Biological Opinion and Conference Opinion
Fire Island Inlet to Moriches Inlet
Fire Island Stabilization Project
Suffolk County, New York,

Prepared for:

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INTRODUCTION

This document transmits the U.S. Fish and Wildlife Service's (Service) Biological and Conference Opinion (Opinion) addressing the U.S. Army Corps of Engineers' (Corps) proposed Fire Island Inlet to Moriches Inlet, Fire Island Stabilization Project (FIMI). At issue are the effects of the proposed action on the threatened piping plover (*Charadrius melodus*; Atlantic Coast population) and the threatened seabeach amaranth (*Amaranthus pumilus*; threatened), and on the rufa red knot (*Calidris canutus rufa*; red knot), a species proposed for listing as threatened under the ESA. This Opinion was prepared in accordance with section 7 of the Endangered Species Act (ESA) of 1973 as amended (16 U. S.C. 1531 *et seq*.). The Corps' biological assessment (BA) and request for formal consultation was accepted by the Service on March 4, 2014, and amended May 21, 2014. The Corps requested, and the Department of the Interior (DOI) agreed to, an expedited consultation timeframe, requiring that the Service complete the Opinion on or about 60 days after acceptance of the section 7 initiation package. This deviates from the normal timeframe for consultation of 135 days (50 CFR Part 402.14e). The Service has used all the means at our disposal in an attempt to meet this sharply truncated timeline. The Service reinitiated consultation on September 30, 2014 and finalized the revised Opinion on October 14, 2014.

This Opinion is based on information provided in the Corps' final BA (U.S. Army Corps of Engineers, February 2014a), along with other sources of information cited herein. The BA is herein incorporated by reference. A complete decision record for this consultation is on file at the Service's Long Island Field Office in Shirley, New York. The Service formally reinitiated consultation on September 30, 2014.

Based on an analysis of the impacts of the proposed project presented in the BA, the Corps determined that the proposed project "may affect, and is likely to adversely affect" the Federally-listed piping plover (*Charadrius melodus*; threatened) and seabeach amaranth (*Amaranthus pumilus*; threatened). This determination means that listed resources are likely to be exposed to the action or its environmental consequences and will respond in a negative manner to the exposure. The BA did not provide a determination for the rufa red knot (*Calidris canutus rufa*; proposed) or roseate tern (*Sterna dougallii dougallii*; endangered).

With respect to ESA compliance, all aspects of the Corps' project description in the Service's biological opinion will be binding, including the specific nature, timing, and extent of dune and beach construction, as well as all conservation measures agreed to by the Corps and Service.

In addition to the piping plover and seabeach amaranth, the roseate tern is occasionally observed roosting on Fire Island and breeding on the islands in the Great South Bay. However, no nesting activity of roseate terns on Fire Island has been documented. No Critical Habitat for the roseate tern has been designated in New York.

After consideration of the project description and conservation measures, the Service does not anticipate any adverse impacts to the roseate tern from the proposed project. Therefore, no further coordination with the Service is required pursuant to the ESA for this species. Should project plans change, or if additional information on this species becomes available, this evaluation may be reconsidered.

CONSULTATION HISTORY

The history of the consultation request includes any informal consultation, prior formal consultations on the action, documentation of the date consultation was initiated, a chronology of subsequent requests for additional data, extensions, and other applicable past or current actions (U.S. Fish and Wildlife Service and National Marine Fisheries Service 1998).

Dec. 9, 2013 — The Corps transmits via electronic transmission the plan layout designs for the entire FIMI Project. The plan includes dune and beach construction in piping plover and seabeach amaranth habitat on Fire Island, at areas including Robert Moses State Park, Fire Island Lighthouse Beach, Robbins Rest, Ocean Bay Park, Point O' Woods, Cherry Grove, Fire Island Pines, Water Island, Davis Park, and Smith Point County Park. The plan also includes beach fill tapers (lateral extensions of dune and beach fill) on most of the major Federal tracts on Fire Island, including the Federal Wilderness Area.

Dec. 13, 2013 — The Service transmits written correspondence to the Corps, providing the Service's recommendations to avoid or minimize impacts to listed and proposed species and their habitats. These recommendations include changes in dune alignment and beach elevation on Federal properties at Lighthouse Beach and in the Robbins Rest area to maximize protection of partial overwash habitats at these sites. The Service also recommended a "Berm only" design profile and maximum berm elevation of 9 feet (ft) National Geodetic Vertical Datum (NGVD) at Smith Point County Park in the area in front of the overwash habitats on Fire Island near Pattersquash Island, Narrow Bay, and New Made Island. Other recommendations including, but not limited to, sediment textural compatibility and vegetation density were also provided.

Dec. 16, 2013 — The Corps transmits via electronic transmission a preliminary Draft Environmental Assessment (Draft EA). The Draft EA includes two alternatives, a "No Action Alternative" and a "Beach Fill Alternative." The Corps notes that the BA for piping plover, seabeach amaranth, and

	roseate tern is being revised based on the December 13, 2013, meeting and is not included with the preliminary Draft EA.
Dec. 18, 2013	The Corps convenes a meeting with the Service, National Park Service (NPS), New York State Department of Environmental Conservation (NYSDEC), Suffolk County Department of Parks, Recreation and Conservation, and the Suffolk County Department of Public Works at their New York District Office to discuss endangered species conservation measures and habitat restoration alternatives in the proposed project area. The Corps slightly modifies the dune alignment at Fire Island Lighthouse Beach and Robbins Rest to address the Service's December 13, 2013, comments. The Corps also proposes to lower tolerance limits for berm elevation to 0.5 ft from 1.0 ft, proposes several options for vegetation maintenance throughout the project area, and habitat restoration near the east end of Smith Point County Park in an area known as Great Gun Beach.
Dec. 19, 2013	The Corps provides via electronic transmission its final proposed dune and berm alignment for the Smith Point County Park portion of the project area. The alternative includes dune and beach construction, vegetation maintenance in piping plover breeding habitat, and habitat restoration at the eastern end of Smith Point County Park.
Jan. 9, 2014	In response to the Corps' December 19, 2013, correspondence, the Service transmits written correspondence to the Corps identifying additional alternatives the Corps should consider for the Smith Point County Park portion of the project area.
Jan.10, 2014	The Corps sends via electronic transmission updated project plans for a portion of the project at Smith Point County Park. The plans are identified as draft concept drawings for revised dune alignment for Smith Point County Park. The Corps advises that the constructed dunes must be straight lines, with as shallow transitions as possible, but they can be modified during the Plans & Specification period of project planning. The Corps indicates that the back slope of the dune design can be modified slightly to 1:4 or 1:3 for a "smaller" overall foot print.
Jan. 24, 2014	The Department of the Interior (DOI), Office of Environmental Policy and Compliance, submits DOI's Bureau written comments on the Corps' preliminary Draft EA, including comments from the U.S. Geological Survey (USGS), NPS, and the Service.

Jan. 29, 2014	The Corps informs the Service that they are revising the plan sheets based on the December 18, 2013, interagency meeting and will include the plan sheets in the Assessment when it is transmitted to the Service sometime in mid-February 2014.
Feb. 4, 2014	The Service received the Corps' BA entitled, "Fire Island to Moriches Inlet Fire Island Stabilization Project, Biological Assessment," dated February 2014, via electronic transmission. With this submission, the Corps requested initiation of formal consultation pursuant to section 7 of the ESA for the piping plover and seabeach amaranth. The Corps informs the Service that the report has also been sent via U.S. mail to the New York and Long Island Field Offices in Cortland and Shirley, NY, respectively.
Feb. 7, 2014	The Corps informs the Service via electronic correspondence that no beach fill will be placed within 1000 meters (m) of known populations of piping plover or other state or Federally-listed shorebirds/seabirds during the breeding season. The Corps also indicates that they expect that the effects of the proposed action will provide storm damage protection for approximately five years and then erode over the next five years to a point where it would not provide storm damage protection.
Feb. 12, 2014	The Service meets with the Corps, DOI, NPS, and U.S. Geological Survey (USGS) in Washington, D.C., to discuss the proposed project, the Corps' ESA responsibilities, as well as the schedules for the BA and biological opinion.
Feb. 14, 2014	The Service transmits written comments to the Corps on the BA, providing general comments on the consultation process and guides to completing the Assessment, as well as specific comments on the proposed project design.
Feb. 18-May 20, 2014	Weekly coordination conference calls are convened between high level personnel of the Department of the Interior and the U.S. Army Corps of Engineers.
Feb. 20-21, 2014	The Service, Corps, NPS, and USGS meet in the Corps' New York

District Office to discuss the proposed project in more detail, looking at project features that would minimize impacts to listed species in the project area. The Corps discusses the relationship between the Fire Island Montauk Point General Re-evaluation Report (FIMP GRR) and the FIMI, expressing that the FIMP GRR may result in no further Federal involvement in beach nourishment.

Feb. 28, 2014	The Corps transmits via electronic correspondence the revised Assessment. Plan sheets were not provided, but the Corps indicated these would be available on Monday, March 3, 2014, via a file transfer protocol site. In separate electronic correspondence, the Corps also provides a "Breach Frequency Report" dated February 2, 2006, and a document entitled, "Overwash Frequency vs Breach Closure Design Document," dated September 26, 2008.
Mar. 3, 2014	The Corps transmits via electronic correspondence its determination that the proposed project may affect, and would be likely to adversely affect the piping plover and seabeach amaranth. The Corps also provides in several separate emails updated plan layout sheets for the proposed project. The plans depict the location of each design template as applied throughout the proposed project area. Dune and or beach construction is proposed for 19 miles (mi) of beach on Fire Island in areas that experienced either partial or bay to ocean overwash as a result of Hurricane Sandy. The updated plans do not provide specific descriptions of habitat maintenance or restoration in the area of Smith Point County Park or elsewhere in the project.
Mar. 4, 2014	The Service and Corps' biologists discuss via telephone the proposed project description and several areas where clarification in the project description is needed. The Corps follows up via electronic correspondence addressing such issues as local maintenance of the project, land use management that might occur in the project area after construction, and Corps' commitment to continue to work with the Service on issues related to predator management and pre-, concurrent, and post-construction monitoring in the project area.
Mar. 4, 2014	The Service transmits correspondence to the Corps accepting the BA and formal consultation officially begins.
April 8, 2014	The New York/Long Island Field Offices Supervisor spoke to Colonel Owen by telephone regarding the details needed to complete the biological

opinion, including the State and Suffolk County commitments for vegetation and predator management, fencing of nesting areas, ORV management, etc.

May 7, 2014	An interagency meeting was held in Hauppauge, New York. Participants included the Corps, NPS, Service, NYSDEC, Suffolk County, and congressional representatives from Senator's Schumer and Gillibrand's offices and Congressman Bishop's office. The purpose of the meeting was to discuss the County's proposed changes to the Corps' proposed project description for the area in Smith Point County Park and to discuss the Service's draft biological opinion. The Service communicated the fact that a preliminary determination had been made at the Field Office level that the project, as proposed, was likely to jeopardize the continued existence of the piping plover. During this discussion, representatives of the Service explained the rationale for this preliminary Field Office-level determination, including the status of the species, environmental baseline, effects of the action, and cumulative effects of the project, as well as the regulatory standard required when undertaking jeopardy analyses in a biological opinion.
May 8, 2014	An interagency meeting was held on May 8, 2014, at the Service's Long Island Field Office. Participants included the Corps, NPS, Service, NYSDEC, and Suffolk County. The purpose of the meeting was to solicit comments on the Service staff's proposed methodology for evaluating the effects of the action, including an assessment of the carrying capacity of storm-created habitats affected versus those not affected by the proposed project, in the with-project scenario.
May 15-16, 2014	An interagency meeting was held at the Corps' office. Participants included the Corps, NPS, Service, DOI, NYSDEC, and Suffolk County. The purpose of the meeting was to finalize conservation measures to minimize impacts to the piping plover. Significant new conservation measures and the necessary funding to implement those measures are committed to by the Corps during this meeting.
May 16-23, 2014	The Service considers in detail all of the comments and commitments made at the interagency meetings of May 7, 8, and 15-16, as well as all of the comments and data submitted to the Service to that point in time with respect to the Service's draft biological opinion, the methodology for evaluating the effects of the action, the project description, and the conservation measures to minimize impacts to the piping plover, including

	the State and Suffolk County commitments for vegetation and predator management, fencing of nesting areas, ORV management, etc. Contrary to the preliminary determination that had been made by Service staff at the Field Office level prior to the May 15-16 meeting, and that had been communicated to the other stakeholders at the May 7 meeting, the Service's final determination at the Regional level (the level authorized to make a final decision on behalf of the Service) was that the project, as proposed, was not likely to jeopardize the continued existence of the piping plover. This determination, which fully considered the views of Service staff at the Field Office level but disagreed with aspects of their preliminary determination (see Appendix 7), was incorporated into a final biological opinion and incidental take statement signed by the Service's Assistant Regional Director for the Northeast Regional Office.
May 23, 2014	The final biological opinion is delivered to the Corps.
September 30, 2014	The Service formally reinitiates consultation with the Corps concerning the effects of the project on the piping plover. The rationale for the reinitiation is that the agency action now includes significant mitigation measures, many initially included as terms and conditions of the project but now and more properly included as part of the agency action, that may alter the effects of the agency action in a manner not considered in the original BO.
October 15, 2014	The Service finalizes the revised BO and sends to the Corps.

BIOLOGICAL OPINION

I. DESCRIPTION OF THE PROPOSED ACTION

A. Background and General Description

The proposed Stabilization Project is located on Fire Island, New York. The project area stretches from Robert Moses State Park in the west to Smith Point County Park in the east for a total of 19 mi (Figure 1). The purpose of the project is to address shoreline erosion on Fire Island that occurred as a result of Hurricane Sandy and to provide a level of storm damage protection to mainland developments (U.S. Army Corps of Engineers 2014b). On October 29, 2012, Hurricane Sandy made landfall on Long Island. According to the National Hurricane Center, Hurricane Sandy, at nearly 2,000 kilometers (km) in diameter, is the largest storm on historical record in the Atlantic basin (Hapke *et al.* 2013). It affected extensive areas of the east coast of the United States, and on Long Island, the storm caused substantial beach erosion. In some areas, dunes were extensively overwashed and several breaches formed as the storm made landfall during astronomical high tides (Hapke *et al.* 2013). While strong coastal storms such as Hurricane Sandy can often result in severe damages to physical structures, particularly on the barrier island, they are an important natural process of barrier islands that allow these systems to evolve in response to sea-level rise (Hapke *et al.* 2013).

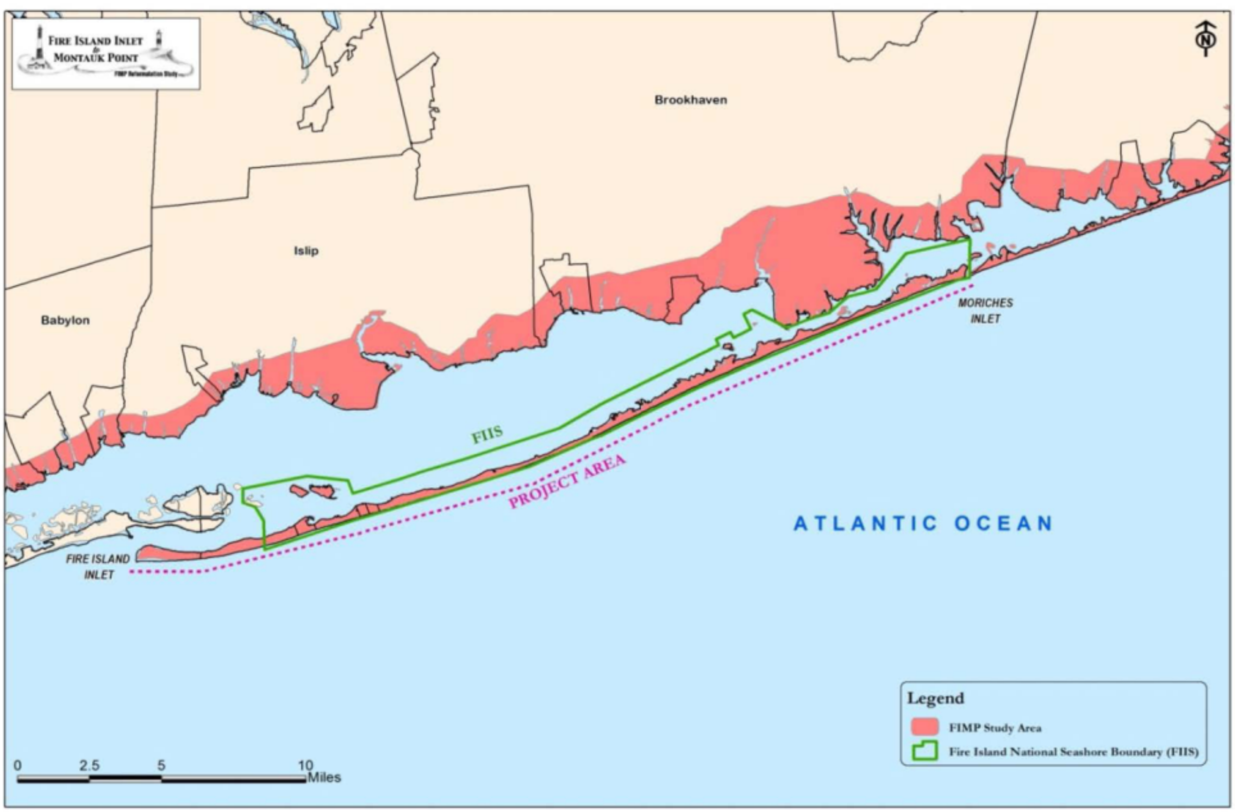

Figure 1. Map of FIMI Project Area. From U.S. Army Corps of Engineers (2014b).

Both developed and undeveloped beaches on Fire Island experienced profound changes as a result of the storm (Hapke *et al.* 2013). The storm created three breaches and extensive overwash areas on the eastern end of Fire Island. The USGS undertook a rapid assessment of the areal extent and depth of overwash deposits shortly after the storm (Hapke *et al.* 2013). In the western portion of the island, 147 acres (ac) of overwash areas were identified. However, these deposits were limited in many locations by residential development and other infrastructure. Much of the material was deposited on private property, concrete walkways, etc., and was mechanically redistributed back on the beach during post-storm clean up and dune construction activities. In the central areas of Fire Island, the occurrence of overwash was relatively low (31 ac) and primarily confined to existing dune cuts that served as vehicle access points or other low spots between the dunes. The greatest areal extent of overwash deposits, or 220 ac, occurred on eastern Fire Island, and was concentrated in the vicinity of Old Inlet in the Federal Wilderness Area and east of the TWA Flight 800 Memorial at Smith Point County Park (Hapke *et al.* 2013).

Three breaches formed on Fire Island at Smith Point (40.750156N, -72.811806W), Old Inlet (40.723509N, -72.894704W), and eastern Fire Island Pines (40.667489N, -73.055264W). The "breach" within Smith Point County Park did not appear to exhibit exchange of ocean and bay waters at low tide (Papa, personal observation), but was nonetheless closed by the Corps in December 2012 (via a request from the New York State Department of Environmental Conservation) using the authorities under the Breach Contingency Plan (BCP) (U.S. Army Corps of Engineers 1996). The breach at Old Inlet remains open and options concerning its management are being explored by the NPS in accordance with the Fire Island Wilderness Act of 1983 (Public Law 95-585) and NEPA. (On March 14, 2013, the New York State Department of Environmental Conservation (DEC) requested the Corps to take preliminary steps to prepare to implement closure of the breach at Old Inlet). The breach at eastern Fire Island Pines did not require any action under the Corps' BCP as no exchange of bay and ocean water was observed after the storm passed and tidal levels subsided.

Shoreline stabilization projects have been undertaken on Long Island since the 1920s. Since the 1930s, the beaches on Fire Island have been stabilized via sand fence placement, dune construction, jetty construction, and beach nourishment. The first large-scale dune and beach construction was undertaken in the developed FIIS communities in the late 1940s (Gravens 1999). Overall, in the past 70 or so years, nearly five million cubic yards (cy) of sand have been placed on Fire Island (Gravens 1999; Coastal Planning and Engineering 2004).

The project description provided below is based on the Corps' BA dated March 2014, and incorporates any additional project details obtained either in writing or verbally from the Corps. The proposed project would be the largest single Federal beach nourishment project ever constructed on Fire Island and would be accomplished at a full Federal cost of about $185,000,000.00 (U.S. Army Corps of Engineers 2013 [LRR Report]).

B. CORPS' PREFERRED ALTERNATIVE

The recommended stabilization alternative includes dune and/or beach construction for 19 mi. of the entire 30 mi., or 63 percent, of Fire Island's coastline. It would cross 100 percent of the overwash habitat created by Hurricane Sandy in the project area that is used by, or could be utilized by piping plover and seabeach amaranth. Sand for dune and beach construction would be obtained from ocean sand mining areas. The construction schedule would entail continuous dredging, sand placement, dune building, and beach construction from late 2014 to August 2015. The proposed project also includes measures the Corps has proposed to avoid and minimize adverse effects to the piping plover and seabeach amaranth.

1. Project Design and Layout

The proposed project is comprised of several design templates identified as "berm only," "small," and "medium" (U.S. Army Corps of Engineers 2014b).

The "berm only" design template includes a berm width of 90 ft at elevation +9.5 NGVD, and no dune behind the berm. It also includes a foreshore slope of 12 vertical (V) 1 on 1 horizontal (H) from +9.5 to +2 ft NGVD, or mean high water (MHW), equating to an additional 115 ft of beach above MHW. This template is proposed in areas where eroded berm conditions have been observed, but where existing dune elevation and width are sufficient to reduce the risk of overwashing and breaching. Areas that meet these criteria include Robert Moses State Park and the beach fronting the TWA Flight 800 Memorial in Smith Point County Park (U.S. Army Corps of Engineers 2014b).

The "small" template is intended to reduce the risk of breaching, but does not prevent a significant portion of the damages to oceanfront structures (U.S. Army Corps of Engineers 2014b). It is proposed for areas with limited oceanfront structures, including the eastern section of Robert Moses State Park, NPS Fire Island Lighthouse Beach, and the eastern section of Smith Point County Park. The "small" fill template includes a berm width of 90 ft, at elevation +9.5 ft NGVD and a dune with a crest width of 25 ft at an elevation of +13 ft NGVD. It also includes a foreshore slope of 12V:1H from +9.5 to +2 ft NGVD, equating to an additional 115 ft of beach above MHW.

The "medium" design template is proposed for areas that have the greatest potential for damages to oceanfront structures which includes the 17 communities on FIIS, the minor Federal land tracts in this area, the western section of Robert Moses State Park (U.S. Army Corps of Engineers 2014b). The medium design template includes a berm width of 90 ft at an elevation of +9.5 ft NGVD, and a dune with a crest width of 25 ft at an elevation of +15 ft NGVD. It also includes a foreshore slope of 12V:1H from +9.5 to +2 ft NGVD, equating to an additional 115 ft of beach above MHW (Figure 2).

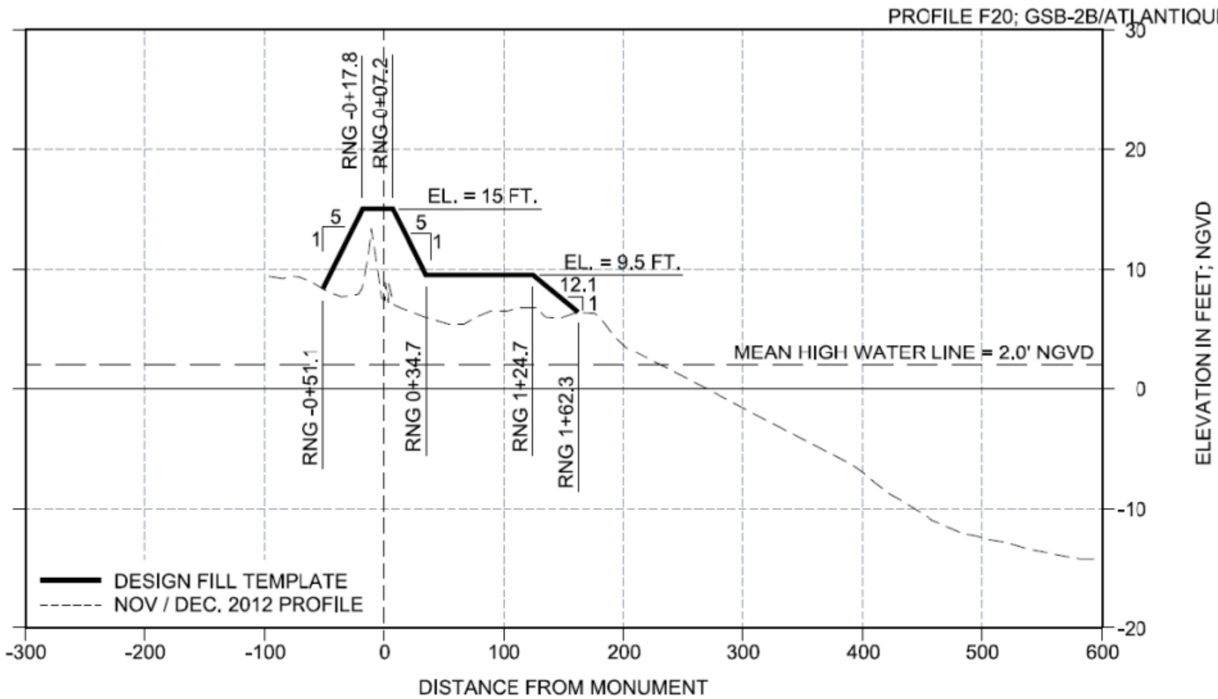

Figure 2. Typical 'medium' design template. From U.S. Army Corps of Engineers (2014b).

