the profile shape from MLW to depth of closure (occurring at approximately -29 ft NAVD). From centerline of dune it ranges from a minimum of 1045 feet to a maximum of 4500 feet. Average dune widths for LBI are already at +29 feet NAVD. Dune elevations are at 19 feet on average while berm width averages are at 111 feet. As part of the berm and dune restoration approximately 1,030.85 acres would be covered, of these, approximately 365.10 acres would be above mean high water (MHW) and 665.75 acres would be below MHW. The elevation of MHW is 1.5 feet in NAVD datum. The above surface areas extend from the inland toe of the dune to MHW and from MHW to depth of closure at -29.0 feet NAVD.

C. Authority and Purpose

1. The authority for the project is The New Jersey Shore Protection Study which was authorized under resolutions adopted by the Committee on Public Works and Transportation of the U.S. House of Representatives and the Committee on Environment and Public Works of the U.S. Senate in December 1987.

2. The purpose of the project is to provide beach erosion control, hurricane protection, and storm damage reduction to the shoreline of Long Beach Island that is engineeringly, economically, and environmentally feasible.

D. General Description of Dredged or Fill Material

1. The proposed dredged material is fine to course sand as defined by the Unified Soil Classification System.

2. The design template plan required 4.95 million cubic yards of sand for initial berm placement, and 2.45 million cubic yards for dune placement over the entire project area (EIS, 1999). Approximately

1.9 million cubic yards would be needed for periodic nourishment every 7 years over a 50-year period of analysis. In order to complete initial construction, approximately 7.8 mcy of sand will be placed on the remaining unconstructed portions of the project area. An estimated additional 20-25% (of the estimated placement quantity of 7.8 mcy) may be dredged from Borrow Area D2 to account for potential losses during the dredging operation due to settlement and erosion or due to storms. Dredging of sand shall be accomplished by either a cutter suction or trailing suction hopper dredge. Cut characteristics at the borrow site can vary depending on which type of plan is used. An hydraulic cutter suction dredge typically cuts in lanes approximately 150 feet in length by approximately 4 feet wide. Contract specifications limit dredging cut depths to less than 10 feet. Hopper cut characteristics are dispersed over a broad area in between transiting and typical are 4 feet in width and 3 feet deep. Borrow Areas D1 and D2 are located in 35 to 65 feet of water.

3. Five offshore borrow areas were proposed as a source of sand for this project. Only Borrow Area D1 has been utilized for initial berm and dune restoration to date. Borrow Area D1 and offshore Area D2 are proposed for future nourishment.

E. Description of Proposed Discharge Site

1. The proposed discharge site is comprised of an eroding berm and dunes along the coastline of Long Beach Island, Ocean County, New Jersey.

2. The proposed discharge site is unconfined with placement to occur on a shoreline area.

3. The type of habitat present at the proposed location is intertidal and beach habitat.

4. The remaining portions for initial construction will require approximately 7.8 million cubic yards of sand for initial berm and dune placement along the municipalities of Long Beach Township, the Borough of Ship Bottom, and the Borough of Beach Haven. The constructed completed project includes berm and dune restoration that extends from groin 4 (Seaview Drive, Loveladies) to the terminal groin (groin 98) in Long Beach Township, approximately 17 miles. The Barnegat Light (northern end of the study area) area is not included in the project because of low erosion and healthy beaches. The US Fish and Wildlife Service (USFWS, 1996) states that they do not consider beach nourishment on the Holgate Unit of the Edwin B. Forsythe National Wildlife Refuge necessary. Hence, the Holgate Unit (southern end of study area) was also not included in the project. Due to the fact that both ends of the project terminate at a groin, no tapers would be needed. The template for the plan is a dune at elevation +22 ft NAVD, with a 30 foot dune crest width, 1V:5H slopes from dune crest down to a berm at elevation +8 ft NAVD, a berm width of 125 feet from centerline of dune (105 feet of dry berm from toe of dune to MHW), 1V:10H slopes from the berm to MLW, and maintenance of the profile shape from MLW to depth of closure (occurring at approximately -29 ft NAVD). Average dune widths for LBI are already at +29 feet NAVD. Dune elevations are at 19 feet on average while berm width averages are at 111 feet. As part of the berm and dune restoration approximately 1,030.85 acres would be covered; of these, approximately 365.10 acres would be above mean high water (MHW) and 665.75 acres would be below MHW. The elevation of MHW is 1.5 feet in NAVD datum. The above surface areas extend from the inland toe of the dune to MHW and from MHW to depth of closure at - 29.0 feet NAVD.