2. Offshore Sand Borrow Areas Locations and Dredged Material Volumes

The proposed project area includes nearshore ocean bottom habitats that have been identified for the purpose of sand mining. Sand, shell, sessile organisms, and benthic infauna would be dredged and transported to the beaches via a series of pipes and pumps. Once transported to the beach, the dredged material would be dewatered, redistributed by bulldozers and other heavy equipment to create the dune and beach, then further stabilized with sand fencing and beach grass plantings, depending on the placement site.

The sandy offshore habitats that are designated as sand mining areas are known as Borrow Area 2C and Borrow Area 4C. Borrow Area 2C is located approximately 2 mi south of Point O' Woods. It is roughly 500 ac in area and contains an estimated 9,000,000 cubic yards (yd^3) of compatible sediment (U.S. Army Corps of Engineers 2014b). Borrow Area 4C is located approximately 1.5 mi. offshore of Westhampton Island near Pikes Beach. It is roughly 90 ac in area and contains an estimated 2,000,000 yd^3 of compatible sediment (U.S. Army Corps of Engineers 2014b).

The total initial project fill volume would be 6,992,145 yd^3 which represents the volume of sand necessary to achieve the design fill, advance fill, overfill, and contingency profiles for 19 mi of beach. The Corps has indicated that there would be no renourishment cycles planned for the proposed project.

a. Dune and Beach Construction Areas on New York State Lands

Robert Moses State Park is owned and administered by the New York State Office of Parks, Recreation and Historic Preservation (NYSOPRHP). It is located on the western five miles of Fire Island and falls outside the administrative boundary of the FIIS.

A total of 23,200 ft of dune and beach construction at Robert Moses State Park is proposed, beginning near Field 2 and extending to the eastern boundary of this park. The construction activity is planned in areas that experienced partial overwash and is intended to protect the park's infrastructure, such as recreational facilities, roads, and water supply.

b. Dune and Beach Construction Areas on Federal Lands

A total of 9,600 ft of dune and beach construction is planned on Federal lands within the FIIS. A total of 2,100 ft of beach fill tapers (lateral extensions of the dune and beach construction areas) would be constructed at Sailors Haven, Carrington Tract, Talisman, Blue Point Beach, and Watch Hill. According to the Corps, the tapers are necessary to create a gradual, more natural appearing shoreline and to provide storm damage protection to the terminus of each filled area.

In addition to these tapers, the Corps has proposed a total of 7,500 ft of dune and beach construction on Federal lands, including the NPS' Fire Island Lighthouse Beach, as well as the so-called minor Federal tracts near the western and central communities of Kismet and Robbins Rest in areas that experienced partial overwash. Dune and beach construction is proposed in these areas to protect private infrastructure, residential development, non-Federal recreational facilities, roads, and local water supplies.

The largest area of partial overwash habitat that formed in these areas is at the NPS Fire Island Lighthouse Beach. This area along with the Federal tracts at Watch Hill, Robbins Rest, and Sailors Haven are documented breeding areas of piping plovers.

c. Dune and Beach Construction Areas in the Community Districts

Municipal landowners in the project area include the Town of Islip, Town of Brookhaven, and the incorporated Villages of Ocean Beach and Saltaire. In total, seventeen Fire Island communities are within the project area, stretching from Kismet in the west to Davis Park in the east, including Kismet, Fair Harbor, Dunewood, Lonelyville, Atlantique, Robbins Rest, Ocean Beach, Corneille Estates, Ocean Beach, Seaview, Ocean Bay Park, Point O'Woods, Cherry Grove, Fire Island Pines, Water Island, and Davis Park.

A total of 37,700 ft of dune and beach construction is proposed within the FIIS Community Districts. This would entail acquisition of about 41 residences and properties and relocation of six residential structures. Additional fill known as advanced fill would also be placed during the time of construction.

d. Dune and Beach Construction Areas on County Lands

Suffolk County owns and administers Smith Point County Park, which occupies the eastern six miles of Fire Island. Smith Point County Park is within the FIIS and is subject to obtaining Special Use Permits from the NPS for certain activities it undertakes.

A total of 27,200 ft of dune and beach construction is proposed at Smith Point County Park. Of this total, 6,400 ft is planned for areas directing fronting infrastructure and recreational facilities at Smith Point County Park. The remaining 20,800 ft is planned for undeveloped areas of the park and would adversely affect breeding populations of plovers and their habitat.

3. Land Acquisition and Relocation

In order to undertake the dune and beach construction project in the FIIS communities and achieve the proposed dune and beach alignments, the Corps has proposed the removal or relocation of 48 existing residential structures along the oceanfront within the FIIS communities. To accomplish this, the Corps has budgeted $79,800,000.00 for the acquisition of 41 properties and relocation of six houses. This figure also includes costs for any necessary permanent or temporary easements.

C. ENDANGERED SPECIES CONSERVATION MEASURES

As part of the project description, for a period of ten years after project completion, the Corps will implement a number of conservation measures to avoid or minimize adverse effects of the dune and beach construction to the piping plover and seabeach amaranth (see *Contributions Toward Minimizing Adverse Effects*). The Corps will follow recommendations previously provided by the NYSDEC and Service (Corps 1998, U.S. Fish and Wildlife Service 1999) to minimize potential adverse indirect impacts on other species that may use coastal habitats in the project area, including several state-listed shorebird species. The Corps has committed to providing $10.5 million (at no more than $1.5 million annually) from already appropriated funds over the project's 10 years to support implementation of these conservation measures. The design measures described in this section are conservation measures as they are intended to minimize the footprint of the dunes so as to minimize adverse effects on listed species. These design measures also incorporate comments from the Service regarding dune alignment so as to maximize piping plover nesting and foraging habitat.

1. Modifications of Beach Construction Tapers on Federal Lands.

Following a series of meetings with the DOI, NPS, USGS, and the Service, the Corps modified the extent of length of each fill taper on Federal lands on Fire Island to 300 ft. The Corps indicated that these were the minimum lengths of taper that would be feasible and that no tapers or smaller tapers would increase flanking erosion of the design profile. As a result, the length of each section as per the Corps' current plan layout design is as follows:

C17 - unchanged from originally proposed
C18 - Change taper to 300 ft -- end at station 607+00
C19 - Change taper to 300 ft -- end at station 643+00 (last full section at station 640+00)
C20 - Change taper to 300 ft -- end at station 655+00 (last full section at station 658+00), last two properties are owned by the Federal government so end dune at station 658+00
C22 - Current design acceptable
C23 - Change taper to 200 ft -- end at station 789+00
C24 - Change taper to 300 ft -- end at station 813+50
C25 - Change taper to 300 ft -- end at station 853+50
C27 - Change taper to 300 ft -- end at station 901+20
C28 - End taper at station 1294+00 (last full section at station 1297+00)

2. Modifications to Dune Slopes and Alignment in the Project Placement Areas

Fire Island Lighthouse Beach:

The Corps modified the dune and beach design template at the NPS Fire Island Lighthouse Beach, which corresponds to stations 223+50 through 274+50, to include a "straight" dune alignment. The 3,800 ft length of dune will be constructed at +13 NGVD and have side slopes of 1V:10H, and a 25 ft crest width. Consultation under Section 106 of the National Historic Preservation Act of 1966 (NHPA) will be required to finalize this modification. The tolerances for the proposed berm elevation of +9.5 NGVD will also be reduced from ±1 ft to ±0.5 ft, meaning that minimum and maximum fill heights can not go below +9 ft or above +10 ft NGVD.

East of station 274+50 (the border of NPS Fire Island Lighthouse Beach and Kismet), the Corps has proposed dunes with slopes of 1V:5H with the seaward dune toe to match alignment.

West of Robbins Rest:

In the area between Atlantique and Robbins Rest, the Corps modified approximately 900 ft of the proposed dune alignment northward to the existing vegetation in an effort to conserve partial overwash habitat that formed in this area due to Hurricane Sandy (U.S. Army Corps of Engineers 2014b). The tolerances for the berm height will also be reduced from ±1 ft to ±0.5 ft to minimize berm height after construction. The dune design template in this area will include side slopes of 1V:5H and a 25 ft crest width.

All other FIIS Communities' Dune and Beach Design template:

The "medium" design template is followed for the FIIS Communities.

Smith Point County Park Dune and Beach Design Template:

Final details of the dune heights, widths and slopes are provided below. In all areas, the beach design profiles include a berm width of 90 ft, at elevation +9.5 ft NGVD and foreshore slope of 12V:1 H from +9.5 to +2 ft NGVD, equating to an additional 115 ft of beach above MHW.

- In the area of Pattersquash Island (stations 1386+00 to 1420+00), the Corps will follow a straight dune alignment. The dune design template includes a dune height of +13 ft NGVD, side slopes of 1V:5H, 25 ft crest width;
- From stations 1420+00 to 1443+00, a straight dune alignment with a 1V:5H seaward slope, 25 ft crest width, and 1V:15H landward slope;
- From stations 1445+00 to 1465+00 (recently closed Smith Point County Park Breach), a straight dune alignment with a 1V:5 seaward slope, 25 ft crest width, and 1V:10H landward slope;
- From stations 1465+00 to 1486+00, a straight dune alignment, with a 1V:5H seaward slope, 25 ft crest width, and 1V:15H landward slope;
- From stations 1486+00 to 1515+00 (New Made Island), a straight dune alignment, with a 1V:10H seaward slope, 25 ft crest width, and 1V:5H landward slope; and
- From stations 1515+00 to 1534+50, match the dune alignment with existing dunes. Dune slopes would be 1V:5H slope.

Overall, the dunes will be realigned to meet up with existing dune line in the three overwash areas (New Made Island, the recently closed BCP breach fill area, and Pattersquash Island).

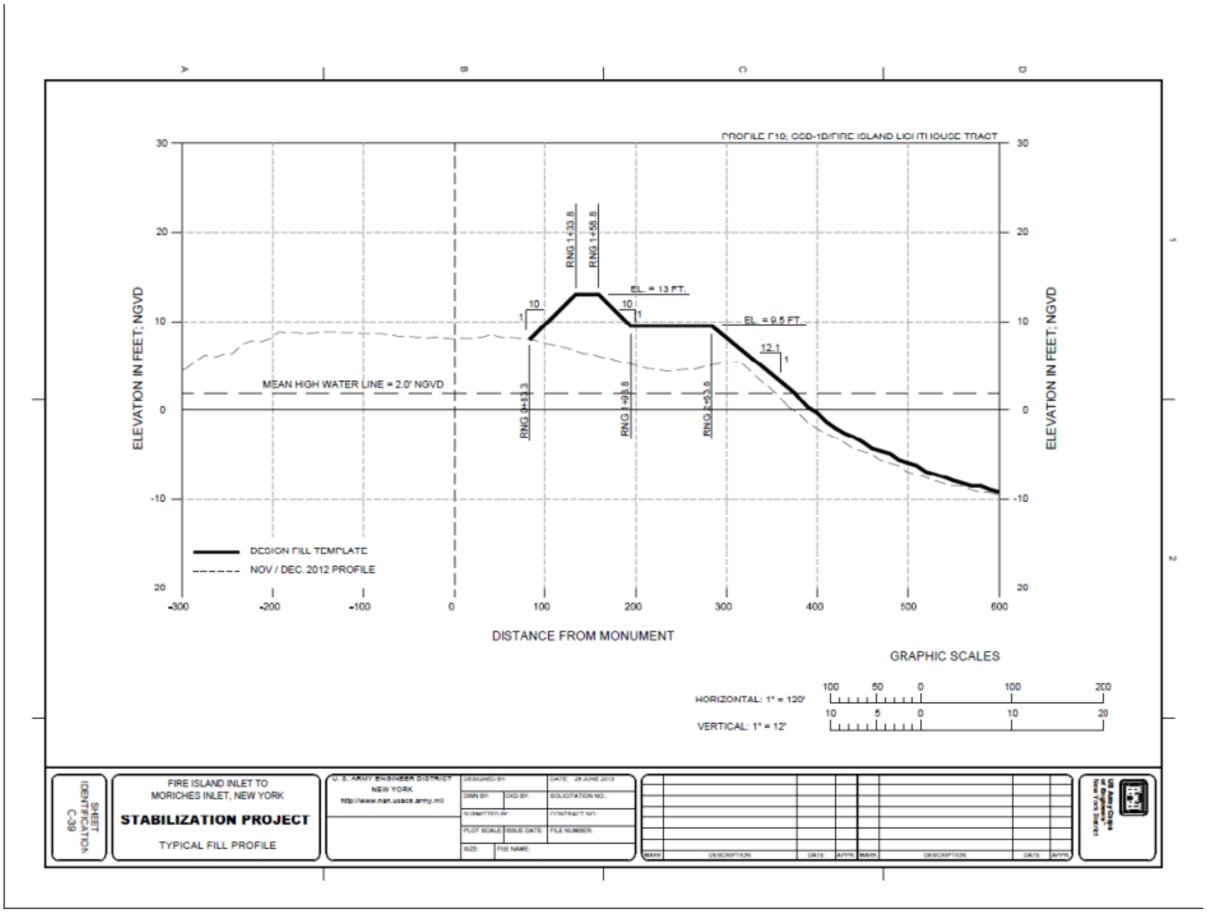

Figure 3. Typical 'berm only' design template. From U.S. Army Corps of Engineers (2014b).

3. Vegetation Control

In the areas known as Great Gun Beach (east of station 1534+50), the Corps will remove vegetation (trees, shrubs, and beach grass) and manage the habitat, from an approximately 33.7 hectares (ha or 83.2 ac) area to provide habitat for endangered species.

In addition, the Corps will monitor and adaptively manage vegetation at 30-40 percent cover on the bayside from stations 1386+00 to 1465+00 via mechanical, manual, or chemical means dependent on conditions and regulations of Suffolk County Department of Parks, Recreation and Conservation and the NYSDEC.

Within the FIIS Communities, the Corps will plant beach grass on the dunes at a density of 18 inches (in) on center.

4. Predator Management

The Corps will coordinate with the Service in the preparation of a predator plan (mammalian) for pre-season and in-season predator monitoring program for all project areas. The predator monitoring plan will include measures needed to protect piping plovers, nests, and chicks. The plan would be implemented for ten years.

5. Habitat Restoration

As noted above, the Corps will clear vegetation and modify the topography in approximately 33.7 hectares (ha or 83.2 ac) of ocean side habitat at Great Gun Beach, so as to mimic early successional habitat. The Corps has stated that vegetation will be removed via mechanical, manual, or chemical treatment, dependent on land manager and state regulations. Additionally, the Corps will clear vegetation and modify topography of an additional 6 ha (15.8 ac) of bay side habitat south of New Made Island, so as to mimic nesting and foraging plover habitat.

6. Coordination and Notification

The Corps will:

(1) Contact the Service upon initiation and completion of construction activities. In addition, the Corps will conduct pre-construction meetings with all project staff to provide all information on resource protection and terms of the project permit.

(2) Provide all project personnel, construction staff, etc., with information regarding the conditions of the project (including all conservation measures).

7. Time of Year Restrictions

The Corps has committed that construction activities will not occur during the piping plover breeding season April 1 to September 1, except within the boundaries of the FIIS communities. If breeding piping plovers are not observed in a proposed project area, or are not within 1000 m of the project area by July 15, then project activities may commence, following consultation with the agencies.

The Corps will conduct surveys during the spring/summer, and prior to construction activities, to identify nesting plovers in the project area and to document all known locations of piping plover. In addition, the Corps will document any other Federal or state-listed wildlife species observed in the project area during the survey and will initiate consultation with appropriate state and Federal agencies. Finally, low impact construction activities, such as beach surveying during the piping plover breeding season utilizing a 300-ft protective buffer zone are proposed.

8. Surveying, Monitoring, and Adaptive Management

The Corps has committed to the following measures:

- Surveying and monitoring of the action area for threatened and endangered species during the spring and summer nesting seasons for and not to exceed 10 years or as long as effects of the action occur. The monitoring shall be completed in coordination with the NPS, NYSDEC, Suffolk County and the Service. Monitoring shall include identification and protection of suitable breeding habitat throughout the entire project area, breeding abundance, brood foraging ranges, predators, nesting areas, symbolic fencing, signage, and the other parameters listed below.

- Surveying and monitoring shall be undertaken by a qualified designated biologist(s) approved by the Service. Qualified biologists shall also work on the threatened and endangered species management activities (e.g., coordinating with local communities and agencies, as well as organizing the pre-season planning).

- The qualified biologist(s) shall also recommend and implement changes in the location and configuration of symbolic fencing and warning signs and gauge the effectiveness of management actions. The qualified biologists will be educated about the biology of listed species and required to attend a piping plover management course organized by the Service, NYSDEC, and The Nature Conservancy (TNC), prior to undertaking surveying, monitoring or management actions.

- Protection of breeding piping plovers on all suitable habitats in the action area from human disturbance (e.g., recreational activities and off-road vehicles (ORVs), and recreational activities) and predation will be undertaken following the conditions outlined below. These conditions are also intended to offset impacts of habitat degradation and to assist in the recovery of the species.

- Suitable piping plover and seabeach amaranth habitats shall be defined by the Service within the project area and shall be protected via symbolic fencing and warning signs.

- Symbolic fencing would be erected to avoid or minimize accidental crushing of nests and repeated flushing of incubating adults, as well as provide an area where chicks can rest and seek shelter when people are on the beach. Therefore, prior to the piping plover breeding or seabeach amaranth growing seasons, the Corps shall coordinate with the land manager(s) and the Service to design and obtain written agreement from the Service on a "symbolic fencing plan."

- Coordination on the placement of symbolic fencing would incorporate field population and habitat data for the project area and visual assessment of all oceanside and bayside habitats each year. Habitats would be deemed suitable if piping plovers and seabeach amaranth were observed at the site in previous years or the beach width, slope, cover material (shell fragments), etc., are deemed adequate by the Service.

- Consistent with current Service management measures, breeding and growing areas shall be protected with symbolic fencing using steel or CarsoniteTM fiberglass posts placed approximately 33 ft apart and connected with string or twine. Fluorescent flagging material will be tied to the string every 1.6 ft to increase visibility, and piping plover or seabeach amaranth habitat warning signs shall be placed on every second or third post. Posts stretch from the toe of the dune seaward to about 40 ft south of the toe of dune line. As sand accretes through the season, posts and fences would be moved seaward to maintain symbolic fencing at this distance.

- All pedestrian and ORV access into, or through, the breeding or growing areas shall be prohibited. Walkways may be permitted after an assessment by a qualified biologist and with the written agreement of the Service. Only persons engaged in monitoring, management, or research activities shall enter the protected areas. These areas shall remain symbolically fenced for piping plovers until at least July 15, and as long thereafter as viable eggs or unfledged chicks are present. If no breeding piping plovers or their chicks are observed in the symbolically fenced areas, the fencing may be removed or reduced in scale provided that the seabeach amaranth is not present or the site is not suitable for seabeach amaranth. Symbolic fencing erected to protect seabeach amaranth shall be in place until the plant dies, or until October 15, whichever comes first.

- Productivity and population surveys would be conducted each year. Population survey information shall include the total number of breeding pairs; the total number of piping plovers, paired and unpaired, within the action area; and detailed mapping of breeding (i.e., courtship, territorial, scrapes, egg-laying, incubating, and brood-rearing) and foraging use habitats in the action area. Productivity information shall include the total number of nests, the total number of fledged chicks per pair, and quantification of take, if observed, including eggs, chicks, and adults that occurred, including reasons for take and actions that were taken to avoid take.

- Surveys would be recorded and summarized, and plover locations will be recorded on maps, indicating areas surveyed and habitat types. Daily reports shall be furnished to the Service and include the following:
    - date;
    - time begin/end;

- weather conditions;
- tidal stage;
- area of coverage;
- ownership of site;
- number of adults observed;
- number of pairs observed;
- habitat type;
- nearest known plover occurrence;
- banded plovers;
- predator trail indices and identification of predators;
- geographical position system (GPS) coordinates of symbolic fencing, and nest, brood and adult foraging locations;
-location of nearest vehicle cuts; and
-reports of disturbance factors such as pedestrians, ORVs, fireworks

- Prior to implementation of the monitoring program, the Corps will consult with, and obtain agreement from, the Service on the methodology. Surveys would be conducted daily with observations evenly distributed over a minimum time period (to be determined). Survey time periods shall be conducted during daylight hours from 30 minutes after sunrise to 30 minutes before sunset and should include a wide range of tidal conditions and habitat types. Areas should be surveyed slowly and thoroughly and should not be conducted during poor weather (e.g., heavy winds greater than 25 miles-per-hour (mph), heavy rains, and severe cold), since birds may seek protected areas during these times.

Seabeach Amaranth

Surveys:

If any beach nourishment activities are scheduled to occur during the growing season of seabeach amaranth (defined as May 15 to October 15), qualified biologist hired by the applicant would survey the project area(s) for this species twice a month from June 1 to October 1, and also immediately prior to any construction or other work. Plant locations, numbers, and sizes would be recorded.

Fencing and Avoidance of Seabeach Amaranth:

If construction personnel or ORVs will be present in, or may pass through, seabeach amaranth growing areas, symbolic fencing will be erected encompassing a 10-ft protective buffer around the plants if practical. All construction activities will avoid all delineated locations of seabeach amaranth where feasible. The applicant will undertake all practicable measures to avoid any adverse impacts to plants.

Transplantation of Seabeach Amaranth Likely to be Destroyed:

In the event that seabeach amaranth is present in the action area, and it is likely that the plants will be destroyed, the applicant will transplant the individual plants to a similar habitat near, or within, the action area to lessen the impact. Transplantation will include removal of a sufficiently large and intact volume of sand to include the full extent of the roots. Transplanted individuals will be monitored until their deaths, and the monitoring results will be provided to the Service.

Seed Collection and Other Measures:

In consultation and cooperation with the Service, beginning in 2014, the applicant will develop and implement a plan to compensate for plant mortality and burial of the seed bank, involving collection of a portion of the seabeach amaranth seeds produced in all areas to be nourished or renourished where the plant is present. Seeds will be sent to a qualified greenhouse. A portion of the collected seeds will be stored under controlled conditions appropriate for the species (e.g., temperature, humidity, and light) and later redistributed within the action area.

Qualified practitioners will attempt to germinate the remainder of the seeds. If successful, germinated plants will be replanted in suitable habitats within the action area, according to plans coordinated with the Service. If the number of wild plants bearing seeds is insufficient to collect an adequate amount of seeds, individual plants will be sent to a qualified greenhouse and propagated to produce additional seeds to be used for the purposes described above. Transplanted individuals will be monitored until their deaths, and the monitoring results will be provided to the Service.

The Corps has proposed that the Service determine an acceptable course of action to compensate for seed bank burial, including the amount of seeds to be collected; thresholds for collecting and propagating plants for production of additional seeds; the proportions of collected seeds to be stored versus germinated; protocols for collection, storage, germination, and reintroduction of plants and seeds into the project area; and procedures for scraping and re-spreading sand, if deemed appropriate. The applicant will monitor reintroduced plants and seeds for the duration of the growing season and report the results to the Service.

These actions will be undertaken to offset the anticipated adverse impacts to the seed bank and individual plants whose destruction cannot be avoided. These actions will serve to compensate for any such loss, but will not be construed as a long-term commitment to species propagation between this and future renourishments. Such activities will not continue past the second year of placement cycle.

Evaluation of Seabeach Amaranth Conservation Measures:

The Corps has proposed to evaluate the success of measures to protect seabeach amaranth in consultation with the Service and revise these protective measures as appropriate.

Access

The Corps has proposed that the Service and their authorized representatives would be allowed unrestricted access to all project sites within the action area for the purposes of conducting research, monitoring, enforcement, looking for evidence of rare, threatened, or endangered wildlife or plants, preserving or protecting habitat, and erecting symbolic fencing or exclosure fencing for the purpose of protecting wildlife or plants. Access will be permitted from the landward toe of the dune to the water's edge.

SEABEACH AMARANTH

II. STATUS OF THE SPECIES

A. Species Description

Seabeach amaranth (family *Amaranthaceae*) is an annual plant native to the barrier island beaches of the Atlantic Coast, from Massachusetts (MA) to South Carolina (SC). The original range of this species extended from Cape Cod, MA, to central SC, a stretch of coast about 994 miles (mi). This stretch correlates with a geographic range of low tidal amplitude. Tidal amplitude and the relative importance of tidal versus wave energy in shaping coastal morphology are thought to limit the geographic range of seabeach amaranth rather than availability of sandy beach substrates or sea water temperatures. The range of seabeach amaranth is also characterized by islands developed by high wave energy, low tidal energy, frequent overwash, and frequent breaching by hurricanes with resulting formation of new inlets (Weakley and Bucher 1992).

Within its range, the species' primary habitat consists of flats originally created by overwash events at accreting ends of barrier islands and lower foredunes and upper strands of non-eroding beaches. Seabeach amaranth is never found on beaches where the foredune is scarped by undermining water at high storm tides (Weakley and Bucher 1992). Occasionally, small temporary populations are established in secondary habitats, such as blowouts in foredunes, and in sand or shell dredge spoil or in beach nourishment material (Weakley and Bucher 1992).

Upon germination, the plant initially forms a small un-branched sprig. Soon after, it begins to branch profusely into a low-growing mat. Seabeach amaranth's fleshy stems are prostrate at the base, erect or somewhat reclining at the tips, and pink, red, or reddish in color. The leaves of seabeach amaranth are small, rounded, and fleshy, spinach-green in color, with a characteristic notch at the rounded tip. Leaves are approximately 0.5 to 0.98 inches in diameter and clustered toward the tip of the stem (Weakley and Bucher 1992). Plants often grow to 15 inches in diameter, consisting of 5 to 20 branches, but occasionally reach 35.4 inches in diameter, with 100 or more branches. Flowers and fruits are inconspicuous and are borne in clusters along the stems. Seeds are 0.1 inches in diameter, dark reddish-brown, and glossy, borne in low-density, fleshy, iridescent utricles (bladder-like seed capsules or fruits), 0.15 to 0.23 inches in length (Weakley and Bucher 1992). The seed does not completely fill the utricle, leaving an air-filled space (U.S. Fish and Wildlife Service 1996*).

Many utricles remain attached to the parent plant and are never dispersed, leading to *in situ* planting. This phenomenon has also been observed in sea rockets (*Cakile edentula*) and may be an adaptation to dynamic beach conditions. If conditions remain favorable at the site of the parent plant, then the seed source for retention of that site is guaranteed. When habitat conditions become unsuitable, other seeds have been dispersed to colonize new sites (Weakley and Bucher 1992).

B. Life History

Individual plants live only one season with only a single opportunity to produce seeds. The species overwinters entirely as seeds. Germination of seedlings begins in April and continues at least through July. In the northern part of the range, germination occurs slightly later, typically late June through early August. Reproductive maturity is determined by size rather than age and flowering begins as soon as plants have reached sufficient size. Even very small plants can flower under certain conditions. Flowering sometimes begins as early as June in the Carolinas, but more typically commences in July and continues until the death of the plant. Seed production begins in July or August and reaches a peak in most years in September. Seed production likewise continues until the plant dies. Senescence and death occur in late fall or early winter (U.S. Fish and Wildlife Service 1996*). While seabeach amaranth seems capable of essentially indeterminate growth (Weakley and Bucher 1992), predation and weather events, including rainfall, hurricanes, and temperature extremes, have significant effects on the length of the species' reproductive season. As a result of one or more of these influences, the flowering and fruiting period can be terminated as early as June or July (U.S. Fish and Wildlife Service 1993).

Seabeach amaranth does not occur on well-vegetated beaches, particularly where perennials have become strongly established (Weakley and Bucher 1992). Pauley *et al.* (1999) documented a negative correlation between seabeach amaranth and several dominant foredune species. A particularly strong negative association has been reported between seabeach amaranth and beach grasses (U.S. Fish and Wildlife Service 1996*). A positive correlation has been observed between seabeach amaranth and sea rocket *(Cakile edentula*), an annual plant (Hancock 1995).

A dynamic, early successional "pioneer" species, seabeach amaranth is also termed as "fugitive" because its populations are constantly shifting to newly-disturbed areas. The plant is eliminated from existing habitats by competition and erosion and colonizes newly-formed habitats by dispersal and (probably) long-lived seed banks. A poor competitor, seabeach amaranth is eliminated from sites where perennials have become established, probably because of root competition for scarce water and nutrient supplies (Weakley and Bucher 1992).

Existing habitats erode away, but new habitats are created by island overwash and breaching in areas where natural processes are allowed to proceed. Therefore, seabeach amaranth requires extensive areas of barrier island beaches and inlets, functioning in a relatively natural and dynamic manner. Such conditions allow the plant to move around in the landscape, occupying suitable habitats as they are formed (U.S. Fish and Wildlife Service 1996*).

Seeds are dispersed by a variety of mechanisms involving transport via wind and water. Seeds retained in utricles are easily blown about, deposited in depressions, the lee behind plants, or in the surf. Naked seeds are also commonly encountered in the field and are also dispersed by wind, but to a much lesser degree than seeds retained in utricles. Naked seeds tend to remain in the lee of the parent plant or get moved to nearby depressions (Weakley and Bucher 1992). Observations from SC indicate that seabeach amaranth seeds are also dispersed by birds through ingestion and eventually deposited with their droppings (Hamilton 2000).

C. Population Dynamics

Density of seabeach amaranth is extremely variable within and between populations. The species generally occurs in a sparse to very sparse distribution pattern, even in the most suitable habitats. A typical density is 100 plants per 0.6 mi of beach, though occasionally on accreting beaches, dense populations of 1,000 plants or more per 0.6 mi of beach can be found. Island-end sand flats generally have higher densities than oceanfront beaches (Weakley and Bucher 1992). Seabeach amaranth has been found to have a strongly clumped distribution (Hancock 1995). On Long Island, New York (NY), however, dense assemblages and high abundances have been recorded on central barrier island locations, such as Cedar and Gilgo Beaches in the Town of Babylon (Young 2002).

Within its primary habitats, seabeach amaranth concentrations can be found in the wrackline (Mangels 1991; Weakley and Bucher 1992; Hancock 1995; MacAvoy 2000). In 2001, a study by Pauley *et al.* (1999) suggested that organic litter may be an advantageous microhabitat for seabeach amaranth when it contains higher levels of organic material and moisture than bare sand.

D. Rangewide Status and Distribution

On April 7, 1993, seabeach amaranth was added to the List of Endangered and Threatened Wildlife and Plants as a threatened species. The listing was based upon the elimination of seabeach amaranth from two-thirds of its historic range, and continuing threats to the 55 populations that remained at the time (U.S. Fish and Wildlife Service 1993). No critical habitat, as defined under the Endangered Species Act (ESA), has been designated for this species.

1. Threats/Reasons for Listing

a. *Habitat Loss and Degradation*

The primary threats to seabeach amaranth are the adverse alterations of habitat caused by beach erosion and shoreline stabilization. Although seabeach amaranth does not persist on eroding scarped beaches, erosion is not a threat to the continued existence of the species under natural conditions. Erosion in some areas is balanced with habitat formation elsewhere, such as accreting inlets and overwash areas, resulting in an equilibrium that allows the plant to survive by moving around the landscape. Seabeach amaranth has persisted through even relatively rapid episodes of sea level rise and barrier island retreat. A natural barrier island landscape, even a retreating one, contains localized accreting areas, especially in the vicinity of inlets (U.S. Fish and Wildlife Service 1996*).

Human alteration of the barrier island ecosystem generally tips the equilibrium between habitat destruction and creation in favor of destructive erosional forces. Erosion is accelerated in many areas by human-induced factors, such as reduced sediment loads reaching coastal areas due to damming of rivers and beach stabilization structures (*e.g.,* groins and inlet jetties). When the shoreline is "hardened" by artificial structures (*e.g.*, seawalls and bulkheads), overwash and inlet formation are curbed. Erosion may also be increasing due to sea level rise and increased storm activity caused by global climate change (U.S. Fish and Wildlife Service 1993).

Although storms and erosion threaten seabeach amaranth, attempts to artificially stabilize beaches against these natural processes are generally more destructive to the species and to the beaches themselves in the long term (U.S. Fish and Wildlife Service 1993). Structural and non-structural beach stabilization techniques, such as beach nourishment, sand fences, and beach grass planting, are generally detrimental to seabeach amaranth, a pioneer, upper beach annual whose niche or “life strategy” is the colonization of unstable, un-vegetated new land (U.S. Fish and Wildlife Service 1996*). Seabeach amaranth only very rarely occurs when sand fences and vegetative stabilization have taken place and, in these situations, is present only as rare, scattered individuals or short-lived populations (Weakley and Bucher 1992).

Beach nourishment can have temporary, small-scale positive site-specific impacts on seabeach amaranth. Although more study is needed before the long-term impacts can be accurately assessed, seabeach amaranth has colonized several nourished beaches and has thrived in some sites through subsequent reapplications of fill material (U.S. Fish and Wildlife Service 1993). On the landscape level, beach nourishment is intended to stabilize the shoreline and curtail the natural geophysical processes of barrier islands, something that is detrimental to the range-wide persistence of the species. Beach nourishment projects may cause site-specific adverse effects by crushing or burying seeds or plants or by altering the beach profile or upper beach microhabitat in ways not conducive to colonization or survival. Deeply burying seeds during any season can have serious effects on populations (U.S. Fish and Wildlife Service 1996*), particularly to isolated populations, as no nearby seed sources are available to re-colonize the nourished site. Adverse effects of beach nourishment may be compounded if accompanied by artificial dune construction and dune stabilization with sand-fencing and/or beachgrass or followed by high levels of erosion and flooding of the upper beach, which create scarped conditions.

Seabeach amaranth is vulnerable to habitat fragmentation and isolation of small populations (U.S. Fish and Wildlife Service 1993). Fifty to seventy-five percent of coastlines have been rendered "permanently" unsuitable. This makes it increasingly more difficult to recover the species because any given area will become unsuitable at some time due to natural forces. If a seed source is no longer available in the vicinity, seabeach amaranth will be unable to re-establish itself when the area once again provides suitable habitat. In this way, the species can progressively be eliminated even from generally favorable stretches of habitat surrounded by “permanently” unfavorable areas. Fragmentation of habitat in the northern part of the species range apparently led to regional extirpation during the last century as no nearby seed sources were available to re-colonize nourished sites (Weakley and Bucher 1992).

As noted below, New York (NY) and New Jersey (NJ) beaches have been especially affected by past and ongoing habitat modification. NJ has the highest degree of shoreline stabilization of any state. As measured by the amount of shoreline in the totally stabilized category (90 to 100 percent “walled”), NJ, America's oldest developed shoreline, is 43 percent hard-stabilized (Pilkey and Wright 1988). Much of NY is included in current or proposed long-term beach nourishment programs. Cumulatively, these nourishment projects contribute significantly to the overall stabilization of the NY-NJ shoreline. Furthermore, multiple, simultaneous disturbances to the habitats upon which this species depends increase the vulnerability of seabeach amaranth to declining habitat conditions and catastrophic events. These factors are particularly important given the recent seabeach amaranth population shift from south to north, discussed further below.

b. *Recreational and ORV Impacts to Seabeach Amaranth*

Intensive recreational use and ORV traffic on beaches can threaten seabeach amaranth populations, both through direct damage and mortality of plants and by impacting their habitats. Light pedestrian traffic, even during the growing season, usually has little effect on seabeach amaranth (U.S. Fish and Wildlife Service 1993). Problems generally arise only on narrow beaches or beaches that receive heavy recreational use. In such areas, seabeach amaranth populations are sometimes eliminated or reduced by repeated trampling.

ORV use on the beach during the growing season can have detrimental effects on the species, as the fleshy stems of this plant are brittle and are easily broken. Plants generally do not survive even a single pass by a truck tire (Weakley and Bucher 1992). Sites where ORVs are allowed to run over seabeach amaranth plants often show severe population declines (New York Natural Heritage Program [NYNHP] 2002) or decreased habitat suitability (U.S. Fish and Wildlife Service, internal field notes, 2008). ORV use during the plant's dormant season has shown little evidence of significant detrimental effects, unless it results in massive physical erosion or degradation of the site, such as compacting or rutting of the upper beach. In some cases, winter ORV traffic may actually provide some benefits for the species by setting back succession of perennial grasses and shrubs with which seabeach amaranth cannot successfully compete.

Extremely heavy ORV use, however, even in winter, may have some negative impacts, including pulverization of seeds (Weakley and Bucher 1992). Beach grooming, more common on northern beaches, may also have contributed to the previous extirpation of seabeach amaranth from that part of its range. Motorized beach rakes that remove trash and vegetation from bathing beaches, do not allow seabeach amaranth to colonize long stretches of the beaches (U.S. Fish and Wildlife Service 1996*). In NJ, plants were found along a nearly continuous length of beach, noticeably interrupted by stretches that are routinely raked.

c. *Herbivory*

Predation by webworms (caterpillars of small moths) is a major source of mortality and lowered fecundity in the Carolinas, often defoliating plants by early fall (U.S. Fish and Wildlife Service 1993). Defoliation at this season appears to result in premature senescence and mortality, reducing seed production, the most basic and critical parameter in the life cycle of an annual plant. Webworm predation may decrease seed production by more than 50 percent (Weakley and Bucher 1992). In NY, herbivory by saltmarsh caterpillars (*Estigmene acraea*) has been observed (U.S. Fish and Wildlife Service 1996*). Webworm herbivory of seabeach amaranth has not been documented in Delaware (DE) or Maryland (MD). Overall, webworm herbivory is probably a contributing, rather than a leading, factor in the decline of seabeach amaranth. In combination with extensive habitat alteration, severe herbivory could threaten the existence of the species (Weakley and Bucher 1992).

d. *Utilization and Collection*

Seabeach amaranth is generally not threatened by over-utilization or collection, as it does not have showy flowers and is not a component of the commercial trade in native plants. However, because the species is easily recognizable and accessible, it is vulnerable to taking on Federal lands, vandalism, and the incidental trampling by curiosity-seekers. Seabeach amaranth is an attractive and colorful plant, with a prostrate growth habit that could lend itself to planting on beach front lots. The species effectiveness as a sand binder could make it even more attractive for this purpose. In addition, seabeach amaranth is being investigated by the U.S. Department of Agriculture and several universities and private institutes for its potential use in crop development and improvement. Over-collection and development of genetically-altered, domesticated varieties are potential, but currently unrealized, threats to the species (U.S. Fish and Wildlife Service 1993).

2. Rangewide Trends

Weakley and Bucher (1992) completed range-wide surveys of seabeach amaranth at known historical sites in 1987 and 1988. In 1987, 39 populations contained a total of 11,740 plants. In 1988, 45 populations contained a total of 43,651 plants, representing a one-year increase of 372 percent. A survey in 1990 revealed 43 populations with a total of 11,075 plants in the Carolinas, plus an additional 13 populations with 357 plants that reappeared on Long Island, NY (Clements and Mangels 1990). Even with the addition of the NY populations, the 1990 survey documented a range-wide reduction of 74 percent from the 1988 census.

Range-wide population data from 1987 to 2013 are provided in Table 1. From 2000 to 2013, the range-wide population of seabeach amaranth has drastically declined from 249,261 to 1,308 plants. Long Island had a drastic decline from a high of 244,608 plants in 2000 to 729 plants in 2013. Drastic declines also occurred in Maryland-Virginia (high of 3,331 in 2001 to 8 in 2013); North Carolina (33,514 in 1995 to 153 in 2013); South Carolina (2,312 in 2000 to 0 in 2013); and New Jersey (10,908 in 2002 to 314 in 2013).

Table 1. Seabeach Amaranth Range-Wide Plant Counts 1987-2013.

Year	DE	NY	MD-VA	NC	NJ	SC	RI-CT-MA	Total
1987	0	0	0	10278	0	1341	0	11619
1988	0	0	0	20261	0	1800	0	22061
1989	0	0	0	0	0	0	0	0
1990	0	331	0	4459	0	188	0	4978
1991	0	2251	0	1170	0	0	0	3421
1992	0	422	0	32160	0	15	0	32597
1993	0	195	0	22214	0	0	0	22409
1994	0	182	0	13964	0	560	0	14706
1995	0	599	0	33514	0	6	0	34119
1996	0	2263	0	8455	0	0	0	10718
1997	0	11918	0	1445	0	2	0	13365
1998	0	10699	2	11755	0	141	0	22597
1999	0	31196	1	596	0	196	0	31989
2000	37	244608	1160	105	1039	2312	0	249261
2001	71	205233	3331	5088	5813	231	0	219767
2002	417	193412	2794	4387	10908	0	0	211918
2003	12	114535	503	11230	5087	1381	0	132748
2004	9	30942	535	11214	6817	2110	0	51627
2005	6	16813	627	19978	5795	671	0	43890
2006	39	32553	1551	3190	6522	721	0	44576
2007	19	3914	2179	872	2191	60	0	9235
2008	11	4416	1048	1575	1141	51	0	8242
2009	44	5402	1260	798	3226	26	0	10756
2010	29	534	203	2299	936	0	0	4001
2011	33	2662	240	373	2641	0	0	5949
2012	302	1213	251	152	1238	0	0	3156
2013	104	729	8	153	314	0	0	1308
State Totals	1133	917022	15693	221685	53668	11812	0	1221013

Since 1987, New York has had the greatest number of plants in 1997, 1999-2004, 2006-2009, 2011, and 2013. North Carolina had the greatest numbers all the other years, with the exception of 2012 where New Jersey had the greatest numbers.

Historically, seabeach amaranth occurred in nine states from MA to SC. The populations, which have been extirpated, are believed to have succumbed as a result of hard shoreline stabilization structures, erosion, tidal inundation, and possibly as a result of herbivory by webworms (U.S. Fish and Wildlife Service 1994). The continued existence of the plant is threatened by these activities (Elias-Gerken 1994, Van Schoik and Antenen 1993), as well as the adverse alteration of essential habitat primarily as a result of "soft" shoreline stabilization (beach nourishment, artificial dune creation, and beachgrass plantings), but also from beach grooming and other causes (Murdock 1993).

Populations of seabeach amaranth at any given site are extremely variable (Weakley and Bucher 1992) and can fluctuate by several orders of magnitude from year to year. For example, seabeach amaranth declined from 55,832 plants in 2003 to 2,639 plants in 2006 at the Westhampton Island West survey site (New York Natural Heritage Program 2006). The primary reasons for the natural variability of seabeach amaranth are the dynamic nature of its habitat and the significant effects of stochastic factors, such as weather and storms, on mortality and reproductive rates. Although wide fluctuations in species populations tend to increase the risk of extinction, variable population sizes are a natural condition for seabeach amaranth and the species is well-adapted to its ecological niche.

3. New Threats

New threats (mammalian and avian herbivores and disease) to seabeach amaranth have been documented since the species was listed in 1993. These factors are lesser threats than habitat modification, but may increase the risk of extinction by compounding the effects of other, more severe threats. Several additional herbivores of seabeach amaranth have been observed including white-tailed deer (*Odocoileus virginianus*), Eastern cottontail rabbits (*Sylvilagus floridanus*), and migratory songbirds (Van Schoik and Antenen 1993).

The first known disease of seabeach amaranth was documented in SC in 2000. During the 2000 growing season, an oomycete (*Albugo* spp.) was observed on seabeach amaranth in several SC sites (Strand and Hamilton 2000). This pathogen is a white rust or water mold. Effects on infected individuals were significant, resulting in death of the plants two to four weeks after lesions were first observed. Anecdotal observations suggest that isolated plants tended to avoid infection (Strand and Hamilton 2000).

E. Analysis of Seabeach Amaranth Populations and Habitats Likely to be Affected by the Proposed Action

Beach stabilization activities can result in loss and degradation of suitable seabeach amaranth habitats. These activities are undertaken by both Federal and non-Federal entities (via Federal permits) and include, but are not limited to, inlet maintenance dredging with upland beach disposal, and dune construction and stabilization. Many of these projects accelerate the formation of mature dunes and are implemented to substantially reduce the probability of inlet creation and overwash that would otherwise form optimal seabeach amaranth habitats.

Within the NY Bight, more than half the beaches are classified as “developed” (U.S. Fish and Wildlife Service 1997). The remaining so-called “natural, undeveloped beaches” in the NY Bight receive some protection from development through the Coastal Barrier Resources Act’s

(96 Stat. 1653; 16 U.S.C. 3501 *et seq*.) limitations on Federal assistance and flood insurance. However, many of these areas are also subject to extensive stabilization activities.

There is a long history of beach stabilization activities by the U.S. Army Corps of Engineers (Corps), the principal Federal agency undertaking shoreline protection projects on Long Island. Almost exclusively, beach stabilization projects are implemented for the purpose of protecting development and infrastructure on the barrier islands or the mainland and may be combined with Federal navigation channel maintenance dredging, which the Corps has indicated provides an economical source of material. The Corps has also indicated that use of this material, dredged from the ebb shoal (formed in the oceanside entrance to an inlet) for renourishment of downdrift beaches, is a functional equivalent of an inlet sand bypassing activity.

From 1986 to the present, the Corps has formally consulted with the Service under the ESA for beach nourishment or Federal navigation projects on Long Island, which adversely affected both the seabeach amaranth and its habitat. Some of these consultations included, but were not limited to, the Shinnecock Inlet Federal Navigation Channel (consultation December 1986), Westhampton Interim Storm Damage Protection Project (consultation December 1994), Breach Contingency Plan (consultation July 1995), and the West of Shinnecock Inlet Interim Storm Damage Protection Project (March 2001).

Ultimately, singly and collectively these projects accelerate the formation of mature dunes and substantially reduce inlet creation and overwash that would otherwise form the sparsely vegetated, low-lying, early-successional barrier beach habitats important to seabeach amaranth. Under natural conditions, barrier beaches continually erode and accrete. Storms and high tides create overwash fans and flats behind and between dunes. Periodic breaches along barrier islands allow for the formation of new inlet areas, while accretion over time fills in inlets. Seabeach amaranth evolved in these highly dynamic ecosystems and have adapted to relocating growing sites in response to natural coastal processes. As dune or back beach sites become established in accreting areas and vegetated through natural succession, these sites decline in habitat suitability for this species.

III. ENVIRONMENTAL BASELINE

The environmental baseline includes the past and present impacts of all Federal, State, or private activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early consultation, and the impact of State or private actions that are occurring in the action area. As defined in 50 CFR §402.02, "action" means all activities or programs of any kind authorized, funded, or carried out, in whole, or in part, by Federal agencies in the United States or upon the high seas. The "action area" is defined as all areas to be affected directly or indirectly by the Federal action, and not merely the immediate areas involved in the action.

A. Description of the Action Area

The environmental baseline includes the past and present impacts of all Federal, State, or private activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early consultation, and the impact of State or private actions that are occurring in the action area. As defined in 50 C.F.R. § 402.02, "action" means all activities or programs of any kind authorized, funded, or carried out, in whole, or in part, by Federal agencies in the United States or upon the high seas. The "action area" is defined as all areas to be affected directly, or indirectly, by the Federal action, and not merely the immediate areas involved in the action.

The action area encompasses Fire Island, including ocean beaches, intertidal areas, interdunal areas, and bay side habitats. The action area includes dredged material placement sites and adjacent areas where dredged material deposition is not proposed. These additional areas are included in the action area because of the potential for indirect effects (those effects that are caused by or will result from the proposed action and are later in time, but are still reasonably certain to occur) from littoral drift of sediments from the renourished reaches and, thus, changes to the downdrift beaches in unnourished reaches. It is expected that the Corps' proposed project would have impacts on a much greater scale than the 2008 FIIS Community Project due to the larger scope of the proposed project.

B. Status of Seabeach Amaranth in the Action Area

Surveys for seabeach amaranth on Fire Island are conducted annually by the New York State Office of Parks, Recreation and Historic Preservation at Robert Moses State Park (RMSP), the National Park Service (NPS) in Fire Island National Seashore (FIIS), and Suffolk County at Smith Point County Park since 2009 (NYNHP conducted surveys prior to 2009).

Robert Moses State Park

Most plants within RMSP occur at Democrat Point, with plants also present within the bathing beach fields. Since 2000, Democrat Point had a peak plant count of 825 in 2002 and a low of 1 plant in 2013.

FIIS

In FIIS, the occurrence of seabeach amaranth has been reported to be patchy and only found on the oceanside beaches. From 1997 to 2003, plants had been observed on the ocean beaches in front of Talisman/Barrett Beach, Lighthouse Tract, and Atlantique (New York Natural Heritage Program 2003). Seabeach amaranth was not observed in the western communities of Fire Island (Kismet to Point O'Woods) until 2001 and the Fire Island Pines survey area until 1999. Since 2000, a peak plant count of 250 plants occurred in 2003 at Sunken Forest. In 2013, 15 plants were observed in the western communities, the Fire Island Pines area, and the wilderness area.

Smith Point County Park

Since 2000, Smith Point County Park had a peak count of 816 plants in 2006 and a low of 8 plants in 2013.

Entire Fire Island

The number of observed amaranth plants across all of Fire Island has averaged 564 plants from 2000-2013 with a maximum of 2,089 plants observed in 2003 and a minimum of 28 plants observed in 2013. The largest concentrations of amaranth are typically observed at Democrat Point and Smith Point (National Park Service 2013).