F. Description of Placement Method

A hydraulic dredge or hopper dredge would be used to excavate the borrow material from the borrow area. The material would be transported using a pipeline delivery system to the berm and dune restoration site. Subsequently, final grading would be accomplished using standard construction equipment.

II. Factual Determination

A. Physical Substrate Determinations

1. The final proposed elevation of the beach substrate after fill placement would be +8.0 feet NAVD at the top of the berm and +22.0 feet NAVD at the top of the dune. The proposed profile of the berm would be 10H:1V from the toe of dune to MLW, and maintenance of the profile shape from there to the depth of closure. The dune would have a 1V:5H slope from dune crest down to the berm.

2. The sediment type involved would be sand.

3. The initial phase of construction would establish a construction template that is higher than the final intended design template or profile. It is expected that compaction and erosion would be the primary processes resulting in the change to the design template. In addition, the loss of fine-grained material into the water column would occur during initial settlement. Until the berm template is achieved and stabilized, sand will erode into the water column. The Corps plans for an approximate loss of 15% to 20% dredging losses. Material lost in establishing the template actually serves to create the area known as the depth to closure. The referenced quantities, 7.8 MCY initial and 1.9MCY for periodic nourishment, are pay quantities, *i.e*. the quantity required to be on the beach for payment. Assuming at most a 25% contingency for dredging losses due to sediment characteristic variability, shoreline change prior to construction, and erosion due to storms during construction dredging quantities, the project may require approximately 2.9 mcy from Area D1 and approximately 7.0 mcy from D2 for initial construction and 2.3 mcy dredged for each periodic nourishment.

4. The proposed construction would result in removal of the benthic community from the borrow areas, and burial of the existing beach and nearshore communities.

5. Other effects would include a temporary increase in suspended sediment load and a change in beach profile, particularly in reference to elevation.

6. Actions taken to minimize impacts include selection of fill material that is similar in nature to the pre-existing substrate. In addition, standard construction practices to minimize turbidity and erosion would be employed and complete elimination of borrow areas identified as essential fish habitat.

B. Water Circulation, Fluctuation and Salinity Determinations

1. Water. Consider effects on:

a. Salinity - No effect.
b. Water Chemistry - No significant effect.
c. Clarity - Minor short-term increase in turbidity during construction.
d. Color - No effect.
e. Odor - No effect.
f. Taste - No effect.

g. Dissolved gas levels - No significant effect.
h. Nutrients - Minor short-term effect
i. Eutrophication - No effect.
j. Others as appropriate – None.

2. Current patterns and circulation

a. Current patterns and flow - Circulation would only be impacted by the proposed work in the immediate vicinity of the borrow area, and in the placement areas where the existing circulation pattern would be offset seaward the width of the berm and dune restoration.

b. Velocity - No effect on tidal velocity and longshore current velocity regimes.

c. Stratification - Thermal stratification occurs beyond the mixing region created by the surf zone. There is a potential for both winter and summer stratification. The normal pattern should continue post construction of the proposed project.

d. Hydrologic regime - The regime is largely marine and oceanic. This would remain the case following construction of the proposed project.

3. Normal water level fluctuations - the tides are semidiurnal with a mean tide range of 4.1 feet and a spring tide range of 5.0 feet in the Atlantic Ocean. Construction of the proposed work would not affect the tidal regime.

4. Salinity gradients - There should be no significant effect on the existing salinity gradients.

5. Actions that would be take to minimize impacts - None are required, however, the borrow area would be excavated in a manner to approximate natural ridge slopes to ensure normal water exchange and circulation. Utilization of clean sand and its excavation with a hydraulic dredge would also minimize water chemistry impacts.

C. Suspended Particulate/Turbidity Determinations

1. Expected changes in suspended particulate and turbidity levels in the vicinity of the placement and borrow sites - There would be a short-term elevation of suspended particulate concentrations during construction phases in the immediate vicinity of the dredging and discharge activities. Elevated levels of particulate concentrations at the discharge location might also result from “washout” after beachfill is placed.

2. Effects (degree and duration) on chemical and physical properties of the water column

a. Light penetration - Short-term, limited reductions would be expected at the borrow and placement sites from dredge activity and berm washout.

b. Dissolved oxygen - There is a potential for a decrease in dissolved oxygen levels but the anticipated low levels of organics in the borrow material should not generate a high, if any, oxygen demand.

c. Toxic metals and organics - Because the borrow material is essentially all fine sand as defined by the Unified Soil Classification System, no toxic metals or organics are anticipated.

d. Pathogens - Pathogenic organisms are not known or expected to be a problem in the borrow or placement areas.

e. Aesthetics - Construction activities and the initial construction template associated with the fill site would result in a minor, short-term degradation of aesthetics.

3. Effects on Biota

a. Primary production, photosynthesis - Minor, short-term effects related to turbidity.

b. Suspension/filter feeders - Minor, short-term effects related to suspended particulates outside the immediate deposition zone. Sessile organisms would be subject to burial within the deposition area.

c. Sight feeders - Minor, short-term effects related to turbidity.

4. Actions taken to minimize impacts include selection of clean sand with a small fine grain component and low organic content. Standard construction practices would also be employed to minimize turbidity and erosion.

D. Contaminant Determinations

The discharge material is not expected to introduce, relocate, or increase contaminant levels at either the borrow or placement sites. This is assumed based on the characteristics of the sediment, the proximity of borrow sites to sources of contamination, the area's hydrodynamic regime, and existing water quality.

E. Aquatic Ecosystem and Organism Determinations

1. Effects on plankton -The effects on plankton should be minor and mostly related to light level reduction due to turbidity. Significant dissolved oxygen level reductions are not anticipated.

2. Effects on benthos - There would be a major disruption of the benthic community in the borrow area, when the fill material is excavated, and in the placement area due to burial or displacement. The loss is somewhat offset by the expected rapid opportunistic recolonization from adjacent areas that would occur following cessation of construction activities.

Recolonization is expected to occur at the placement site by vertical migration also. Surf clams are found in the borrow site, but evidence for their recovering is good.

3. Effects on Nekton - Only a temporary displacement is expected as the nekton would probably avoid the active work areas.

4. Effects on Aquatic Food Web - Only a minor, short-term impact on the food web is anticipated. This impact would extend beyond the construction period until recolonization of the buried area has occurred.

5. Effects on Special Aquatic Sites - No wetlands would be impacted by the project. Wetlands were found in the original study area. The placement site/project area has been reduced in scope to no longer include wetlands.

6.Threatened and Endangered Species - Several species of threatened and endangered sea turtles might be in the vicinity of the sand borrow areas depending on time of year. Sea turtles have been known to become entrained and subsequently destroyed by suction hopper dredges. However, current practices require the use of screens placed on the dredge draghead or cutterhead as well as the beach discharge pipe, for the prevention of ordnance deposition on beaches. This method serves to minimize impacts to sea turtles as well, and has been coordinated with the National Marine Fisheries Service.

The piping plover, a Federal and state threatened species, could potentially be impacted by construction of the proposed project. This bird nests on ocean beaches and nesting sites have occurred within the project area. Once constructed, the project could provide more suitable nesting habitat for the plovers and other beach nesters. Avoidance of nesting times could minimize the impact to plovers during construction. Maximum use of dredging during non-nesting seasons and implementation of a comprehensive beach nesting bird management plan coordinated with USFWS and NJDEP Endangered and Non-Game Species Program will also serve to minimize impacts to nesting least terns and black skimmers.