Table 2. Numbers of individual plants at each site within Fire Island since 2010 (several sites not surveyed in 2009) is listed as follows:

Year	Democrat Pt	RMSP Fields	FIIS	Smith Point	Total
2010	23	2	16	40	81
2011	8	47	40	86	181
2012	58	6	26	32	122
2013	1	4	15	8	28

Fire Island Contributions to the New York Total Population

Since 2000, Fire Island has contributed an average of 5 percent of the New York total population, contributing a low of 0.2 percent in 2000, and a peak of 15 percent in 2010. In 2013, Fire Island (28 plants) contributed 4 percent of the New York total (729 plants).

C. Factors Affecting Seabeach Amaranth and Its Habitats Within the Action Area

Beach stabilization, lack of optimal foraging and nesting habitat, beach scraping, barrier island and vegetative stabilization, and ORV use (commercial, recreational, residential, and the NPS' administrative activities) are all factors that have contributed to the lack of suitable seabeach amaranth habitats in the action area. Suitable habitats are mostly found where human activities, such as ORV use, dune stabilization, and intense recreational activities, are generally prohibited or restricted.

1. Beach Stabilization

Efforts within the action area to stabilize barrier islands include beach nourishment, beach scraping, installing snow fencing, and dune construction, as well as vegetative and structural shoreline stabilization. These activities inhibit the natural barrier island processes which affect morphology, allowing for the creation of transitory, storm-created habitats that are important to the recovery of seabeach amaranth. The protection of natural landforms, processes, and wildlife resources on the barrier island is often in conflict with long-term, large-scale beach stabilization projects and their indirect effects, i.e., increases in residential development, infrastructure, and public recreational uses, as well as preclusion of overwash and breach-created habitat formation.

Public and private beach stabilization efforts have occurred on the ocean beaches in the action area between 1938 and present day (U.S. Army Corps of Engineers 1999; U.S. Fish and Wildlife Service, internal field notes, 2008). Between 1955 and 1994, approximately 6.4 million cubic yards (cy) of fill were placed on Fire Island by the Federal government, local municipalities, and local interests. Approximately 54 percent of this fill activity occurred during the 1960s in response to the severe shoreline change caused by Hurricane Donna (1960) and the Ash Wednesday Storm of 1962. Some 1.66 million cy of fill were placed on Fire Island's beaches between 1993 and 1997. Most of this latter fill was placed by local communities at Fire Island Pines, Ocean Bay Park, Fair Harbor, and Saltaire in response to the severe storms that occurred during the early 1990s (National Park Service 2003). In 2003-2004, a number of Fire Island communities placed up to 1.27 million cy of sand on the beach. Additional nourishment occurred following the April 2007 nor'easter with 25,460 cy of sand being placed in the Davis Park Reach (National Park Service 2008) and the Fire Island communities placed 1.8 million cy of sand on the beach in 2008. Recent dredging and ocean beach material placement activities include: dredging of the Captree Boat Basin and placement of 320,000 cy of material at Fields 4 and 5 of RMSP in 2013, the placement of 400,000 cy at Field 5, and an adjacent upland stock pile in 2014; dredging of Fire Island Inlet and placement of 224,000 cy at Field 5 and beach fronting the RMSP water tower in 2013; and dredging of Moriches Inlet with placement of 460,000 cy at Smith Point County Park in 2009.

The U.S. Army Corps of Engineers (1999) speculated that most of the existing dune line on Fire Island has been affected by storm damage protection projects, illustrating the large degree of artificial stabilization that has affected seabeach amaranth habitat. On the north side of the barrier island, individual permits issued by the Corps under Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act have resulted in dramatic changes to the bay shoreline on Fire Island, including the nearly complete stabilization of the bay shoreline north of the 17 communities (U.S. Army Corps of Engineers 1999). The Corps' Regulatory Program is responsible for authorization of individual permits for piers, docks, and bulkheads that have affected natural barrier island processes and habitat formation, particularly on the bayside of the barrier island. As mentioned above, natural barrier island processes create and renew early successional beach habitats favorable to many beach strand species, such as the least tern (*Sterna antillarum*), the seabeach knotweed (*Polygonum glaucum)*, and the American oystercatcher (*Haematopus palliatus*).

Beach stabilization through the process of beach scraping involves use of heavy machinery to remove approximately the top 6-in layer of sand over a wide section of the dry beach. The material is then deposited to augment or reconstruct artificial dunes. Beach scraping activities have previously been permitted in 15 of the 17 communities on Fire Island (Land Use Ecological Services, Inc. 2002; National Park Service 2008b). However, the NPS has indicated that they do not plan on issuing additional beach scraping permits in the near future (Soller pers. comm. 2014).

2. Disturbance from Recreational Activities, ORVs, and Law Enforcement Vehicles

Recreational threats to seabeach amaranth in the action area include pedestrians and ORVs. Since seabeach amaranth prefers habitats similar to those used by piping plovers (*i.e.*, early successional beach habitat), some protection for seabeach amaranth from ORV use is realized through protection and restriction of ORV use during the piping plover and seabeach amaranth season. In some areas, this protection only extends to the end of the piping plover season, which is September 1, or possibly earlier if plover breeding is successful. Adverse impacts are possible beyond this period to seabeach amaranth plants if they are not surveyed and protected. The exact extent of the impacts due to ORVs on seabeach amaranth in the action area is unknown; however, ORVs do pose a threat for which management efforts are required.

IV. EFFECTS OF THE ACTION

In evaluating the effects of the Federal action under consideration in this consultation, 50 CFR 402.2 and 402.13(g)(3) require the Service to evaluate both the "direct and indirect effects of an action on the species, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline." Indirect effects are those that are caused by the proposed action and are later in time, but are still reasonably certain to occur. Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration.

Information used in this section was compiled from information contained in the "Recovery Plan for Seabeach Amaranth (*Amaranthus pumilus*) Rafinesque" (U.S. Fish and Wildlife Service 1996*), other biological opinions, and the action agency's biological assessment (Corps 2014a).

Factors that were considered in this effects analysis were proximity of the proposed project to the listed species and their habitats, the geographic area where the disturbance will occur, the timing of the proposed actions to the sensitive periods of the species' life cycle, the effects of the action on the species life cycle, population size, variability or distribution, the duration of the action, and the frequency of disturbance.

A. Direct Effects

The Service anticipates that the proposed project would result in direct adverse effects to seabeach amaranth as it allows beach nourishment during the growing season, in a project area, as well as transplantation of seabeach amaranth plants if the plants cannot be adequately protected or avoided. Plants would be transplanted to similar nearby project sites and protected through fencing and educational signs and monitored.

When beach nourishment is conducted during the growing season, plants that germinated will be torn from their substrate. Whether conducted during the growing season or after it, existing seed banks will be redistributed and re-deposited along the shore. Placement of fill on areas where seabeach amaranth occurs during, or prior to the end of, the growing season will likely result in mortality of those plants buried (Weakley and Bucher 1992) and the loss of seed production that would have occurred until the end of the growing season. Beach nourishment can impact seabeach amaranth and its habitat through burial, trampling, or accelerated inter-specific competition (Murdock 1993). Beach nourishment, which is conducted in the winter, would likely have minimal impacts to the <u>adult plants</u> as they will already have set seed. Deeply burying seeds with several feet of sand taken from the offshore borrow areas as provided for in the Proposed project may also affect their ability to germinate in the next growing season, having potential deleterious effects on local populations. The severity of the impacts depends on the depth of burial, erosional climate, the nature of seabeach amaranth's seed bank, and the importance of long distance seed dispersal to outlying population maintenance. In addition, any seeds dispersed to the project area from nearby populations prior to beach nourishment would likely be buried after beach nourishment commenced. Therefore, the Service expects up to 100 percent burial of the amaranth seed bank within the template of the beach nourishment design profiles contained in the proposed project. Transplantation itself is not without adverse effects –

it poses direct adverse effects to the plant as it requires digging up the plant(s) and physically moving it to another environment.

Beach nourishment will also alter existing early successional habitat that was created by Hurricane Sandy in October of 2012. This storm created extensive overwash habitat throughout Long Island. Within the project area, both developed and undeveloped beaches on Fire Island experienced profound changes as a result of the storm (Hapke *et al.* 2013). The storm created three breaches and extensive overwash areas on the eastern end of Fire Island. The U.S. Geological Survey undertook a rapid assessment of the areal extent and depth of overwash deposits shortly after the storm (Hapke *et al.* 2013). In the western portion of the island, 147 acres of overwash areas were identified. However, these deposits were limited in many locations by residential development and other infrastructure. Much of the material was deposited on private property, concrete walkways, etc., and was mechanically redistributed back on the beach during post-storm clean up and dune construction activities. In the central areas of Fire Island, the occurrence of overwash was relatively low (31 acres) and primarily confined to existing dune cuts that served as vehicle access points or other low spots between the dunes. The greatest areal extent of overwash deposits, (220 acres), occurred on eastern Fire Island, and were concentrated in the vicinity of Old Inlet in the Federal wilderness area and east of the TWA Flight 800 Memorial at Smith Point County Park (Hapke *et al.* 2013). Beach nourishment will alter/stabilize these existing habitats and limit future overwash events that could otherwise maintain these habitats created by the storm.

B. Indirect Effects

The Service has identified the following indirect adverse effects on seabeach amaranth resulting from the proposed project. Indirect effects can occur at a later time, and a distance from the individual projects that may be implemented under the proposed project.

1. Potential Long-term Reduction in Habitat Formation Due to Continuation of Stabilized Beaches

Overwashing and the formation and closure of inlets have historically occurred on eastern portions (from Davis Park eastward) of Fire Island throughout its history (Leatherman and Allen 1985). Leatherman and Allen (1985) reported that this portion of Fire Island would probably be covered with more overwashes, more open vegetation, and perhaps more inlets if civil works activities had not been implemented to counter natural geologic processes and storm-related changes to barrier island morphology following the 1938 hurricane. However, from Davis Park westward to Ocean Beach, geologic evidence indicates that this portion of Fire Island has not migrated northward for 750 to 1,300 years, and there is no evidence of historic inlets in this area (Tanski 2007).

Over the long term, the proposed project will result in indirect adverse effects to seabeach amaranth by perpetuating shoreline stabilization projects that impede natural processes of shoreline movement, thereby preventing the natural formation of highly suitable habitats essential for the recovery of this species. The Service expects that the barrier island, as a whole, if permitted to function and respond to natural forces, would provide much more high quality seabeach amaranth habitat. In developed areas, this would occur if infrastructure destroyed by natural forces was not rebuilt, breaches and overwash habitats were permitted to occur, and new inlets were allowed to form and/or close naturally.

The Service believes that, where naturally functioning habitats exist and are properly managed, these areas would contribute substantially to the recovery of the species. Democrat Point, on the western tip of Fire Island, is functioning as a natural barrier island sand spit due to the natural bypassing of sediment past the Fire Island Inlet jetty.

By preventing these natural processes and the geomorphological changes that they foster, the proposed project could potentially influence the distribution, abundance, and productivity of Federally-listed species on Fire Island.

While it is not known precisely when and where within a project area this habitat will form in the future, the Service believes that formation of highly suitable habitats within the action area will be delayed by the life of the beach nourishment projects and will alter the existing habitat currently present.

2. Creation of Suboptimal Beach and Dune Habitats

The proposed project would perpetuate the artificial creation and maintenance of suboptimal beach and dune habitats within the NY range of seabeach amaranth. The creation of suboptimal habitat may lead to limits in available suitable habitat for growing and accelerated plant competition. Additional effects include increased recreational activities and allowance for ORV access through growing areas (discussed in Section 3, below).

Artificially constructed and stabilized dunes provide less suitable habitat for seabeach amaranth (Weakley and Bucher 1992). High-quality seabeach amaranth habitat is generally characterized by sparse vegetation. Unstabilized dunes provide more potential seabeach amaranth habitat as they tend to have a more gently sloping foredune face than stabilized dunes. Blowouts (breaks, often formed during storms) that may form in the primary line of unstabilized dunes provide marginal habitat for seabeach amaranth (Weakley and Bucher 1992). The installation and maintenance of a continuous dune line, as opposed to a dune swale, blowout, or overwash-configured project design, will indirectly affect this species by interrupting natural processes that maintain suitable habitat. Interdunal swales and gently-sloping foredune habitats become important when the berm has been narrowed by erosion, as happens following severe coastal storms or toward the end of a recurring sand renourishment cycle; this project will impede the formation of such features for twenty years. However, the existing development within the FIIS reduces the opportunity for habitat formation in the short term and over small scales.

Dune vegetation planting and snow fence placement, in association with beach nourishment and beach scraping, that have previously occurred within developed portions of the action area, will artificially accelerate growth of dense vegetation that preclude use of habitat by seabeach amaranth. This effect will limit the amount of available suitable habitat for this species and will create suboptimal habitat conditions. Naturally occurring or managed sparse vegetation plots pose limited adverse effects to seabeach amaranth, but artificially planted areas that rapidly grow into dense areas of perennial vegetation precludes use by this species. The planting of perennial grasses will substantially limit the area of seabeach amaranth habitat that is currently available and will introduce added pressures to the species via inter-specific competition. Weakley and Bucher (1992) report that stabilization of seabeach amaranth habitat allows for succession to a densely-vegetated perennial community, rendering the beaches only marginally suitable for seabeach amaranth. Because seabeach amaranth is susceptible to habitat fragmentation (Weakley and Bucher 1992; Murdock 1993), destruction of a single and sizeable population could result in local extirpation. Seabeach amaranth is rarely encountered in areas that have been snow fenced (Weakley and Bucher 1992), but the relationship between snow fencing and seabeach amaranth populations has not been fully investigated on Long Island.

Further, vertical sand accretion and burial caused by sand fences are detrimental to seabeach amaranth and their use is contradictory to seabeach amaranth recovery. This dune stabilization practice will further perpetuate the practice of degrading barrier island habitats upon which this species and others depend.

While the proposed project affords protection to, and perpetuates, upland development by buffering structures from ocean storm and wave attack, the Service recognizes that no new hard stabilization structures are permitted in the proposed project. Economic consideration of the extensive upland infrastructure and development receiving storm protection from the existing stabilization features further suggests that, in the absence of a large storm, their abandonment is unlikely in the short-term, irrespective of the proposed project.

3. Effects of Increasing Recreational Activities, Preserving ORV Access to Oceanside Habitats, and Creating Habitat for Predators

The Service anticipates that the proposed measures will not completely avoid indirect adverse effects attributable to implementation of the proposed project.

The proposed project would most likely increase recreational activities on the ocean beaches.

Within Sea Bright and Monmouth Beach, NJ, evidence of adverse impacts to seabeach amaranth was obvious in areas of intensive recreational use, such as at beach access paths or at a site near a volleyball net. The primary effect of increased recreation activities is trampling/crushing of plants. Service observations suggest that high levels of recreational activity are precluding colonization in these areas. Colonization is unlikely to occur on intensively used recreational beaches, but would be more likely in areas fenced for the protection of piping plovers and other beach nesting birds (U.S. Fish and Wildlife Service 2002).

Summary of Effects

The proposed project will result in multiple adverse effects to seabeach amaranth including, but not limited to, direct plant burial, preclusion of the creation of highly suitable habitat, creation and maintenance of suboptimal habitats, increases in recreational impacts, and effects of ORV use of the ocean beach. These effects will occur over the entire duration of effects of twenty years. The proposed project will likely result in an increase in recreational activities on the project beaches affecting seabeach amaranth. This would increase the potential conflicts with, and adverse effects on, seabeach amaranth plants.

C. Duration of Effects

The following is an excerpt from the Corps' Draft Limited Re-evaluation Report (Corps 2014b) regarding the FIMI project life:

> The Project is designed with advance fill to ensure that the design conditions are maintained for a period of 5 years, under normal conditions. After this time, the project will erode into the design template, and offer residual, diminished protection. It is difficult to project the amount of time that residual protection from the fill will remain. It is estimated, under typical conditions, that the residual effect of the fill placement could last another 5 years. Even after the residual effect of beachfill has diminished, there is a longer residual effect that is provided by the acquisition and relocation of structures. Based upon the setback distances and background erosion rate, it has been projected that the residual effects of relocating these buildings would be an additional 10 years. The economics modeling has confirmed that the without project future condition and with-project condition results converge after 20 years, supporting a period of analysis of 20 years.

As such, the Service is of the understanding that, due to advance fill, the project design will be maintained for 5 years, and that residual effects could occur over an additional 10 years, and the economic modelling supports a total project life of 20 years. The Service will therefore consider the project life and associated duration of effects to be 20 years.

D. Conservation Measures

The following seabeach amaranth conservation measures were included in the Corps BA for this project (Corps 2014a):

- *Seabeach Amaranth Surveys*: If any beach nourishment activities are scheduled to occur during the growing season of seabeach amaranth (defined as May 15 to October 15), a qualified biologist hired by the applicant will survey the project area(s) for this species twice a month from June 1 to October 1, and also immediately prior to any construction or other work. Plant locations, numbers, and sizes will be recorded.

- *Fencing and Avoidance of Seabeach Amaranth*: If construction personnel or ORVs will be present in, or may pass through, seabeach amaranth growing areas, symbolic fencing will be erected encompassing a 10-ft protective buffer around the plants if practical. All construction activities will avoid all delineated locations of seabeach amaranth where feasible. The applicant will undertake all practicable measures to avoid any adverse impacts to plants.

- *Transplantation of Seabeach Amaranth Likely to be Destroyed*: In the event that seabeach amaranth is present in the action area, and it is likely that the plants will be destroyed, the applicant will transplant the individual plants to a similar habitat near, or within, the action area to lessen the impact. Transplantation will include removal of a sufficiently large and intact volume of sand to include the full extent of the roots. Transplanted individuals will be monitored until their deaths, and the monitoring results will be provided to the Service.

- *Seed Collection and Other Measures*: In consultation and cooperation with the Service, beginning in 2014, the applicant will develop and implement a plan to compensate for plant mortality and burial of the seed bank involving collection of a portion of the seabeach amaranth seeds produced in all areas to be nourished or re-nourished where the plant is present. Seeds will be sent to a qualified greenhouse. A portion of the collected seeds will be stored under controlled conditions appropriate for the species (e.g., temperature, humidity, and light) and later redistributed within the action area. Qualified practitioners will attempt to germinate the remainder of the seeds. If successful, germinated plants will be replanted in suitable habitats within the action area, according to plans coordinated with the Service. If the number of wild plants bearing seeds is insufficient to collect an adequate amount of seeds, individual plants will be sent to a qualified greenhouse and propagated to production additional seeds to be used for the purposes described above. Removal of a portion of the seed bank through "scraping" and stockpiling the top layer of sand prior to renourishment may also be included in the plan to compensate for adverse effects to plants and to seeds. The stockpiled sand would be respreads on the construction template upon completion of renourishment.

- Based upon the best available scientific data, the Service will determine an acceptable course of action to compensate for seed bank burial, including the amount of seeds to be collected; thresholds for collecting and propagating plants for production of additional seeds; the proportions of collected seeds to be stored versus germinated; protocols for collection, storage, germination, and reintroduction of plants and seeds into the project area; and procedures for scraping and re-spreading sand, if deemed appropriate. The applicant will monitor reintroduced plants and seeds for the duration of the growing season and report the results to the Service.

- These actions will be undertaken to offset the anticipated adverse impacts to the seed bank and individual plants whose destruction cannot be avoided. These actions will serve to compensate for any such loss, but will not be construed as a long-term commitment to species propagation between renourishments. Such activities will not continue past the second year of placement cycle.

- *Evaluation of Seabeach Amaranth Conservation Measures*: In consultation and cooperation with the Service, the applicant will evaluate the success of measures to protect seabeach amaranth and will revise these protective measures as appropriate. In the event that seabeach amaranth is present in the action area, and it is likely that the plants will be destroyed, the applicant will transplant the individual plants to a similar habitat near or within, the action area to lessen the impact. Transplantation will include removal of a sufficiently large and intact volume of sand to include the full extent of the roots. Transplanted individuals will be monitored until their deaths, and the monitoring results will be provided to the Service.

The Service recognizes that these conservation measures will ameliorate project impacts to seabeach amaranth to some degree. The fencing of plants, where feasible, will avoid direct impacts and the transplanting of plants could save some plants from direct loss. Seed collection and germination could also assist in minimizing project impacts.

V. CUMULATIVE EFFECTS

Activities that occur within the boundaries of the NPS would require issuance of a special use permit, a Federal action that would require Section 7 consultation with the Service. All other beach nourishment related projects along the ocean shoreline would require Corps authorization. Therefore, cumulative effects from beach nourishment projects, which include the effects of future State, local, or private actions that are reasonably certain to occur in the action area, would not be likely due to Federal jurisdiction of all activities on Fire Island.

Other than beach nourishment projects, local/State actions that are reasonably certain to occur in the project area that could potentially affect seabeach amaranth include beach cleaning, installation of sand fencing, and issuance of ORV permits.

The installation of snow fencing or the planting of beach grass are common practices in attempting to stabilize nourished beaches and have occurred on other sites on Long Island without Federal (Service, Corps) or state (New York State Department of Environmental Conservation) coordination/authorization.

Vegetation planting and snow fence placement, in association with beach nourishment, will artificially accelerate growth of dense vegetation that precludes use of habitat by seabeach amaranth and degrades the habitat for this species. This effect will limit the amount of available suitable habitat for these species and will create suboptimal habitat conditions. Artificially planted areas that rapidly grow into dense areas of perennial vegetation precludes use by this species. Weakley and Bucher (1992) report that stabilization of seabeach amaranth habitat allows for succession to a densely-vegetated perennial community, rendering the beaches only marginally suitable for seabeach amaranth, which is rarely encountered in areas that have been snow fenced.

Another beach management practice not mentioned in the project description that could occur over the life of the project is beach raking. Beach raking/cleaning does occur within RMSP and Smith Point County Park. Mechanized beach cleaning adversely affects seabeach amaranth through direct crushing of plants.

New York State Office of Parks, Recreation and Historic Preservation and Suffolk County authorize ORV access on Fire Island ocean beaches at RMSP and Smith Point County Park, respectively. Service personnel have observed heavy traffic (hundreds of vehicles) within suitable ocean beach habitats in these areas, which, as described in Section IV above, severely limits amaranth habitat suitability through crushing of plants.

VI. CONCLUSION

50 CFR 402.14 requires that BOs include the Service's opinion on whether the proposed action is likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of critical habitat. Jeopardize the continued existence of a species means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a recovery unit by reducing the reproduction, numbers, or distribution of that species in the wild.

The proposed project is likely to adversely affect seabeach amaranth. Effects will depend on the degree of connection between populations within the action area, the importance of seed import and export to population maintenance, the success of proposed conservation measures in minimizing adverse effects, and the net effect of the proposed project on populations within the project area.

After reviewing the current status of seabeach amaranth, the environmental baseline for the action area, the direct, indirect, and cumulative effects of the proposed project, and the proposed project conservation measures, it is the Service's biological opinion that, while authorization of the proposed project may result in the destruction of plants and seeds, the alteration of existing habitat, and preclusion of new habitat from partial overwashes and dune blowouts, it is not likely to jeopardize the continued existence of seabeach amaranth range-wide. This conclusion is based upon the likelihood of the proposed conservation measures ameliorating some the project effects and the relatively small contribution that the Fire Island populations provide to the overall Long Island/New York total population.

Sections 7(b)(4) and 7(o)(2) of the ESA do not apply to the incidental take of Federally listed plant species, and, therefore, no Incidental Take Statement, and subsequently, no reasonable and prudent measures, nor terms and conditions, will be provided in this opinion.

PIPING PLOVER

II. STATUS OF THE SPECIES

Summary Of Main Points (Full Discussion Follows This Summary).

Current status.

- The piping plover was listed as endangered and threatened pursuant to the ESA on January 10, 1986. Protection of the species under the ESA reflects the species precarious status rangewide. Three separate breeding populations, each with its own recovery plan and recovery criteria, were affirmed in the 2009 5-Year Review (U.S. Fish and Wildlife

Service 2009). Piping plovers that breed on the Atlantic Coast of the United States (U.S.) and Canada are classified as threatened under the ESA. Piping plovers that breed in the Great Lakes watershed are listed as endangered, while the population breeding on Northern Great Plains of the U.S. and Canada is listed as threatened (U.S. Fish and Wildlife Service 1985, 2009). All piping plovers are classified as threatened on their shared migration and wintering range, which extends along the U.S. Atlantic and Gulf Coasts from North Carolina to Texas and into Mexico, the Bahamas, and West Indies (Elliott-Smith and Haig 2004, Elliott-Smith *et al.* 2009).

- The Atlantic Coast piping plover, which is the focus of this opinion, breeds on sandy, coastal beaches from Newfoundland to North Carolina. No Critical Habitat has been designated or proposed in the Atlantic Coast breeding area, including the area considered in this Opinion

Species recovery needs

- A large body of evidence documents the importance of wide, flat, sparsely-vegetated barrier beach habitats for recovery of Atlantic Coast piping plovers. Such habitats include abundant moist sediments associated with blowouts, washover areas, spits, unstabilized and recently closed inlets, ephemeral pools, and sparsely vegetated dunes. Habitat becomes unsuitable when vegetative cover exceeds 33.5 percent , distance from the high tide line to toe of the dune is less than 9.5 meters, dune height exceeds 2.0 meters, and dune slope exceeds 20 percent.

- Dramatic increases in plover productivity and breeding population on the north end of Assateague Island in Maryland following the 1991 to 1992 overwash events corroborated findings by Loegering and Fraser (1995) of significantly higher survival rates of piping plover chicks using sparsely vegetated access routes to reach foraging habitats on the island interior and bay beaches compared with those which foraged solely on the ocean beach. Similarly, a number of other examples corroborate the fact that piping plovers respond positively to the creation of high quality habitat.

- The overall security of the Atlantic Coast piping plover is fundamentally dependent on even distribution of population growth, as specified in subpopulation targets, to protect from environmental variation (including catastrophes) a sparsely-distributed species with strict biological requirements, and to provide connectivity that facilitates within-recovery unit recolonization of any sites that experience declines or local extirpations due to low productivity and/or temporary habitat succession. Strong genetic structure within the Atlantic Coast piping plovers further supports the importance of maintaining geographically well-distributed populations that conserve representation of genetic diversity and adaptations to variable environmental selective pressures that may be important to long-term survival of the entire population.

- The narrow habitat tolerances of piping plovers in the Southern recovery unit have been a major (but not the sole) factor in its slow recovery and continuing precariousness. However, the population continues to respond positively to habitat creation events, most recently to habitat improvements following Hurricane Irene in 2011. Despite a gradual dip in numbers between 2007 and 2011, the population attained a post-listing record high of 377 pairs in 2012.

- Although abundance has remained high in New England, no noticeable movements of piping plovers from New England to either Eastern Canada or New York-New Jersey have occurred, nor are they expected in the future. The survival and recovery of Atlantic Coast piping plovers remain highly dependent on the conservation of remaining habitats and habitat-formation processes, as well as annual implementation of expensive labor-intensive management to minimize the effects of pervasive and persistent threats from predation and disturbance by humans and pets. Reversals of major ongoing declines in the Eastern Canada and New York-New Jersey recovery units are urgent.

- Substantial regional declines in the abundance and distribution of piping plovers may increase a loss of genetic diversity and the species' ability to adapt to variable environmental selective pressures. Consequently, the achievement and maintenance of the assigned population level and the associated habitat conditions necessary to support that population for each of the four recovery units are necessary for both the survival and recovery of the Atlantic Coast breeding population of the piping plover.

Threats

- As stated in the 1996 Atlantic Coast recovery plan, "While it is expected that carrying capacity will fluctuate locally, and perhaps even within a state over time, it is anticipated that long-term carrying capacity of the Atlantic Coast's piping plover habitat (and that of regional subpopulations, which correspond to the recovery units laid out on page 55) will be maintained if natural coastal habitat formation processes are not interrupted. *Shoreline development and stabilization projects may, however, erode carrying capacity locally and regionally (see pages 34-37) and, therefore, have potential to compromise the survival and recovery of the population* (emphasis in original)."

- Continuing threats to Atlantic Coast piping plovers in the breeding portion of their range identified in the 1996 Recovery Plan include habitat loss and degradation, disturbance by humans and pets, increased predation, and oil spills (USFWS 1996). The 1996 Recovery Plan states that discouraging new structures or other developments, discouraging interference with natural inlet processes, and discouraging beach stabilization projects are "priority 1" actions (those that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future).

- Loss and degradation of habitat to development is a serious threat to piping plovers in the New York-New Jersey recovery unit (USFWS 2012). Past permanent habitat losses have irrevocably diminished the available habitat, continuing artificial shoreline stabilization perpetuates many low quality habitats, and proposals for new or larger artificial beach features threaten the few remaining areas where natural habitat processes have the potential to create and maintain preferred habitats. Widespread artificial habitat stabilization also exacerbates conflicts with human beach recreation by constraining nests and chicks to narrow ocean-front habitats.

- A detailed review of threats to piping plovers and their habitat in their continental U.S. migration and wintering range (USFWS 2012) shows a continuing loss and degradation of habitat due to sand placement projects, inlet stabilization, sand mining, groins, seawalls and revetments, dredging of canal subdivisions, invasive vegetation, and wrack removal. This cumulative habitat loss is, by itself, of major threat to piping plovers, as well as the many other shorebird species competing with them for foraging resources and roosting habitats in their nonbreeding range

- Scientific research conducted on Long Island explicitly recommended avoiding beach management practices (e.g., jetty construction, breach filling, dune building, beach nourishment) that typically inhibit natural renewal of ephemeral pools, bay tidal flats, and open vegetation (Elias *et al.* 2000) and allowing natural storm processes that create habitat to act unimpeded (Cohen *et al.* 2009). The magnitude of threats from habitat loss and degradation vary across the three U.S. recovery units.

- It is believed habitat loss and degradation via artificial coastal stabilization are one of the factors limiting growth and expansion of the recovery unit population of Atlantic Coast piping plovers, especially in the New York-New Jersey and Southern recovery units. The rates of habitat loss are increasing coincident with more stabilization activities.

- That said, in areas where much of the shoreline is already stabilized and erosion has occurred, plover habitat would not exist without renourishment. In these areas, stabilization and renourishment practices may work to create and maintain habitat. This issue has been witnessed in New Jersey, and Cohen *et al.* (2009) also recognized this phenomenon – "In places such as WHD [West Hampton Dunes], where human development is to occur, renourishment may partially offset habitat loss due to erosion" (page 19).

- Research and reports indicate that predation poses a continuing (and perhaps intensifying) threat to Atlantic Coast piping plovers – "Predation has been identified as a major factor limiting piping plover reproductive success at many Atlantic Coast sites" (USFWS 1996, page 41). Predation is a pervasive, persistent, and serious threat to breeding Atlantic Coast piping plovers, and reducing predation is a "priority 1" action in the Recovery Plan (USFWS 1996). Implementation of conservation measures for addressing predation threats is time-consuming and costly, and funding for such measures often only becomes possible as part of beach nourishment and stabilization projects. Although site-specific predator pressures vary from year-to-year, predator management is a recurring need.

- Human disturbance through non-motorized and motorized beach activities, pets, and beach cleaning are also considered a significant threat to piping plovers, and management actions to address these threats are considered "priority 1" (USFWS 1996).

- Finally, oil spills and contaminants are considered a significant threat to the Atlantic Coast recovery unit and addressing these threats are considered "priority 1" (USFWS 1996).

Lack of immigration/emigration

- An 8-year study of >1400 Atlantic Coast piping plovers color banded in Virginia, Maryland, Massachusetts and five eastern Canadian provinces documented almost all of the plovers were breeding within the recovery unit in which they were banded (U.S. Fish and Wildlife Service files; D. Amirault, Canadian Wildlife Service, pers. comm.). Hence, abundance of piping plovers in each recovery unit is almost entirely dependent on within-unit productivity.

  Each recovery unit is essential to the conservation of the Atlantic Coast breeding population of the piping plover. Hecht and Melvin (2009a) found significant positive relationships between productivity and population growth in the subsequent year for each of the three U.S. recovery units (but not for Eastern Canada). Hence, abundance of piping plovers in each recovery unit is almost entirely dependent on within-unit productivity.

Habitat restoration efforts

- Efforts to create and enhance piping plover nesting and foraging habitats, as provided in Atlantic Coast revised recovery plan task 1.24, have been incorporated into a number of shoreline stabilization projects (e.g., U.S. Fish and Wildlife Service 2001, 2005) and implemented by other recovery cooperators (see, for example, Suffolk County Department of Parks, Recreation, and Conservation 2004).

- This task says, "To compensate for disruption of natural process, create and enhance nesting and feeding habitat, especially in the vicinity of existing stabilization projects such as jetties, groins, and other artificial beach stabilization projects" (page 68). It includes encouraging "deposition of dredged material to enhance existing nesting habitat or create new nesting habitat" (page 68), and, the discouragement of "vegetation encroachment at nesting sites" (page 69).

- However, with the exceptions of the Lower Cape May Meadows and Stone Harbor restoration projects in New Jersey (U.S. Fish and Wildlife Service 2005, B.E. Brandreth *in* Guilfoyle *et al.* 2007), most efforts to date have been small-scale. Except at Lower Cape May Meadows, monitoring and evaluation of restoration project effects on piping plovers and habitat indicators (e.g., habitat availability-use ratios, predator track indices) have been nonexistent or extremely limited (Maslo 2009).

<u>Discussion</u>

A. Species/Critical Habitat Description

The piping plover was listed pursuant to the ESA on January 10, 1986. Protection of the species under the ESA reflects the species' precarious status range-wide. Three separate breeding populations, each with its own recovery plan and recovery criteria, were affirmed in the 2009 5-Year Review (U.S. Fish and Wildlife Service 2009). Piping plovers that breed on the Atlantic Coast of the United States (U.S.) and Canada are classified as threatened under the ESA. Piping plovers that breed in the Great Lakes watershed are listed as endangered, while the population breeding on Northern Great Plains of the U.S. and Canada is listed as threatened (U.S. Fish and Wildlife Service 1985, 2009). All piping plovers are classified as threatened on their shared migration and wintering range, which extends along the U.S. Atlantic and Gulf Coasts from North Carolina to Texas and into Mexico, the Bahamas, and West Indies (Elliott-Smith and Haig 2004, Elliott-Smith *et al.* 2009).

The Atlantic Coast piping plover, which is the focus of this Opinion, breeds on sandy, coastal beaches from Newfoundland to North Carolina. No Critical Habitat has been designated or proposed in the Atlantic Coast breeding area. However, the needs of all three breeding populations were considered in the 2001 critical habitat designation for wintering piping plovers (U.S. Fish and Wildlife Service 2001b) and in subsequent re-designations (U.S. Fish and Wildlife Service 2008g, 2009e).

B. Life History

Piping plovers are small, sand-colored shorebirds, approximately 7 inches long with a wingspread of about 15 inches (Palmer, 1967). Named for their plaintive bell-like whistle, piping plovers are often heard before they are seen.

Piping plovers begin returning to their Atlantic Coast nesting beaches in mid-March (Coutu *et al.* 1990; Cross 1990; Goldin 1990; MacIvor 1990; Hake 1993). Males establish and defend territories and court females by early April (Cairns 1982). Piping plovers are monogamous during the breeding season, but usually shift mates between years (Wilcox 1959; Haig and Oring 1988; MacIvor 1990) and, less frequently, between nesting attempts in a given year (Haig and Oring 1988; MacIvor 1990; Strauss 1990). Plovers are known to breed at one year of age (MacIvor 1990; Haig 1992), but the rate at which this occurs is unknown. Egg-laying and incubation can start as early as mid-April (U.S. Fish and Wildlife Service 1996a).

Piping plover nests are situated above the high tide line on coastal beaches, sandflats at the ends of sandspits and barrier islands, gently sloping foredunes, blowout[1] areas behind primary dunes, and washover[2] areas cut into or between dunes. They may also nest on areas where suitable dredge material has been deposited at a low slope and elevation, but many factors (discussed below) affect their nesting density and success in these areas. Nests are usually found in areas with little or no vegetation although, on occasion, piping plovers will nest under stands of American beachgrass (*Ammophila breviligulata*) or other vegetation (Patterson 1988, Flemming *et al.* 1992, MacIvor 1990).

Nest sites are shallow-scraped depressions in substrates ranging from fine-grained sand to mixtures of sand and pebbles, shells, or cobble (Bent 1929; Cairns 1982; Burger 1987; Patterson 1988; Flemming *et al.* 1990; MacIvor 1990; Strauss 1990). Nests may be difficult to detect, especially during the six- to seven-day egg-laying phase when the birds generally do not incubate (Goldin 1994). Eggs may be present on the beach from mid-April through late July and clutch size for an initial nest attempt is usually four eggs, with one egg laid every other day. Eggs are pyriforme in shape and variable buff to greenish brown in color, marked with black or brown spots. Full-time incubation usually begins with the completion of the clutch and is shared equally by both sexes for a period lasting from 27 to 28 days (Wilcox 1959; Cairns 1977; MacIvor 1990). Eggs in a clutch usually hatch within 4 to 8 hours of each other, but the hatching period may extend to 48 hours.

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1 Blowouts are distinctive "bowl-like" areas within the interdune area caused by wind erosion behind the primary dune ridge; the ocean view is often obstructed.

2 Washover areas are created by the flow of water through the primary dune line with deposition of sand on the barrier flats, marsh, or into the lagoon, depending on the storm magnitude and the width of the beach (Leatherman 1979). Nests may be situated on portions of these storm-created areas that are relatively dry during the nesting season, while plovers may feed. on any portions that stay moist.

Piping plovers generally fledge only a single brood (one or more chicks from a nest) per season, but may re nest several times if previous nests are lost. Chicks are precocial and are capable of foraging for themselves within several hours of hatching (Wilcox 1959; Cairns 1982) and may move hundreds of feet from the nest site during their first week of life (U.S. Fish and Wildlife Service 1996a). Chicks may increase their foraging range up to 3,280 ft (Loegering 1992) or more based on observations in the Fire Island National Seashore in 2008 (Raphael, pers. comm., 2008), and will remain with one or both parents until they fledge (are able to fly) at 25 to 35 days of age. Depending on the date of hatching, flightless chicks may be present from mid-May until late August, although most fledge by the end of July (Patterson 1988; Goldin 1990; MacIvor 1990; Howard *et al.* 1993).

Cryptic coloration is a primary defense mechanism for this species; nests, adults, and chicks all blend in with their beach surroundings. Chicks sometimes respond to ORVs and/or pedestrians by crouching and remaining motionless (Cairns 1977). Adult piping plovers respond to avian and mammalian predators by displaying a variety of distraction behaviors including squatting, false brooding, running, and injury feigning. Distraction displays may occur at any time during the breeding season, but are most frequent and intense around the time of hatching (Cairns 1977).

Piping plovers feed on invertebrates, such as marine worms, fly larvae, beetles, crustaceans, and mollusks (Bent 1929; Cairns 1977; Nicholls 1989). Important feeding areas may include intertidal portions of ocean beaches, overwash areas, mudflats, sand flats, wrack lines[3], sparse vegetation, and shorelines of coastal ponds, lagoons, or salt marshes (Gibbs 1986; Coutu *et al.* 1990; Hoopes *et al.* 1992; Loegering 1992; Goldin 1993; Elias-Gerken 1994; Cohen 2005; Houghton 2005). The relative importance of various feeding habitats may vary by site (Gibbs 1986; Coutu *et al.* 1990; McConnaughey *et al.* 1990; Loegering 1992; Goldin 1993; Hoopes 1993; Elias-Gerken 1994) and by stage in the breeding cycle (Cross 1990). Adults and chicks on a given site may use different feeding habitats in varying proportion (Goldin 1990).

Most time-budget studies reveal that chicks spend a high proportion of their time feeding. Cairns (1977) found that chicks typically tripled their weight during the first two weeks after hatching; those that failed to achieve at least 60 percent of this weight-gain by day 12 were unlikely to survive. Courtship, nesting, brood-rearing, and feeding territories are generally contiguous to nesting territories (Cairns 1977), although instances when brood-rearing areas are widely separated from nesting territories are common, thus increasing the geographic boundaries of their breeding area. Feeding activities of both adults and chicks may occur during all hours of the day and night (Burger 1994) and at all stages during the tidal cycle (Goldin 1993; Hoopes 1993).

Both spring and fall migration routes of Atlantic Coast breeders are believed to occur primarily within a narrow zone along the Atlantic Coast (U.S. Fish and Wildlife Service 1996a).

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3 Wrack is organic material including seaweed, seashells, driftwood and other materials deposited on beaches by tidal action.

Relatively little is known about migration behavior or habitat use within the Atlantic Coast breeding range (U.S. Fish and Wildlife Service 1996a). However, the pattern of both spring and fall counts at migration sites along the southeastern Atlantic Coast demonstrates that many piping plovers make intermediate stopovers lasting from a few days up to one month during their migrations (Noel *et al.* 2006; Stucker and Cuthbert 2006; C. Davis, New Jersey Division of Fish and Wildlife, pers. comm. 2010).

C. Habitat Requirements in the Atlantic Coast Breeding Range

Finding

A large body of evidence (discussed below) documents the importance of wide, flat, sparsely-vegetated barrier beach habitats for successful completion of piping plover life history requirements on their Atlantic Coast breeding area. Such habitats include abundant moist sediments associated with blowouts, washover areas, spits, unstabilized and recently closed inlets, ephemeral pools, and sparsely vegetated dunes.

Supporting Documentation

At Cape Cod National Seashore in Massachusetts, Jones (1997) found that, although almost two-thirds of piping plover nests occurred on beaches without chick access to bayside foraging, significantly more nests were on beaches accessible to bayside feeding habitat than would have been expected based on availability of such habitat. Two logistic regression models indicated that sparse vegetation and distance from pedestrian access points were important indicators of beach suitability, while one of the models also identified bay access as characteristic of nest habitat selection. Beach slope at nests averaged 5.6 percent , less than the mean slope at random points (8.3 percent). Nest hatching success was significantly greater on beaches without bayside access, while fledging success did not differ significantly. Jones (1997) identified presence of wrack that supports abundant invertebrate fauna as a likely explanation for higher breeding success of piping plovers on ocean beaches at Cape Cod Seashore compared with piping plover study sites further south.

Out of 80 piping plover nests observed by Strauss (1990) at Sandy Neck in Barnstable, Massachusetts, no nests were located seaward of “steep foredunes,” where this habitat constituted 83 percent of the beach front. Much of the beach in Strauss's study site that was not used by piping plovers had been artificially plugged with discarded Christmas trees and/or sand fences. Piping plover distribution and foraging rates during the pre-nesting period (during establishment of territories and courtship) on South Monomoy Island, Massachusetts, indicated that sound and tidal-pond intertidal zones were the most important feeding areas in the period before egg-laying (Fraser *et al.* 2005).

Goldin and Regosin (1998) found significantly higher chick survival and overall productivity among chicks with access to salt pond "mudflats" than those limited to oceanside beaches at Goosewing Beach, Rhode Island. Goldin and Regosin (1998) also reported that broods on the pond shore spent significantly less time reacting to human disturbance (1.6 percent) than those limited to the ocean beach (17 percent). Because ocean beaches are used by recreational beachgoers, limiting plovers to mainly oceanside habitats may also increase the potential for disturbance from people and pets.

A 1992-1993 study of nest site selection on 90 km (55.8 miles) of beach on Jones Beach Island, Fire Island, and Westhampton Island, New York (Elias *et al.* 2000) found that all 1-km beach segments with ephemeral pools or bay tidal flats were used for nesting and brood rearing, whereas less than 5 percent of beach segments without these habitats were used. When the amount of time that plover broods used each habitat was compared with its availability, broods preferred ephemeral pools on segments where pools were present. On beach segments with bay tidal flats, broods preferred bay tidal flats and wrack to other habitats. On segments with neither ephemeral pools nor bay tidal flats, wrack was the most preferred habitat, and open vegetation was the second most preferred. Indices of arthropod abundance were highest on ephemeral pools and bay tidal flats. Chick peck rates were highest on ephemeral pools, bay tidal flats, and the ocean intertidal zone.

Cohen *et al.* (2008) reported that mean vegetative cover around piping plover nests on a recently re-nourished Long Island beach was 7.5 percent, and all plovers nested in <47 percent vegetation cover. Although almost 60 percent of nests were on bare ground, nests occurred in sparse vegetation more often than expected based on availability of this habitat type. Plovers also exhibited some preference for nest sites with coarse substrate compared to pure sand. At the same study area, piping plover chicks foraged more than expected and exhibited high peck rates in wrack, where arthropod abundance indices were also high (Cohen *et al.* 2009).

Following storm-and human-related increases in nesting and foraging habitat, the population at the Village of West Hampton Dunes, New York, grew from 0 pairs in 1992 to 39 pairs in 2000, and then declined to 18 pairs by 2004 concurrent with habitat losses to human development and vegetation growth associated with the construction of the Corps' Westhampton Interim Storm Damage Protection Project (Cohen *et al.* 2009). The population has continued to decline since 2004. The current preliminary abundance estimate is 9 pairs (New York State Department of Environmental Conservation 2013). Final data from 2014 are not yet available to the USFWS as of this writing. Distribution of nests was heavily concentrated on the bayside of the barrier island in the early years following inlet formation and artificial closure by the Corps, but bayside nests decreased precipitously starting in 2001 and disappeared by 2004 as the study area was redeveloped and the bayside revegetated. The chick foraging rate was highest in bayside intertidal flats and in ocean- and bay-side fresh wrack. Chicks used the bayside more than expected based on the percentage of available habitat, and survived better on the bayside before residential and village infrastructure construction and the initiation of predator trapping, but not after construction.

In most years, density of nesting pairs adjacent to bayside overwash was 1.5 to two times that at an adjacent ocean beach reference site, where beach nourishment increased nesting habitat but not foraging habitat. Cohen *et al.* (2009) concluded that local population growth can be rapid where storms create both nesting and foraging habitat in close proximity. An increase in local nesting habitat via artificial beach nourishment, however, is not necessarily followed by an increase in the local population if nearby foraging habitat is limiting (Cohen *et al.* 2009). Cohen *et al.* (2009) also note similarity between their results and observations by Wilcox (1959) of rapid colonization of habitats created on Westhampton barrier beaches by storms in the 1930s and their subsequent decline following revegetation and redevelopment.

Classification and regression tree analysis of piping plover nest-site selection at 19 New Jersey beaches was used to develop target values for habitat (*i.e.*, goals for restoration projects): vegetative cover <10 percent on the backshore and 13 percent on the primary dune, 17-18 percent shell cover, dune height ≤1.1 meter, and dune slope ≤13 percent (Maslo *et al.* 2011). "Triggers" (when action is required to maintain suitable conditions) included vegetation density of 17 percent on the backshore and 22 percent on the primary dune, and a dune height of 1.6 meters. Habitat became unsuitable when vegetative cover exceeded 33.5 percent, distance from the high tide line to toe of the dune was less than 9.5 meters, dune height exceeded 2.0 meters, and dune slope exceeded 20 percent.

Dramatic increases in plover productivity and breeding population on the north end of Assateague Island in Maryland following the 1991-1992 overwash events (Schupp *et al.*, 2013) corroborated findings by Loegering and Fraser (1995) of significantly higher survival rates of piping plover chicks using sparsely vegetated access routes to reach foraging habitats on the island interior and bay beaches compared with those which foraged solely on the ocean beach. Piping plover productivity, which had averaged 0.77 chicks per pair in a five-year period before the overwash, averaged 1.67 chicks per pair from 1992 to 1996 following the overwash events. The nesting population also grew rapidly, doubling by 1995 and tripling by 1996, when 61 pairs nested there. Over the 12 years from 1996 to 2007, the breeding population held steady at approximately 60 pairs (range = 56-66), but increasing vegetation caused, in part, by construction in 1998 of a low foredune that impeded overwash, forced nesting locations further seaward or into atypical vegetated habitats and blocked chick access to bayside foraging habitats (NPS 2012, Schupp *et al.* 2013). The breeding population declined to 49 pairs in 2008, and productivity matched the previous recorded low of 0.41 chicks per pair. Overwash restoration efforts have included the cutting of 14 notches (i.e., cross-shore depressions with a peak elevation of 2.16 meters) in the constructed foredune in 2008 and 2009 (Schupp *et al.* 2013), but the nesting population on the north end continued to decline through at least 2012.

In Virginia, Boettcher *et al.* (2007) reported that the five islands where piping plover breeding was observed every year from 1986-2005, "encompass large segments of broad beaches with low discontinuous dunes and expansive sand-shell flats … providing unimpeded access from beach nest sites to the moist-soil ecotones of backside marshes." Cross and Terwilliger (2000) found that chick habitat use, foraging rates, and invertebrate prey abundance on four Virginia barrier islands was highest at moist inner-beach marsh edge and barrier flat habitats.

At Cape Lookout National Seashore, North Carolina, 13-46 pairs of plovers have nested on North and South Core Banks each year since 1992. While these unstabilized barrier islands total 70.4 km (44 miles) in length, nesting distribution is patchy, with all nests clustered on the dynamic ends of the barrier islands, recently closed and sparsely vegetated "old inlets," expansive barrier mudflats, or new ocean-to-bay overwashes (NPS 2008). During a 1990 study, 96 percent of brood observations at Cape Lookout Seashore were on bay tidal flats, even though broods had access to both bay and ocean beach habitats (McConnaughey *et al.* 1990).

Designation of Recovery Units

The 1996 revised Atlantic Coast Recovery Plan for the Piping Plover established four recovery units for the Atlantic Coast breeding population: (1) Atlantic (Eastern) Canada; (2) New England; (3) New York-New Jersey; and (4) Southern (DE-MD-VA-NC). Each of these units is considered essential to the conservation of the piping plover by providing for its reproduction, numbers, and distribution in that portion of its range to an extent necessary to provide for the long-term survival of the overall Atlantic Coast breeding population. Each unit is assigned a minimum population level (discussed below) that when achieved under conditions where the threats to the species have been adequately addressed, the Atlantic Coast breeding population of the piping plover is eligible for de-listing. In other words, the achievement and maintenance of the assigned population level and the associated habitat conditions necessary to support that population for each of the four recovery units are necessary for the long-term survival and recovery of the Atlantic Coast breeding population of the piping plover.