7. Other wildlife - The proposed plan would not affect other wildlife.

8. Actions to minimize impacts - Impacts to benthic resources can be minimized at the borrow area by dredging in a manner as to avoid the creation of deep pits, using one borrow area as the primary source of initial fill and alternating locations of periodic dredging. Current approximate depths in D1 range between -35 and -65 feet NAVD88 and -40 and -60 feet NAVD88 in D2. Hopper dredges typically make 4 feet wide by 3 feet deep cuts with each drag arm. Hydraulic cutter suction dredges cut lanes approximately 200 feet wide and about 5 feet deep with each pass. A maximum dredge cut depth is specified in the contract to limit cuts to no deeper than 5-10 feet of surrounding bathymetry. Employing dragarm and cutterhead intake screens minimizes the potential for impacts to Federal and state threatened or endangered sea turtles. Impacts to the Federal and state threatened piping plover can be avoided or minimized by establishing a buffer zone around nests during the nesting season. Impacts to the surf clam population may be minimized by selective use of borrow area(s) and the commercial harvest of surf clams prior to dredging.

F. Proposed Placement Site Determinations

1. Mixing zone determination

a. Depth of water - zero to 10 feet mean low water

b. Current velocity - there is no tidal current in the area, predominate current is longshore current which is wave dependent for its velocity

c. Degree of turbulence – Heavy.

d. Stratification – None.

e. Discharge vessel speed and direction - Not applicable.

f. Rate of discharge - Typically this is estimated to be 780 cubic yards per hour

g. Dredged material characteristics - fine sand as defined by the Unified Soil Classification System.

h. Number of discharge actions per unit time - Continuous over the construction period.

2. Determination of compliance with applicable water quality standards - a Section 401 Water Quality Certificate and consistency concurrence with New Jersey's Coastal Zone Management Program were obtained prior to initiation of construction.

3. Potential effects on human use characteristics

a. Municipal and private water supply - No effect.

b. Recreational and commercial fisheries - Short-term effects during construction.

c. Water related recreation - Short-term effect during construction.

d. Aesthetics - Short-term effect during construction.

e. Parks, national and historic monuments, national seashores, wilderness areas, etc. - no effect.

G. Determination of Cumulative Effects on the Aquatic Ecosystem - None anticipated.

H. Determination of Secondary Effects on the Aquatic Ecosystem - Any secondary effects would be minor and short in duration.

III. Finding of Compliance or Non-Compliance with the Restrictions on Discharge

A. No significant adaptation of the Section 404(b)(1) Guidelines was made relative to this evaluation.

B. The alternative measures considered for accomplishing the project are detailed in Section VII of the 1999 *Barnegat Inlet to Little Egg Inlet Feasibility Study and Environmental Impact Statement.*

C. A Section 401 Water Quality Certificate and Federal Consistency Determination has been obtained from the New Jersey Department of Environmental Protection and will be reviewed and modified by NJDEP to reflect addition of the offshore Borrow Area D2 prior to construction.

D. The proposed berm and dune restoration would not violate the Toxic Effluent Standards of Section 307 of the Clean Water Act.

E. The proposed berm and dune restoration would comply with the Endangered Species Act of 1973. Informal coordination procedures have been completed.

F. The proposed berm and dune restoration would not violate the protective measures for any Marine Sanctuaries designated by the Marine Protection, Research, and Sanctuaries Act of 1972.

G. The proposed berm and dune restoration would not result in significant adverse effects on human health and welfare, including municipal and private water supplies, recreation and commercial fishing, plankton, fish, shellfish, wildlife, and special aquatic sites. Significant adverse effects on life stages of aquatic life and other wildlife dependent on the aquatic ecosystem; aquatic ecosystem diversity, productivity, and stability; and recreational, aesthetic, and economic values would not occur.

H. Appropriate steps to minimize potential adverse impacts of the discharge on aquatic systems include selection of borrow material that is low in silt content, has little organic material, and is uncontaminated.

I. On the basis of the guidelines, the placement site for the dredged material is specified as complying with the requirements of these guidelines, with the inclusion of appropriate and practical conditions to minimize pollution or adverse effects on the aquatic ecosystem.

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