D. Recovery Criteria and Strategy

The objective of the 1996 revised Atlantic Coast Recovery Plan is to assure the long-term viability of the Atlantic Coast piping plover population in the wild, thereby allowing removal of this population from the Federal List of Endangered and Threatened Wildlife and Plants (50 CFR 17.11 and 17.12). The Atlantic Coast piping plover population may be considered for delisting when the following recovery criteria, established in the plan, have been met:

1. Increase and maintain for 5 years a total of 2,000 breeding pairs, distributed among four recovery units.

Recovery Unit	*Minimum Subpopulation*
Atlantic (Eastern) Canada[4]	*400 pairs*
New England	*625 pairs*
New York-New Jersey	*575 pairs*
Southern (DE-MD-VA-NC)	*400 pairs*

2. Verify the adequacy of a 2,000 pair population of piping plovers to maintain heterozygosity and allelic diversity over the long term.
3. Achieve a 5-year average productivity of 1.5 fledged chicks per pair in each of the four recovery units described in criterion 1, based on data from sites that collectively support at least 90 percent of the recovery unit's population.
4. Institute long-term agreements to assure protection and management sufficient to maintain the population targets and average productivity in each recovery unit.
5. Ensure long-term maintenance of wintering habitat, sufficient in quantity, quality, and distribution to maintain survival rates for a 2,000-pair population.

Attainment of subpopulation targets for each recovery unit provides resiliency and redundancy, thereby increasing the likelihood of survival and recovery of the Atlantic Coast population as a whole. Extensive efforts to re-sight >1,400 Atlantic Coast piping plovers color-banded in Virginia, Maryland, Massachusetts and five Eastern Canadian provinces between 1985 and 2003 documented almost all piping plovers breeding within the recovery unit in which they were banded (U.S. Fish and Wildlife Service files; D. Amirault, CWS, pers. comm.). Hecht and Melvin (2009a) found significant positive relationships between productivity and population growth in the subsequent year for each of the three U.S. recovery units (but not for Eastern Canada). Hence, it is believed that abundance of piping plovers in each recovery unit population is almost entirely dependent on within-unit productivity. Dispersal of the population across its breeding range serves to protect against stochastic events such as large storms during the breeding season, oil spills, or disease that might depress regional survival and/or productivity. Maintaining robust, well-distributed subpopulations should reduce variance in survival and productivity of the Atlantic Coast population as a whole and provide connectivity that facilitates within-recovery unit recolonization of any sites that experience declines or local extirpations due to low productivity and/or temporary habitat succession at individual sites (Gilpin 1987, Goodman 1987, and Thomas 1994). The recovery units are large enough that their overall carrying capacity should be buffered from stochastic variability in the frequency of storms that naturally maintain habitat at individual nesting sites (*i.e.* the units represent a fairly coarse distribution requirement), while still assuring a geographically well-distributed population if habitat is not lost or artificially degraded.

4 Recent Canadian Wildlife Service documents and published literature refer to piping plovers breeding in Nova Scotia, New Brunswick, Prince Edward Island, Quebec, and Newfoundland as the piping plover *melodus* subspecies or the "eastern Canada population." This subpopulation coincides exactly with the geographic area termed "Atlantic Canada Recovery Unit" in the USFWS 1996 Recovery Plan. To reduce confusion, we refer henceforth in this status review to the Eastern Canada recovery unit.

Recent genetic analysis found strong genetic structure, supported by significant correlations between genetic and geographic distances in both mitochondrial and microsatellite data sets for Atlantic Coast piping plovers (Miller *et al.* 2010). Atlantic birds showed evidence of isolation-by-distance patterns, indicating that dispersal, when it occurs, is generally associated with movement to relatively proximal breeding territories. Thus, maintaining geographically well-distributed populations also serves to conserve representation of genetic diversity and adaptations to variable environmental selective pressures. Substantial regional declines in abundance of piping plovers risk loss of genetic diversity that may be important to its long-term survival**.** In other words, the achievement and maintenance of the assigned population level and the associated habitat conditions necessary to support that population for each of the four recovery units are necessary for both the survival and recovery of the Atlantic Coast breeding population of the piping plover.

Attainment and maintenance of the minimum population levels for the four recovery units provides resiliency, redundancy, and representation (Schaffer and Stein 2000) that are fundamental to the overall security of the Atlantic Coast piping plover population. In the event that one recovery unit experiences temporary declines in piping plover productivity or survival that lead to a decline in numbers, the other units can provide near-term security for the species as a whole. In the event that a recovery unit population becomes sparse or is extirpated, the potential for repatriation via dispersal from adjacent recovery unit(s) is possible, but this is likely to be a slow process and any loss of genetic variation and adaptation to the regional environment may be difficult to reverse.

In accordance with the Endangered Species Consultation Handbook (U.S. Fish and Wildlife Service and National Marine Fisheries Service, 1998), since recovery units have been established in an approved recovery plan, this opinion considers the effects of the proposed project on piping plovers in the New York-New Jersey Recovery Unit, as well as the Atlantic Coast population as a whole. When an action impairs or precludes the capacity of a recovery unit from providing both the survival and recovery function assigned to it, that action may represent jeopardy to the species. This document describes how the proposed action affects not only the New York-New Jersey recovery unit's likelihood of survival and recovery, but the relationship of the recovery unit to both the survival and recovery of the listed species as a whole.

E. Population Dynamics and Demographic Status

Abundance

Population trends since listing under the Endangered Species Act

Abundance of Atlantic Coast piping plovers is reported as numbers of breeding pairs, i.e. adult pairs that exhibited sustained (≥ 2 weeks) territorial or courtship behavior at a site or were observed with nests or unfledged chicks (U.S. Fish and Wildlife Service 1996). Annual estimates of breeding pairs of Atlantic Coast piping plovers are based on multiple surveys of almost all breeding habitat, including many currently unoccupied sites. Sites that cannot be monitored repeatedly in May and June (primarily sites with few pairs or inconsistent occupancy) are surveyed at least once during a standard nine-day count period (Hecht and Melvin 2009a). Appendix 1 and 2 summarize nesting pair counts for the Atlantic Coast piping plover population since listing in 1986 through 2013. Numbers in parentheses are preliminary estimates, but it is not anticipated that final estimates will deviate substantially.

The preliminary 2013 Atlantic Coast piping plover population estimate was 1,797 pairs, more than double the 1986 estimate of 790 pairs (Appendix 1). Discounting apparent increases in New York, New Jersey, and North Carolina between 1986 and 1989, which likely were due in part to increased census effort (U.S. Fish and Wildlife Service 1996), the population increased 98 percent between 1989 and 2012 (preliminary estimate), then declined 5 percent between 2012 and 2013 for a net 1989-2013 increase of 88 percent .

Overall population growth is tempered by geographic and temporal variability. By far, the largest net population increase between 1989 and 2013 occurred in New England (317 percent) where the preliminary population estimate was 858 pairs in 2013. Net growth in the Southern recovery unit population was 80 percent between 1989 and 2013. Most of the Southern recovery unit breeding population increase occurred in 2003 to 2005 and 2011 to 2012. Abundance in the New York-New Jersey recovery unit experienced a net increase of 24 percent between 1989 and 2013, but the population declined sharply from a peak of 586 pairs in 2007 to 397 pairs in 2013 (-32 percent) (Figure 4). During this period, several storms occurred as did beach stabilization and nourishment efforts, and human development increased (see *Historic Post-Storm Responses to Breach and Overwash Formation*). In Eastern Canada, where increases have often been quickly eroded in subsequent years, the population posted a 21 percent net decline between 1989 and 2013; between 2007 and 2013, it decreased 31 percent.

Within the New-York-New Jersey recovery unit, the New Jersey piping plover population has fluctuated at low numbers (1989 – 2013 range = 93 to 144 pairs; mean = 120 pairs), standing at 108 pairs in 2013. In 2012, more than 70 percent of the State's nesting pairs were concentrated along less than 20 miles (less than 16 percent) of the New Jersey shoreline that remain unstabilized (see below). Changes in the Long Island population account for most of the absolute growth in the recovery unit population through 2007 and most of the decrease that has occurred in the last six years. On Long Island, the south shore has been the greatest contributor to population changes (both positive and negative), supporting about 50 percent of the entire recovery unit population. Low abundance in New Jersey and recent steep decreases in abundance on Long Island (especially on the south shore) contribute to the recovery unit's demographic vulnerability.

In addition to the ongoing declines in the New York-New Jersey and Eastern Canada recovery units, other periodic regional declines illustrate the continuing risk of rapid and precipitous reversals in abundance trends. Examples include decreases of 21 percent in the Eastern Canada population in just three years (2002 to 2005) and 68 percent in the southern half of the Southern recovery unit during the seven years (1995 to 2001). The 64 percent decline in the Maine population between 2002 and 2008, from 66 pairs to 24 pairs, followed only a few years of decreased productivity. Although intensified protection efforts between 2008 and 2012 contributed to high productivity in Maine (range = 1.52 - 2.12 chicks per pair), the breeding population has only rebounded to 44 pairs as of 2013.

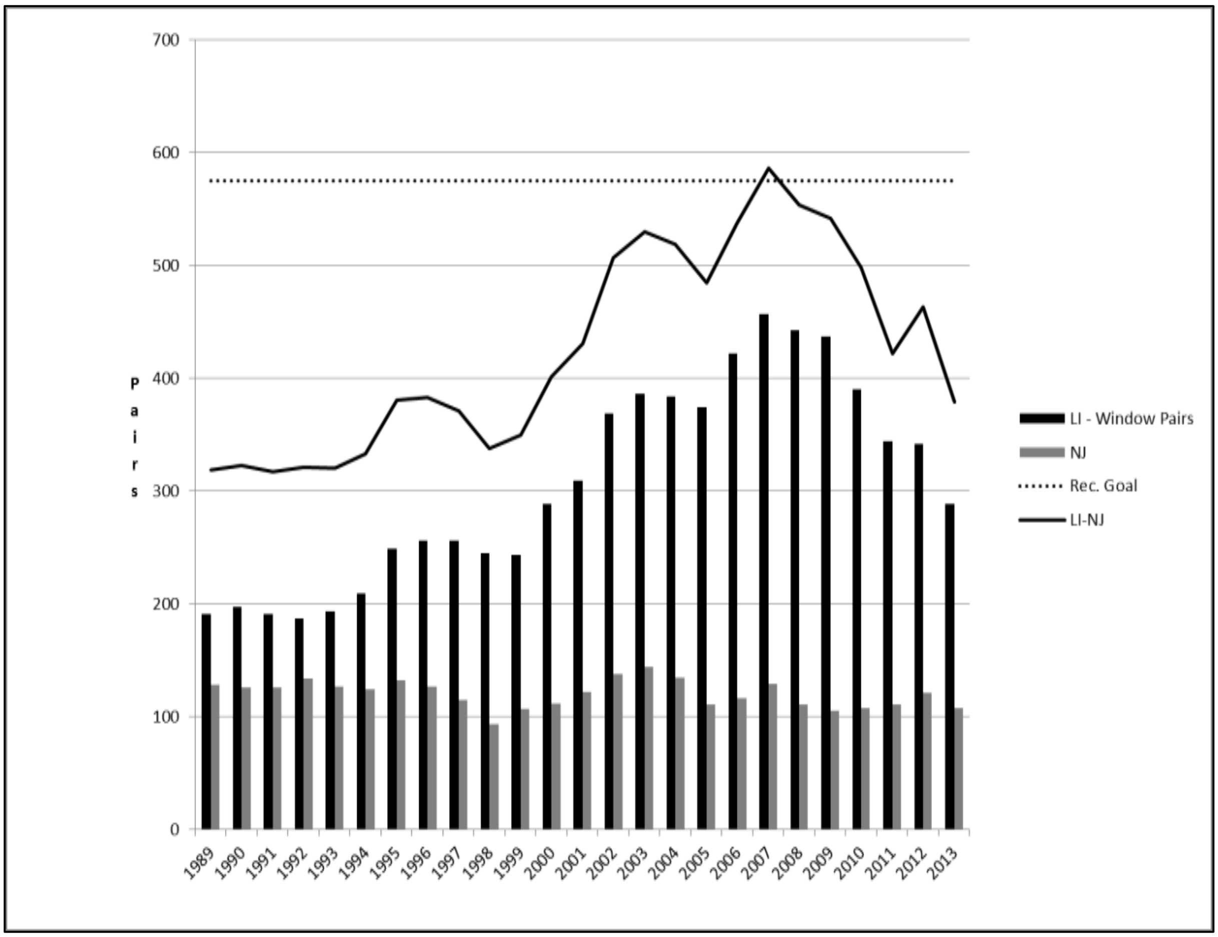


Figure 4. Graph showing Long Island and New Jersey piping plover populations in relation to the New York-New Jersey Recovery Unit recovery goal.

Productivity

Atlantic Coast piping plover productivity is reported as number of chicks fledged per breeding pair. For purposes of measuring productivity, chicks are counted as fledged if they survived to 25 days of age or were seen flying, whichever occurred first. The Service calculated productivity by dividing the number of fledged chicks by the number of pairs that were monitored and for which number of fledglings could be determined. This includes both successful pairs and pairs that fledged no chicks because they failed to nest or because no eggs hatched or no chicks survived to fledging. Accurate assessment of productivity is facilitated by repeated visits to nesting beaches to monitor individual nests and broods during May, June, July and, if necessary, August. Annual productivity estimates for 1987-2013 are summarized by recovery unit and state in Appendix 3; numbers in parentheses are preliminary estimates, but final estimates are unlikely to differ substantially.

Hecht and Melvin (2009a) evaluated latitudinal trends in Atlantic Coast piping plover productivity and relationships between productivity and population growth. Overall productivity for the Atlantic Coast population 1989-2006 was 1.35 chicks fledged per pair (annual range = 1.16-1.54), and overall productivity within recovery units decreased with decreasing latitude: Eastern Canada = 1.61, New England = 1.44, New York-New Jersey = 1.18, and Southern = 1.19 (Hecht and Melvin 2009a). Within recovery units, annual productivity was variable and showed no sustained trends. There were significant, positive relationships between productivity and population growth in the subsequent year for each of the three U.S. recovery units, but not for Eastern Canada. Regression analysis indicated a latitudinal trend in predictions of annual productivity needed to support stationary populations within recovery units, increasing from 0.93 chicks fledged per pair in the Southern unit to 1.44 in Eastern Canada. Relatively small coefficients of determination (r^2 = 0.09-0.59) for the relationships between annual productivity and population increases in the subsequent year indicate that other factors, most likely annual survival rates of both adults and fledged chicks, also had important influences on population growth rates.

The estimate of productivity needed to maintain a stationary population within New England, 1.21 chicks fledged per pair, based on regression analysis (Hecht and Melvin 2009a), is similar to the value of 1.24 that was estimated through population modeling based on survival estimates derived from 1985-1988 banding studies in Massachusetts (Melvin and Gibbs 1996). Regression analysis estimated productivity of 1.44 chicks fledged per pair needed to maintain a stationary population in eastern Canada (Hecht and Melvin 2009a), while Calvert *et al.* (2006) estimated 1.63 chicks per pair for eastern Canada exclusive of southern Nova Scotia, based on estimates of survival derived from 1998-2004 banding studies.

The preliminary 2012 and 2013 U.S. Atlantic Coast productivity estimates of 0.82 and 0.91 chicks per pair were the lowest since the species' 1986 listing. As of this writing, USFWS does not have the finalized 2014 piping plover productivity or population numbers. The 2012 estimate was 37 percent below the 1989-2006 average, and 20 percent below the third worst year, 2009. Productivity in 2012 was lowest for the New York-New Jersey recovery unit (0.72 chicks per pair). The preliminary estimate for New England was 0.84 chicks per pair, while the Southern Recovery Unit had slightly better productivity at 0.89 chicks per pair. In Eastern Canada, productivity in 2012 was higher than in 2011, but below both the 1989-2006 average and the rate needed to maintain a stationary population. Nest loss due to flooding that occurred during an early-June 2012 coastal storm and continuing threats from predation and human disturbance were major factors contributing to the record-low productivity. Productivity estimates in 2013 increased modestly in the New England and Southern recovery units (0.94 and 1.07 chicks per pair, respectively), and the 2013 estimate for the latter recovery unit exceeded the rate needed to maintain a stationary population in that part of the range (Hecht and Melvin 2009a). Productivity of piping plovers in the New York-New Jersey recovery unit increased marginally to 0.74 chicks per pair in 2013. New York-New Jersey productivity has been below 1.0 chicks per pair in four out of the last five years, a circumstance that only occurred in two of the previous 20 years. Even in 2010, when productivity in the rest of the U.S. Atlantic Coast range averaged 1.45 chicks per pair, average productivity in New York was 0.79 chicks per pair.

Breeding site fidelity and dispersal

In New York, Wilcox (1959) recaptured 39 percent of the 744 adult plovers that he banded in prior years (many were recaptured during several successive seasons and all but three of them were retrapped in the same nesting area), but recaptured only 4.7 percent of 979 plovers that he banded as chicks. He also observed that males exhibited greater fidelity to previous nest sites than females. Strauss (1990) observed individuals that returned to nest in his Massachusetts study area for up to six successive years. Also in Massachusetts, 13 of 16 birds banded on one site were resighted the following season, with 11 nesting on the same beach (MacIvor *et al.* 1987). Of 92 adults banded on Assateague Island, Maryland, and resighted the following year, 91 were seen on the same site, as were 8 of 12 first-year birds (Loegering 1992). R. Cross (unpubl. data) reports that 10 of 12 juveniles banded on Assateague Island, Virginia and resighted one and/or two years later were on the Virginia or Maryland portions of Assateague Island, while the other two were observed on other Virginia barrier islands. Site fidelity of banded adults on Long Island in 2002-2004 was 83 percent (Cohen *et al.* 2006).

On the Atlantic Coast, almost all observations of inter-year movements of birds have been within the same or adjacent states. Extensive efforts to re-sight >1,400 Atlantic Coast Piping Plovers color-banded in Virginia, Maryland, Massachusetts and five Eastern Canadian provinces between 1985 and 2003 have resulted in only four records of plovers breeding outside the recovery unit in which they were banded (U.S. Fish and Wildlife Service files; D. Amirault, CWS, pers. comm.).

Forty percent of 329 eastern Canada piping plovers banded as adults in 1998-2003 exhibited fidelity to their nesting beaches in every year that they were resighted, and only six of 152 recaptured adults (4 percent) moved to a different province in a subsequent year (Amirault *et al.* 2005, updated by D. Amirault-Langlais and F. Shaffer, CWS, pers. comm. 2009). By contrast, 5 percent of 95 plovers banded in their hatch year nested at their natal beaches and 84 percent nested in their natal province. Only one of 888 banded birds, however, was detected breeding outside of eastern Canada. That bird, banded as a chick on Prince Edward Island, fledged a chick in Massachusetts after unsuccessfully breeding on Long Island, New York, the previous season.

Survival

Estimates of annual adult survival on Long Island (70 percent; Cohen *et al.* 2006) and eastern Canada (73 percent; Calvert *et al.* 2006) were similar to those reported from late 1980s studies in Massachusetts (74 percent; Melvin and Gibbs 1996) and Maryland (71 percent; Loegering 1992). However, apparent survival (34 percent) for the first year after fledging in eastern Canada (Calvert *et al.* 2006) was much lower than that from earlier Massachusetts banding studies (48 percent; Melvin and Gibbs 1996). Atlantic Coast population viability analyses conducted by Melvin and Gibbs (1996), Calvert *et al.* (2006), and Brault (2007) have consistently found that extinction risk is highly sensitive to small declines in adult and/or juvenile survival rates.

Demographic response to habitat changes

The carrying capacity of habitat to support breeding plovers is subject to fluctuation with the dynamic coastal formation processes that affect topography, vegetation, and other habitat characteristics. As described below, these fluctuations are positively affected by natural factors (especially storms) and negatively affected by human intervention through shoreline development and stabilization projects. Responsiveness of Atlantic Coast piping plovers to both habitat improvements and declines has been observed at many locations, and several noteworthy examples are summarized below.

Wilcox (1959) described the effects on piping plovers from catastrophic storms in 1931 and 1938 that breached the Long Island, New York barrier islands, forming Moriches and Shinnecock Inlets and leveling dunes on Westhampton Island. Only 3-4 pairs of piping plovers nested on 17 miles of barrier beach along Moriches and Shinnecock Bays in 1929; however, following the creation of Moriches Inlet in 1931, plover numbers increased to 20 pairs along a two mile stretch of beach by 1938. Wilcox added that Moriches Inlet moved one mile west between 1931 and 1956. In 1938, a hurricane opened Shinnecock Inlet and also flattened dunes along both Bays. In 1941, plover numbers along the same 17-mile stretch of beach peaked at 64 pairs. Numbers then gradually decreased, a decline that Wilcox attributed to deposition of dredged sand to rebuild dunes, planting of beach grass, and construction of roads and summer homes. Analysis of aerial photographs of Fire Island, immediately west of Wilcox' study area, by Leatherman and

Allen (1985), showed that during the same time period as Wilcox' study, coverage of Fire Island by overwash declined from 26 percent in 1938 to 11 percent in 1954 and 2 percent in 1960.

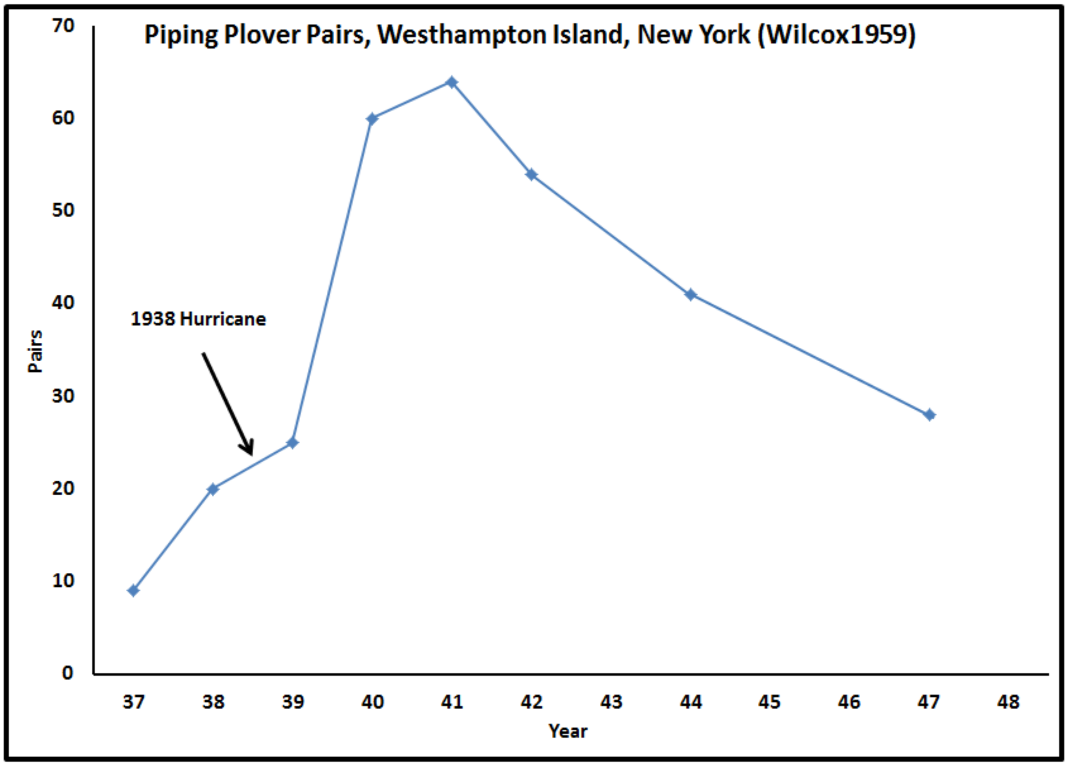


Figure 5. Response of piping plovers to habitat creation and subsequent degradation at Westhampton Island.

In 1965 to 1970, the Corps built a series of groins in the center of Westhampton Island to curb beach erosion and protect houses (Dean 1999). During the 1980s, erosion lowered and narrowed the beach west of the groins, and a storm in December 1992 substantially altered the habitat. This storm led to the foundation of a new plover population that grew until 2000, concurrent with the addition of more habitat by human breach filling, then declined as habitat diminished and became isolated from foraging habitat by redevelopment and vegetation growth. See also discussion of results of Cohen *et al.* (2009) below.

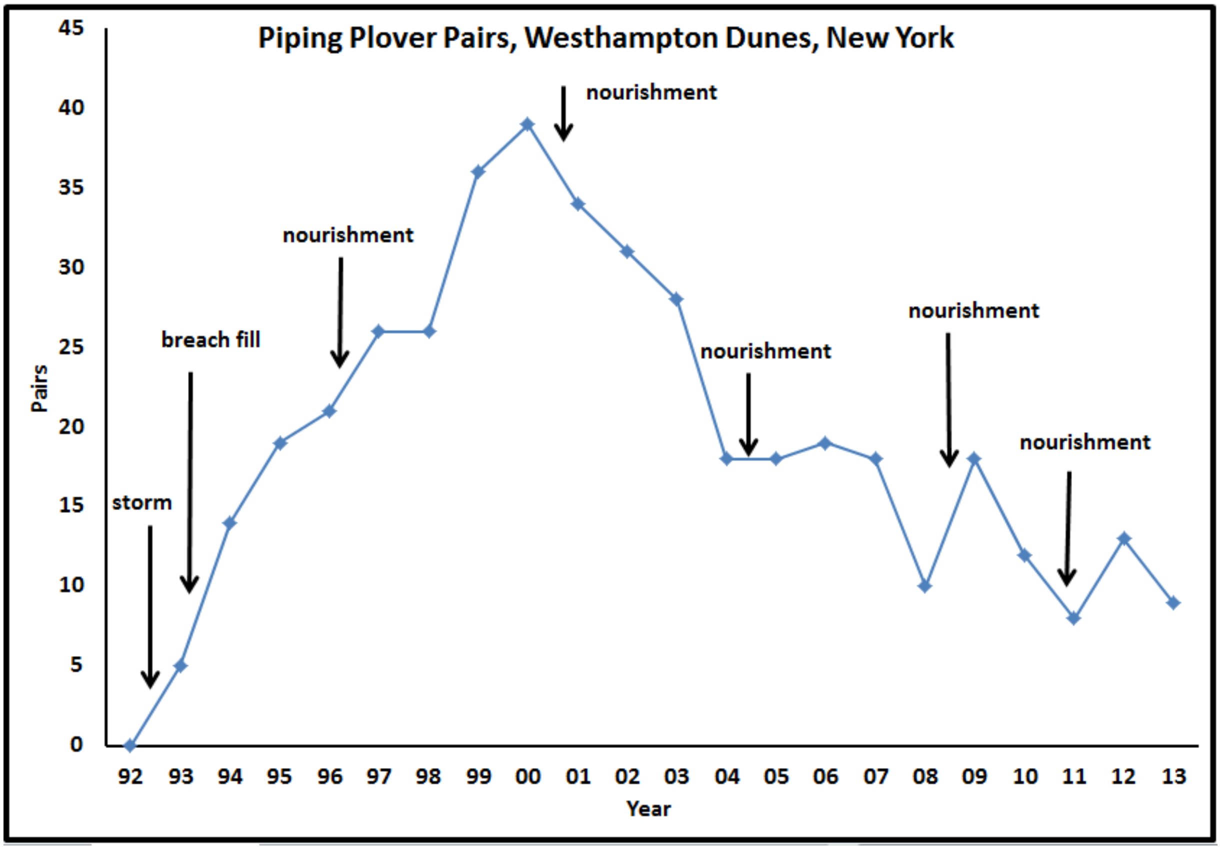


Figure 6. Response of piping plovers to habitat creation and subsequent degradation at Westhampton Dunes.

Northern Assateague Island, Maryland provides an example of rapid response to habitat formed and maintained by a series of strong storms during the period 1991-1998 and a relatively delayed decline following construction in 1998 of a low foredune. Although the foredune was designed with the intent to maintain enough overwash (an estimated frequency of at least one event per year) to preclude the growth of woody plants and maintain sparse herbaceous vegetation (USACE 1998), several unanticipated circumstances (including differences between the targeted and actual grain size of the dredged sediment and calmer than anticipated post-construction meteorological conditions) contributed to its ultimate impenetrability (Schupp *et al.* 2013). Efforts to restore overwash by cutting 14 notches through the constructed foredune in 2008 and 2009 increased island stability by increasing interior island elevation. Areas of sparse vegetation increased and the new foraging habitat was utilized by breeding pairs during the 2010 breeding season (Schupp *et al.* 2013), but the extent and duration of habitat restoration remains uncertain. Abundance of breeding piping plovers continued to decline through 2011, with a modest upturn in 2012 and 2013.

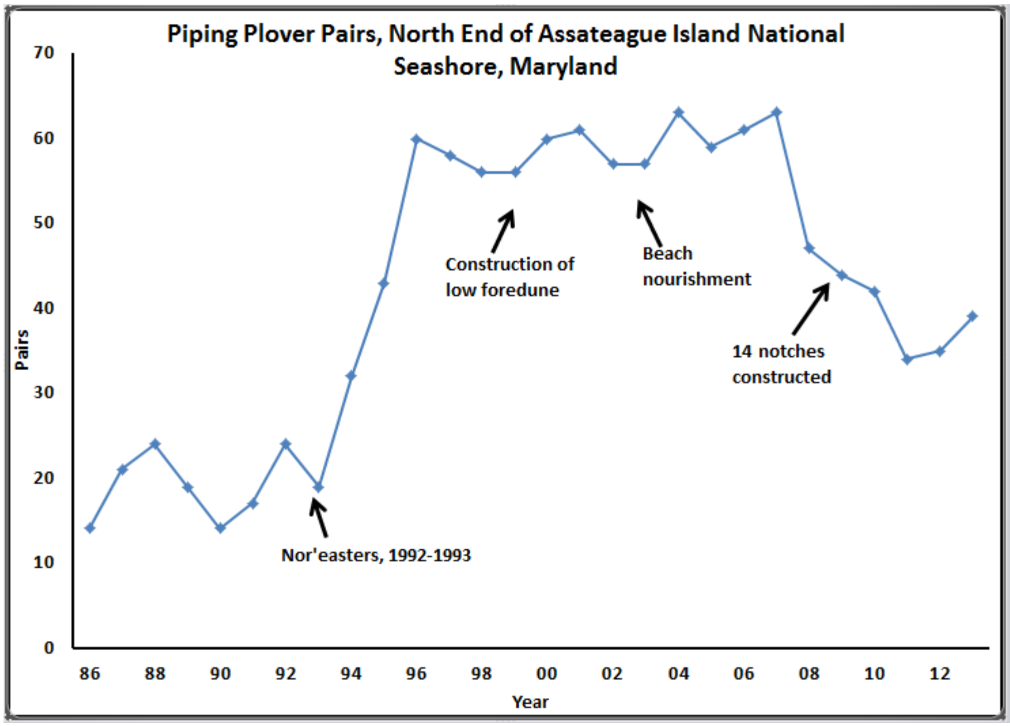


Figure 7. Response of piping plovers to habitat creation and subsequent degradation at Assateague Island National Seashore, Maryland.

The largely undeveloped Virginia barrier islands illustrate a more sustained population response to major storm events in the absence of human stabilization efforts. A period of relative population stability followed the rapid increase after Hurricane Isabel in 2003, until the population increased substantially again after Hurricane Irene in 2011.

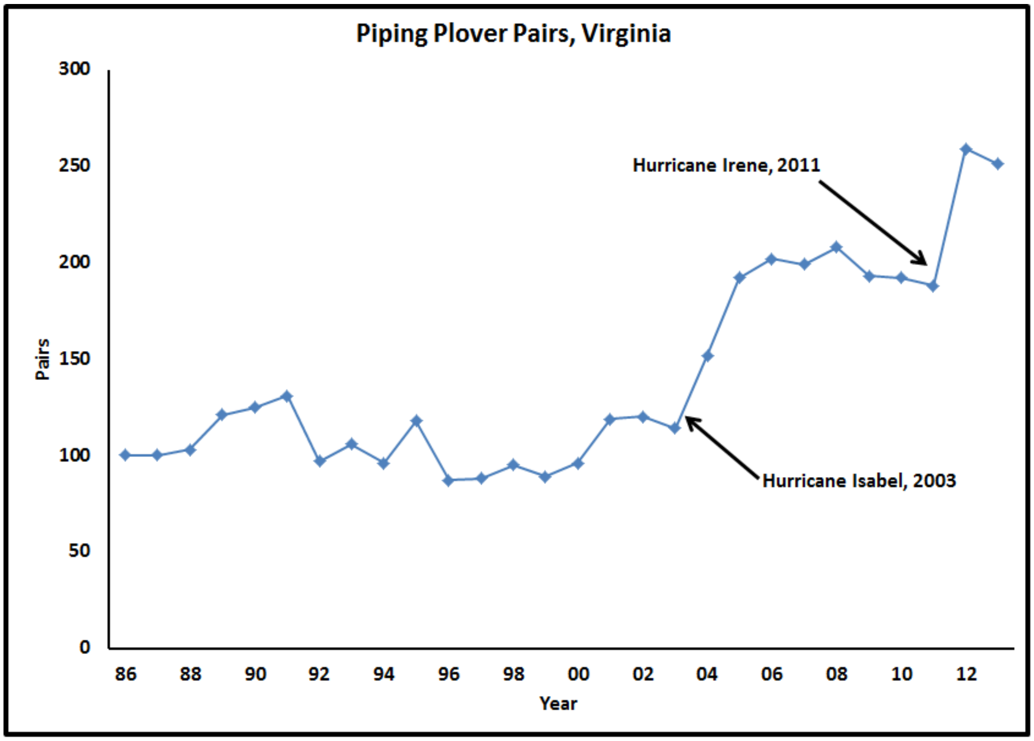


Figure 8. Response of piping plovers to habitat creation and subsequent degradation in Virginia.

These four examples illustrate the rapid response of piping plovers to habitat creation. The two Westhampton examples also show the steep declines that may follow barrier island stabilization. The North End of Assateague project highlights the uncertainty associated with efforts to preserve habitat maintenance processes while implementing a restrained barrier island stabilization project, as well the difficulties associated with restoring overwash. As stated in the 1996 Atlantic Coast recovery plan, "While it is expected that carrying capacity will fluctuate locally, and perhaps even within a state over time, it is anticipated that long-term carrying capacity of the Atlantic Coast's piping plover habitat (and that of regional subpopulations, which correspond to the recovery units laid out on page 55) will be maintained if natural coastal habitat formation processes are not interrupted. *Shoreline development and stabilization projects may, however, erode carrying capacity locally and regionally (see pages 34-37) and, therefore, have potential to compromise the survival and recovery of the population* (emphasis in original)."

Vulnerability to Extinction

Although population growth, from approximately 790 pairs in 1986 to an estimated 1,763 pairs in 2013, has decreased the Atlantic Coast piping plover's vulnerability to extinction since ESA listing, the distribution of population growth remains uneven. Since completion of the 2009 5-Year Review, the New York-New Jersey and Eastern Canada recovery units have experienced declines of 28 percent and 27 percent, respectively, and there is no evidence that these downward trends will be reversed soon, nor a clear, central reason for the significant decline.

As discussed in the 1996 Atlantic Coast recovery plan and above, the overall security of the Atlantic Coast piping plover is fundamentally dependent on even distribution of population growth, as specified in subpopulation targets, to protect a sparsely-distributed species with strict biological requirements from detrimental stochastic events (including catastrophes), and to provide connectivity that facilitates within-recovery unit recolonization of any sites that experience declines or local extirpations due to low productivity and/or temporary habitat succession. The recovery plan also places a priority on addressing threats related to vegetation growth, predation and human disturbance, e.g., pets.

Eastern Canada Recovery Unit—The piping plover population estimate in the Eastern Canada recovery unit in 2013 was 184 pairs, only 5 pairs more than the lowest-ever estimate of 179 pairs in 2012 and 23 percent below the 240 pair estimate in 1986. Although the Eastern Canada population has fluctuated over that period, the decline since 2007 has been the largest (31 percent) and most prolonged, despite much higher overall productivity than in the other recovery units. In-depth evaluation of population and productivity trends and environmental factors by the Wildlife Research Division of the Wildlife and Landscape Science Directorate, Environment Canada, concluded that the limiting factors now impeding recovery are primarily occurring outside Canada, during migration or on the wintering grounds (Gratto-Trevor *et al.* 2013). Efforts to identify these factors have been initiated, but the difficulties inherent to discerning links between environmental factors in the nonbreeding range and vital demographic rates mean that rapid results are unlikely. Furthermore, the availability of measures to ameliorate causal factors that may be identified is completely unknown. In the meanwhile, Canadian Wildlife Service and other conservation partners continue ongoing intensive efforts to protect habitat and breeding activity in order to maximize productivity and reverse or slow the population decline. The Canadian Committee on the Status of Endangered Wildlife recognizes piping plovers breeding in Eastern Canada as belonging to the subspecies *C. m. melodus* and designates them as "Endangered" (Department of Justice Canada 2002). Low abundance, a sharply declining population trend, and lack of identified causal factors that can be remedied make the likelihood of survival and recovery of the Eastern Canada recovery unit uncertain.

New England Recovery Unit—The largest and most sustained population increase has occurred in New England, where the recovery unit population has exceeded (or been within three pairs of) its 625-pair abundance goal since 1998, attaining preliminary estimates of 879 and 858 pairs, respectively, in 2012 and 2013. Although effects from past habitat loss and modification have diminished the piping plover's habitat base in New England, high quality habitat remains, and piping plovers breed productively on a wide range of microhabitats. Limited adverse effects (e.g., to provide for flexibility for beach recreation) to the population in New England may be possible without appreciably reducing the likelihood of survival and recovery (especially if they are accompanied by mitigation) given the health of the population. Notwithstanding the relatively robust status of piping plovers in the New England recovery unit, however, continued monitoring is warranted. Preliminary New England productivity estimates in 2012 and 2013 were the lowest since ESA listing and far below the long-term average. The 64 percent decline in the Maine population between 2002 and 2008, following only a few years of decreased productivity, provides an example of the continuing risk of rapid and precipitous reversals in population growth.

New York-New Jersey recovery unit—Relative optimism about the survival and recovery of piping plovers in the New York-New Jersey recovery unit, based on attainment of the subpopulation goal in 2007, has proved transitory as the population has declined 32 percent and now stands at the lowest abundance since 2000. Record-low productivity in recent years indicates that a near-term improvement in breeding numbers is unlikely. As mentioned previously, this reduction in productivity and overall population numbers is most likely driven by multiple factors including loss and degradation of habitat to development and artificial habitat degradation, predation, and human disturbance. Past permanent habitat losses have diminished the available habitat, in some areas continuing artificial shoreline stabilization perpetuates low quality habitat, and proposals for new or larger artificial beach features threaten to affect some of the remaining areas where natural habitat processes have the potential to create and maintain habitat. Given the importance that the remaining habitat be as productive as possible, it is essential that the other factors affecting piping plover survival and recovery, such as predator and vegetation management, be controlled in this recovery unit.

Southern recovery unit—The narrow habitat tolerances of piping plovers in the Southern recovery unit have been a major (but not the sole) factor in its slow recovery and continuing precariousness. However, the population continues to respond positively to habitat creation events, most recently to habitat improvements following Hurricane Irene in 2011. Despite a gradual dip in numbers between 2007 and 2011, the population attained a post-listing record high of 377 pairs in 2012. As in the rest of the range, security of the population in this recovery unit is fundamentally tied to maintaining newly improved habitats and habitat formation processes, while minimizing threats from human disturbance, predation, oil spills and other contaminants.

Summary and conclusion—Concerns regarding increasingly uneven distribution of Atlantic Coast piping plovers as articulated in the 2009 5-Year Review have partially shifted with respect to their geographic focus, and they have increased with regard to overall population status. The ability of both the Eastern Canada and New York-New Jersey recovery units to meet their population targets are at risk. Although abundance has remained high in New England, no noticeable movements of piping plovers from New England to either Eastern Canada or New York-New Jersey have been observed. The survival and recovery of Atlantic Coast piping plovers remain dependent on the conservation of remaining habitats and habitat-formation processes, as well as annual implementation of management to minimize the effects of pervasive and persistent threats from predation and disturbance by humans and pets. Reversals of major ongoing declines in the Eastern Canada and New York-New Jersey recovery units are urgent.

Status and Trends on Long Island

The Long Island population of the piping plover has been monitored since the early 1980s, with more intensive surveys being undertaken after its listing and protection under the ESA in 1986. Plovers breed on the south shore Atlantic Ocean beaches, Peconic Bay beaches, and Long Island Sound beaches on the north shore of Long Island. In 2013, there were 85 sites where breeding was documented. These sites were monitored under a program overseen by the Service and New York State Department of Environmental Conservation with cooperation and participation by numerous public and private landowners. The area of each survey site varies. Some sites span miles whereas other may only span a few hundred feet of beach. Sites are surveyed regardless of intensity of development or land use patterns. For example, the Federal Wilderness Area on Fire Island spans seven miles and is characterized by no development and natural habitats. Alternatively, the Arverne By the Sea - Rockaway Beach survey site spans one mile and occurs on one of the most developed barrier island in the region. An island-wide census survey is conducted annually between June 1 and June 9. Demographic, habitat condition, threats, etc., data are collected. Surveys are also conducted throughout the season to obtain similar data.

Based on an analysis of the 2000 to 2013 piping plover window census survey data, the south shore Atlantic Ocean Beaches supported between 63 and 71 percent of the Long Island-wide population. Abundance levels in the Peconic and Long Island Sound beaches are fairly close, accounting for between 29 and 37 percent of the Long Island-wide population. The distribution is patchy and reflective of habitat types and quality which is affected by land use patterns, which are in and of themselves affected in large part by stabilization projects.

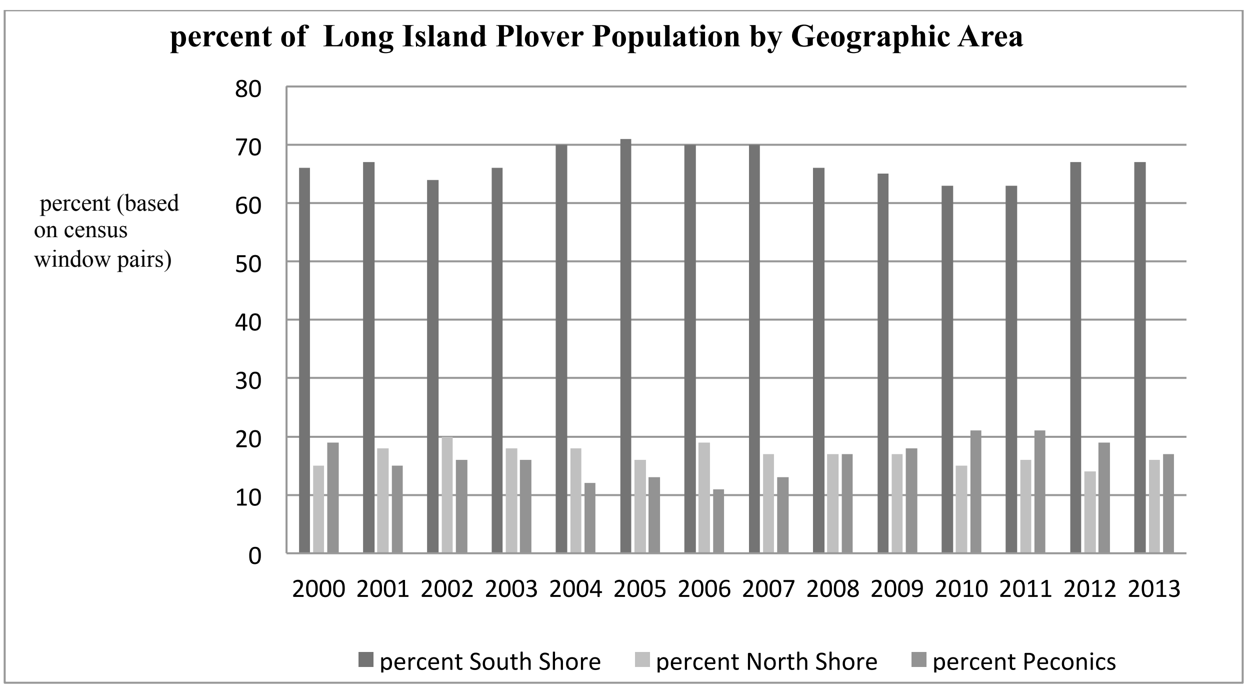


Figure 9. Graph showing percent of Long Island plover population on the south shore, Long Island Sound and Peconic

Bay regions.

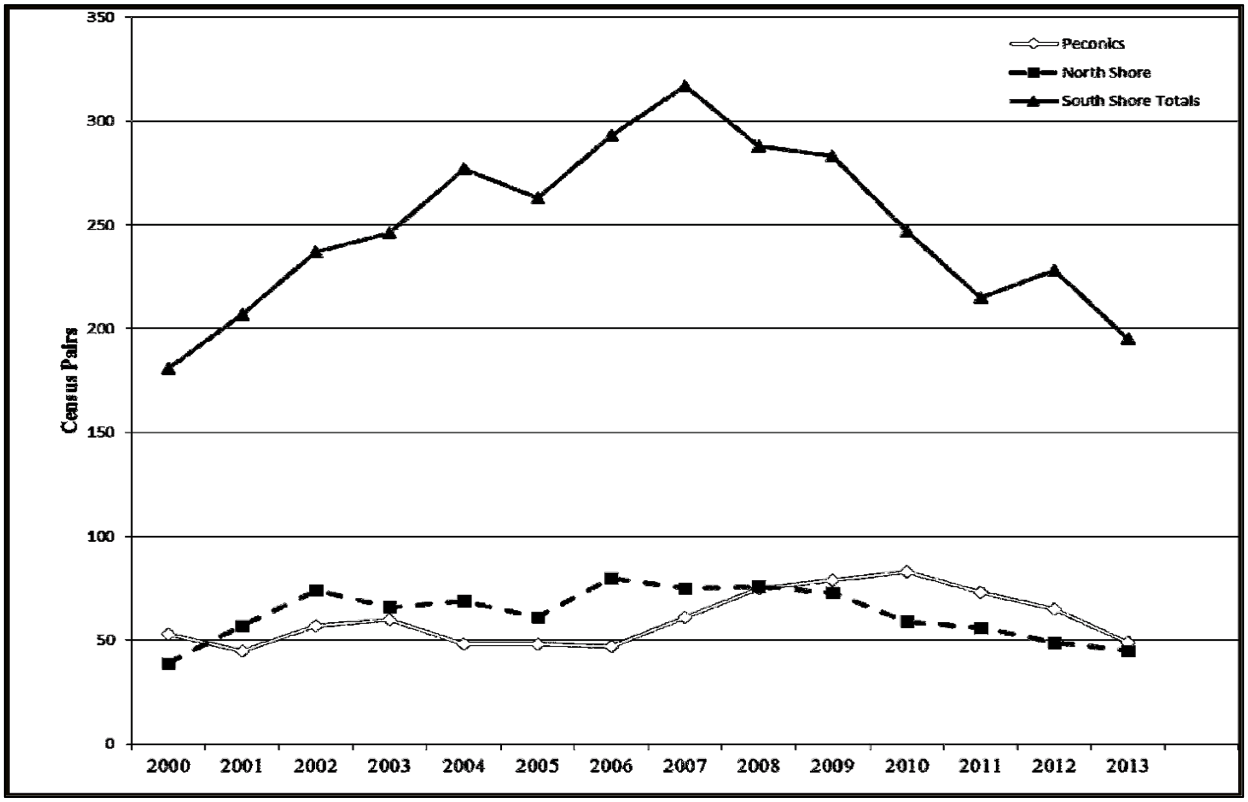


Figure 10. Graph showing population of piping plovers along the South Shore (Atlantic Ocean), North Shore (Long Island Sound) and Peconic Bay area.

From Rockaway Island to Montauk Point on the south shore of Long Island there are 39 sites that are surveyed for plover breeding activity on an annual basis, however, not all of these sites are occupied. In 2013 the number of active sites on Rockaway Island ranged from 2 to 5; on Long Beach Island (2); on Fire Island (3 to 7); Westhampton Island (6); Southampton (3 to 6); and Easthampton (3 to 7) (Table 3).

Table 3. Active breeding sites on the south shore of Long Island.

Barrier Island or Beach	Active Sites Between 2000-2013
Rockaway Island	2 to 5
Long Beach Island	2
Jones Island	3
Fire Island	3 to 7
Westhampton Island	6
Southampton Atlantic Beaches	3 to 6
Easthampton Atlantic Beaches	3 to 7

The majority of breeding sites on the south shore are limited to ocean beaches backed by stabilized dunes and renourished berms. Several sites contain a mosaic of habitats, such as ephemeral pools, tidal pools, wide beaches, low dunes, dune blowouts, etc. A discussion of each area is given below, beginning with Rockaway Beach, Queens County.

The Rockaway barrier beach is significantly developed, with dense residential and commercial development, railways, and improved secondary roads and highways. The barrier beach is about 10.5 mi in length stretching from East Rockaway Inlet in the east to Rockaway Inlet in the west. The Federal Rockaway Inlet Federal Navigation Jetty stabilizes the western end of the barrier beach preventing the formation of natural inlet spit habitats, tidal pools, extensive intertidal flats, etc. Dense development generally extends to the ocean beach, except where the NPS manages several units of the Gateway National Recreational Area at Breezy Point, Fort Tilden, and Jacob Riis Park, on the western portion of the barrier beach. The bay side is generally stabilized with hard structures, such as docks and revetments, although plovers have attempted to nest on a small section of unstabilized bay beach at Breezy Point Cooperative, a privately owned beach community (S. Sinkevich, pers. comm). The main piping plover breeding areas in the Rockaways are at the NPS Breezy Point Unit, Breezy Point Cooperative, and between 39th and 59th Beach Streets (Arvene Site).

Long Beach Island is about 9.3 mi in length. It is a significantly developed barrier island, with commercial and residential development, improved roads, railways, and infrastructure. There are only two piping plover breeding sites on Long Beach Island and each is located on parklands maintained by Nassau County and the Town of Hempstead at either end of the island. All nests are limited to the ocean side beaches, with no bayside habitats in existence. The Silver Point breeding area is adjacent to the East Rockaway Federal Navigation Inlet and consists of three subsites where plovers breed, each separated by areas designated by Nassau County as recreational beaches. On the eastern end of Long Beach Island is the Lido Beach breeding site. That site is characterized by wide lower elevation beaches which support significant moist open sandy foraging habitats on the upper beach. Similar to Silver Point, sub-breeding sites are not contiguous due to intense recreational activities. The East Rockaway Federal Navigation Jetty stabilizes the western end of the barrier beach preventing the formation of natural inlet spit habitats, tidal pools, extensive intertidal flats, etc.

Jones Island is about 17.5 mi. in length, stretching from Fire Island Inlet to Jones Inlet. It is mainly parkland under the jurisdiction of the NYSOPRHP, Town of Oyster Bay, and Town of Babylon. Two residential communities are located on the north side of Ocean Parkway, a four lane highway, at West Gilgo Beach and Gilgo Beach. Town-owned marina facilities exist on the north side of Ocean Parkway at West Gilgo Beach, Gilgo Beach, and Cedar Beach. Oak Beach, a residential community, is located in the eastern end of the Island and borders Fire Island Inlet.

Ocean Parkway runs the length of Jones Island and effectively functions as an enormous dike, preventing the formation of bay to ocean overwash or breaches. Consequently, all of the plover nests are limited to the ocean beach at the four breeding sites, Jones Beach West, Jones Beach Lot 9, Jones Beach East (Gilgo Town Beach, Gilgo State Park, and Cedar Town Beach), with the majority of pairs located at Jones Beach West and Cedar Beach. Both of these breeding areas are characterized by a mosaic of habitats including ocean intertidal, wide beaches (e.g., greater than 500 ft wide at Jones Beach West), and moist open sandy habitats on the upper beaches. The Jones Inlet Federal Navigation Jetty stabilizes the western end of Jones Island, preventing the formation of natural inlet spit habitats, tidal pools, extensive intertidal flats, etc. The main breeding areas at each of these sites are in lesser-used recreational areas.

Fire Island is about 30 mi. in length stretching from Fire Island Inlet to Moriches Inlet. The most consistent and major breeding sites over the last 15 years are Democrat Point, Fire Island Wilderness, and Smith Point. In 2013, Democrat Point, Old Inlet (within the Fire Island Wilderness Area), and Smith Point County Park had bay to ocean overwash habitats, but there was a functional loss of this is habitat at Smith Point County Park due to land use patterns established by Suffolk County Department of Parks, Recreation, and Conservation which permitted ORV and pedestrian recreational uses on the ocean side beaches.

Of note are three ocean overwash areas created by Hurricane Sandy in Smith Point County Park. These are in front of Pattersquash Island, Narrow Bay, and New Made Island. As with Old Inlet and Democrat Point, these areas were modified with by Suffolk County in 2013 with the installment of linear sand fencing and the continued use of Burma Road (N. Gibbons, Suffolk County Parks, email, October 1, 2014). The sand fencing was installed in March, 2013. It remains in the Pattersquash Island and New Made Island areas. Much of the fencing in the Narrow Bay area has been removed due to compliance with the BCP.

Prior to new bay to ocean overwash habitats being formed by Hurricane Sandy at Smith Point County Park and Old Inlet, Democrat Point was the only site which provided a semblance of a natural inlet spits, extensive intertidal flats, ephemeral pools, wide overwash beaches, etc. However, the stabilization of Fire Island Inlet has impacted the formation of these habitats on both a temporal and spatial scale. This is even more so the case at Smith Point County Park, where the Moriches Inlet Federal Navigation Jetty has prevented natural inlet spit habitats, tidal pools, extensive intertidal flats, etc. from forming. All of the other breeding sites at Fire Island Lighthouse Beach NPS, Sunken Forest, Fire Island Pines, and Fire Island Villages are limited to the oceanside. Partial overash habitats did form as a result of Hurricane Sandy at Fire Island Lighthouse Beach, Sunken Forest, and the Wilderness Area.

Westhampton Island is about 15 mi. in length and stretches from Moriches Inlet to Shinnecock Inlet. It is characterized by fairly dense residential development and seasonal condominium complexes on the central area and western end of the island (Quogue, Hampton Beach, Westhampton Beach, and the Village of West Hampton Dunes). Several bridges connect the island with the mainland, and Dune Road, an improved two lane road stretches 14 mi from Shinnecock Inlet to the entrance to Cupsogue County Park. From here, the road transitions to an unimproved ORV access route for 1 mi to Moriches Inlet. Piping plover breeding habitat occurs at Cupsogue County Park, the public beach fronting the Village of West Hampton Dunes, Westhampton Beach, Hampton Beach, and Tiana Beaches (county-owned and privately owned). Nesting habitat is primarily limited to ocean beaches, although on rare occasions one pair of piping plovers has been documented breeding north of Dune Road on the bay side near Ponquogue Bridge. Bayside foraging habitat existed on the bayside at Cupsogue County Park, but this was of low quality due to heavy recreational and degradation of bayside habitat resulting from the BCP breach fill project. Fairly extensive high quality bayside flats still exist north of the Village of West Hampton Dunes, but these flats are only accessible to adults due to heavy residential development and lack of breeding habitat north of the Corps'constructed dune in this area. Overall, except for Cupsogue County Park, there is no other bay to ocean overwash habitat Westhampton Island. As in the case of Long Beach, Jones, and Fire Islands, the stabilization of Moriches and Shinnecock Inlets have prevent the formation of natural inlet spit habitats, tidal pools, extensive intertidal flats, etc. from forming on either end of the island.

The south shore Southampton beaches are characterized by breeding habitats which are limited to ocean beaches and to areas in proximity to small coastal ponds which provide plovers with access to ocean and pond habitats. No plovers nest on the ocean beaches just east of Shinnecock Inlet due to intense recreational ORV and pedestrian uses established by Suffolk County department of Parks, Recreation, and Conservation. East Hampton beaches have similar attributes, with coastal ponds at Georgica Pond and Wainscott Pond.

Table 4. Habitats at each breeding site on the south shore, using the descriptors "Ocean side only," "Inlet Spit," "Bay to Ocean," "Coastal Pond" and "Ephemeral Pools."

Site	Oceanside Only	Inlet Spit	Bayside Foraging	Bay to Ocean	Coastal Pond	Ephemeral Pools
Arverne By The Sea	X					
Breezy Point Cooperative	X					
Breezy Point NPS	X					
Far Rockaway	X					
Fort Tilden	X					
Jacob Riis	X					
Rockaway Beach	X					
Silver Point	X					
Long Beach	X					X

Lido Beach						
Jones Beach West	X					X
Jones Beach East Lot 9	X					
Jones Beach East Gilgo Beach	X					
Jones Beach East Cedar Beach	X					X
Democrat Point		X				X
Fire Island Light House - Robert Moses State Park	X					
Fire Island Light House - NPS	X					
Fire Island Villages	X					
Sunken Forest	X					
Fire Island Pines	X					
Wilderness Area	X	X	X	X		
Fire Island East aka Smith Point	X		X (precluded and or degraded by ORV use and recreation)	X (precluded and or degraded by ORV use and recreation)		
Cupsogue County Park	X*		X (degraded by sand fences and recreation)	X (degraded by sand fences and recreation)		
Westhampton Dunes	X	X				
Westhampton Beach	X					

Hampton Beach	X				

Westhampton Tiana Beach Private	X				
Westhampton Tiana Beach County	X				
Shinnecock East County Park	X				
Southampton Beach (Southampton Village)	X				
Gin Lane Beach	X				
Old Towne Rd Beach	X				
Watermill Beach	X			X	
Sams Creek	X				
Sagaponack Pond	X			X	
Fairfield Pond Lane Beach	X				
Atlantic Double Dunes NWR	X				
Atlantic Double Dunes Town	X				
Napeague Beach State Park	X				
Napeague Beach Town	X				
East Hampton Beach	X				
Georgica Pond				X	
Wainscott Pond				X	

Over the last 14 years, higher densities of plovers on south shore of Long Island, were found on

Long Beach-Lido Beach, Jones Beach West, Jones Beach East - Cedar Beach (Babylon), Democrat Point (Fire Island), and the Federal Wilderness Area (Old Inlet). These areas are mostly characterized by wide, flat beaches with ephemeral pools or wide areas of moist sandy habitats. Historically, Democrat Point was the only site which contained bay to ocean overwash habitats and wide areas for nesting.

The majority of the Long Island Sound, Peconic and Gardiner's Bay breeding sites are located near creek mouths or inlets (Table 5).

Table 5. Breeding Sites Near Inlets and Tidal Creeks

Half Moon Beach
Prospect Point
Centre Island Tidal Creek
Eatons Neck
Long Island Power Authority property
Crab Meadow Beach
Sunken Meadow State Park
Short Beach Smithtown
Long Beach Peninsula Smithtown
Old Field Beach
Mt Misery Point
Wading River Beach
Fresh Pond Landing
Mattituck Inlet
Goldsmith Inlet
Cedar Beach Point
Hog Neck Bay
Little Creek
Cutchogue Harbor
Kimogener Point
Marratooka Point
Jamesport Town Beach
Goose Creek Flanders Bay
Red Creek Pond
Squire Pond
Sebonac Creek
Towd Neck
Jessup Neck
Pine Neck
Crab Creek
Sammys Beach
Lionhead Beach
Accabonac Harbor
Hicks Island

Continuing Threats to Atlantic Coast Piping Plovers with Emphasis on the New York-New Jersey Recovery Unit

Continuing threats to Atlantic Coast piping plovers in the breeding portion of their range identified in the 1996 revised recovery plan include habitat loss and degradation, disturbance by humans and pets, increased predation, and oil spills (U.S. Fish and Wildlife Service 1996). The 2009 5-Year Review updated information regarding these breeding range threats, as well as new threats of climate change and wind turbine generators (U.S. Fish and Wildlife Service 2009). Threats to piping plovers in the Eastern Canada recovery unit are summarized in Environment Canada's 2012 Recovery Strategy for the Piping Plover (*Charadrius melodus melodus*) in Canada (Environment Canada 2012), and they are further assessed in a 2013 Scientific Review of the Recovery Program for Piping Plovers (*melodus* subspecies) in Eastern Canada (Gratto-Trevor *et al.* 2013). Threats in the plover's migration and wintering range, where piping plovers spend more than two-thirds of its annual cycle, were recognized in the revised recovery plan and were substantially elaborated in the 5-Year Review, and the 2012 Comprehensive Conservation Strategy for the Piping Plover in its Coastal Migration and Wintering Range in the Continental United States (U.S. Fish and Wildlife Service 2012). First discussed are threats to piping plovers in the three U.S. recovery units and then provide summaries of threats in the Eastern Canada recovery unit and in the wintering range.

Habitat loss and degradation in the U.S. breeding range

New England recovery unit

Since completion of the 1996 revised recovery plan, one formal section 7 consultation has been completed for a project (at a small site in Maine) involving habitat modification or degradation in New England (U.S. Fish and Wildlife Service 2008a). Informal consultations[5] with the USACE have resulted in project modifications to avoid direct and indirect adverse effects (including project-induced beach recreation) of beach nourishment or inlet dredging. Although effects from past habitat loss and modification have diminished the piping plover's habitat base in New England, many high quality habitats remain, and piping plovers breed productively on a wide range of microhabitats (Jones 1997). Continued efforts to conserve high quality habitats are warranted, but overall threats to habitat from existing or proposed projects are low in the New England recovery unit.

New York-New Jersey recovery unit

5 Examples of projects for which consultation has been concluded informally include dredging of Ellisville Harbor channel in Plymouth, Massachusetts (M. Bartlett, USFWS, in litt. 2003) and navigation improvements in Westport Harbor and disposal of dredge material on Westport Beach, Massachusetts (S. von Oettingen, USFWS, in litt. 2007).

Loss and degradation of habitat remains a prominent threat to piping plovers in the New York-New Jersey recovery unit. Within the New York Bight, which includes the species' entire range in New Jersey and the southern Long Island shoreline, more than half the beaches are classified as "developed" (U.S. Fish and Wildlife Service 1997). The remaining beaches in the New York Bight, classified as "natural and undeveloped." However, many of these areas are also subject to stabilization activities that promote the formation of mature dunes, thus preventing overwash, inlet migration, and other natural coastal processes that create and maintain preferred plover habitats. The section below provides an account of the various stabilization activities, as well as some specific examples where Corps stabilization activities have affected the species and their habitats.

Recent History of Overwash and Breach Response and Shoreline Stabilization by Federal, State, and Local Agencies and the Resulting Habitat Destruction With a Focus on the South Shore of Long Island

In some areas, beach stabilization activities have resulted in loss and degradation of suitable plover and seabeach amaranth habitats and are major causes to the range-wide decline of the piping plover (U.S. Fish and Wildlife Service 1996a). These activities are undertaken by both Federal and non-Federal entities (via Federal permits) and include, but are not limited to, inlet maintenance dredging with upland beach disposal, dune construction and beach construction stabilization. Many of these projects accelerate the formation of mature dunes and are implemented to substantially reduce the probability of natural inlet creation and overwash that would otherwise form optimal piping plover and seabeach amaranth habitats.

Historic Post-Storm Responses to Breach and Overwash Formation

Public and private beach stabilization efforts have occurred on the ocean beaches in the action area between 1938 and present day (U.S. Army Corps of Engineers 1999; U.S. Fish and Wildlife Service, internal field notes, 2008). Between 1955 and 1994, approximately 6.4 million cubic yards (cy) of fill were placed on Fire Island by the Federal government, local municipalities, and local interests. Approximately 54 percent of this fill activity occurred during the 1960s in response to the severe shoreline change caused by Hurricane Donna (1960) and the Ash Wednesday Storm of 1962. Some 1.66 million cy of fill were placed on Fire Island's beaches between 1993 and 1997. Most of this latter fill was placed by local communities at Fire Island Pines, Ocean Bay Park, Fair Harbor, and Saltaire in response to the severe storms that occurred during the early 1990s (National Park Service 2003). In 2003-2004, a number of Fire Island communities placed up to 1.27 million cy of sand on the beach. Additional nourishment occurred following the April 2007 nor'easter with 25,460 cy of sand being placed in the Davis Park Reach (National Park Service 2008) and the Fire Island communities placed 1.8 million cy of sand on the beach in 2008. Recent dredging and ocean beach material placement activities include: dredging of the Captree Boat Basin and placement of 320,000 cy of material at Fields 4 and 5 of RMSP in 2013, the placement of 400,000 cy at Field 5, and an adjacent upland stock pile in 2014; dredging of Fire Island Inlet and placement of 224,000 cy at Field 5 and beach fronting the RMSP water tower in 2013; and dredging of Moriches Inlet with placement of 460,000 cy at Smith Point County Park in 2009.

Over the last 40 years, the response to barrier island breaching has been artificial closure. This trend continued following Hurricane Sandy when three breaches formed; two on Fire Island and one on Westhampton Island. However, Old Inlet remains open due to NPS Fire Island Wilderness Management Plan which requires public meetings and preparation of an Environmental Impact Statement. Breach closures are conducted by the Corps via the BCP, which was originally conceived to guide interim breach response over 57 miles of barrier island beach pending reformulation of the FIMP. Under the BCP, the Corps initiates breach closure activities within 72 hours of a breach (USACE 1996). Studies for the FIMP Reformulation have identified 10 areas vulnerable to breach and estimated that 20-69 acres of intertidal and upland spit habitat might be formed on the bays during a one-month breach, 74-351 acres during a 12-month opening (S. Alfageme, Moffatt and Nichol, in litt. 2006).

It should be noted that a 2007 plan developed by the NPS in consultation with the USGS allows for natural development of breaches within FIIS, especially in the Otis Pike High Dune Wilderness Area, but only if it can be determined that the breach is likely to close naturally within some reasonable time frame (approximately three months), is not likely to lead to the development of a semi-permanent tidal inlet, and is not likely to lead to significant increased flooding damage to mainland development. If breaches are closed and ecological benefits thereby reduced, mitigation measures such as sand transfer or nourishment by dredging to create wash over fans and flood-tide deltas on the landward side of the barriers in Great South Bay may be implemented, but only in developed parts of the Seashore (Williams and Foley 2007).

See Appendix 5: Stabilization Efforts Following Coastal Storms: 1938-present, for a more complete description of the stabilization activities in this area over the past 75 years.

One of the most serious indirect effects of artificial beach stabilization is intensification of conflicts with human recreation induced by loss of alternative (overwash and bayside) plover habitats. As illustrated in Figure 12, the shift in distribution of piping plover nesting and brood-rearing activity at Westhampton Dunes as the barrier beach was redeveloped and the bayside revegetated following cessation of overwash (Cohen *et al.* 2009) also constrained nesting and chick-rearing to narrower oceanfront beaches where conflicts with human recreation are most severe.

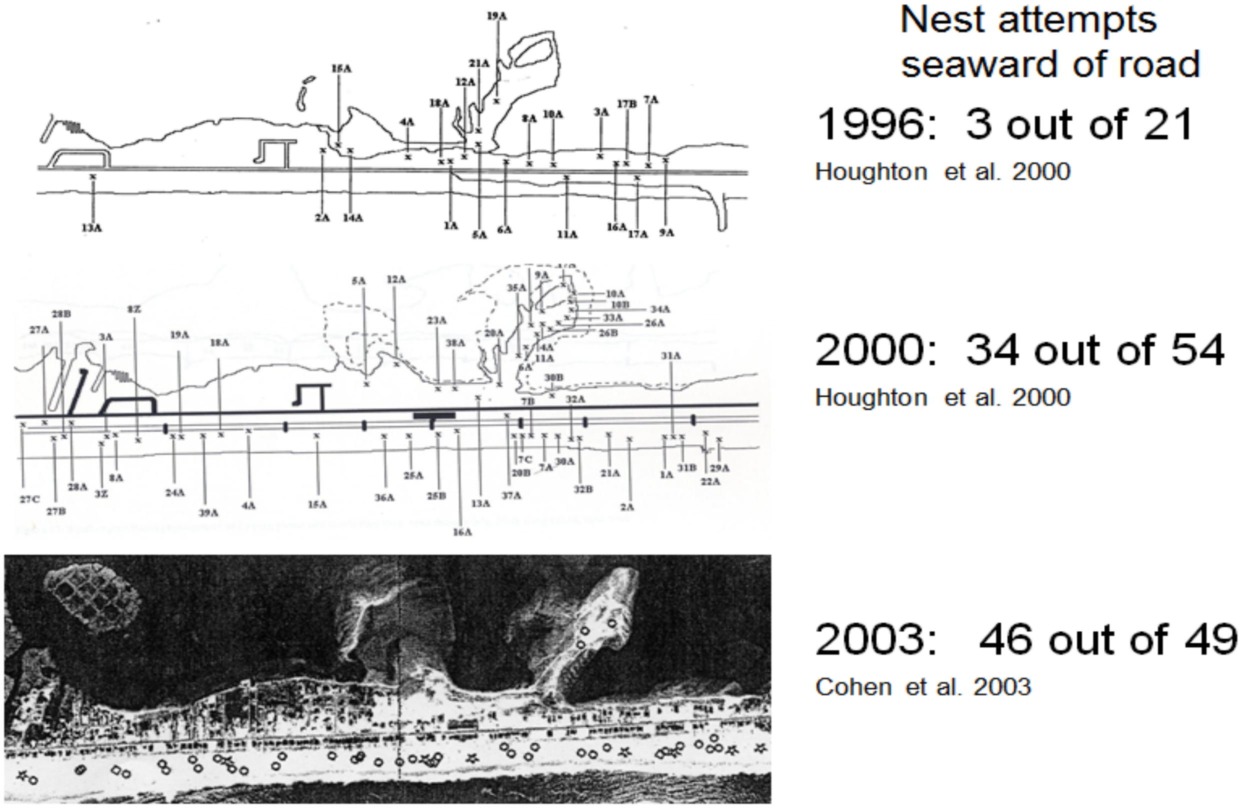


Figure 11. Distribution of piping plover nests at Westhampton Dunes in 1996, 2000, and 2003.

Abouelezz (2013) observed a shift in piping plover nesting locations away from the Breezy Point shoreline at the Jamaica Bay Unit of the Gateway National Recreation area following overwash that occurred during Hurricane Sandy. Mean distance of piping plover nests from the mean high tide line increased from 33.4 m in 2012 to 83.9 meters in 2013.

As further discussed (see discussion of *Disturbance by humans and dogs*), concentration of piping plover breeding activity and human recreation in close proximity on artificially stabilized beaches increases the potential for disturbance. Prevalence of this factor in New York and New Jersey is also identified as a contributor to the higher than average per-pair expenditures for protecting piping plovers in those states compared with expenditures in New England, Maryland, and Virginia (Hecht and Melvin 2009b).

<u>Habitat Trends and Status in New Jersey</u>

New Jersey's Atlantic coast has the longest history of stabilized barrier island shoreline in North America, as well as the most developed coastal barriers and the highest degree of stabilization in the United States (Nordstrom 2000). Seventy-six percent of New Jersey's Atlantic coast is developed, prompting considerable efforts to make the beaches more static (Hafner 2012). Roughly 27 miles are protected by shore-parallel hard structures (Nordstrom 2000), including 5.6

miles of revetments and seawalls (Hafner 2012). Along the State's Atlantic coast there are 368 groins and one breakwater (Hafner 2012). Most if not all of the hard structures inventoried by Pikley and Wright (1988), Nordstrom (2000), and Hafner (2012) still exist, but most have been covered by sand placed as part of the State's beach nourishment program.

Beach Nourishment

Of the 127 miles of Atlantic coastline in New Jersey (from Sandy Hook to Cape May) (Nordstrom and Mauriello 2001), only about 11 miles (Sandy Hook Unit, Gateway National Recreation Area and Little Beach Island within the Edwin B. Forsythe National Wildlife Refuge (Forsythe NWR)) are located outside of Corps beach nourishment study areas, with the remaining 116 miles falling within the boundaries of one or more Corps shore protection study areas (USFWS 2005a). Some areas covered by Corps study areas have not received nourishment to date and are not slated for beach nourishment in the future, and many of these areas are excluded from the Corps' approved project (construction) areas (Brandreth pers. comm. 2014; Gebert 2012; USFWS 2005a; Corps 2003). As shown in Table 8 less than 30 percent of New Jersey's Atlantic coast beaches are excluded from planned or constructed nourishment. About half of the unnourished areas are stabilized by hard structures. Only about 15 percent of New Jersey's Atlantic beaches lack hard stabilization—all of these areas are listed in Table 1 because none of them are nourished other than some tapers at the ends of adjacent nourished areas or via littoral drift from updrift nourishments. These unstabilized beaches support the vast majority of the State's nesting pairs—more than 70 percent in 2012 (Pover and Davis 2012).

Table 8. Unnourished Atlantic coast beaches in New Jersey (Brandreth pers. comm. 2014; Pover pers. comm. 2014; USFWS 2005a; Corps 2003)

Beach	Miles (1)	percent of NJ Atlantic Coast by Miles	Covered by Corps Project	Hard Stabilized (groins, jetties, seawalls, etc.)
Sandy Hook (2)	7.25	5.7 percent	No	South end only (3)
Island Beach State Park	9.75	7.7 percent	No	South end only (4)
Barnegat Light Borough	1.75	1.4 percent	No	Yes
Holgate	3.50	2.8 percent	No	No (3)
Little Beach	4.00	3.1 percent	No	No
North Brigantine Natural Area	3.00	2.4 percent	No	No
Southern Brigantine City	2.25	1.8 percent	No	Yes
Northern Ocean City	0.50	0.4 percent	No	No (3)
Corson's Inlet State Park	1.00	0.8 percent	No	No
Strathmere Natural Area (5)	0.25	0.2 percent	Yes	Minimal (see text)
Southern Sea Isle City (Townsend's Inlet)	0.25	0.2 percent	Yes	No (3)
Stone Harbor Point	1.00	0.8 percent	Yes	No (3)
Two-Mile Beach	1.25	1.0 percent	Yes	Yes
Total Unnourished (6)	35.75	28.1 percent		
Subtotal Outside Federal Project Areas	33.00	26.0 percent		
Subtotal Unhardened (7)	19.50	15.4 percent		

(1) Approximate to the nearest 0.25 mile, and subject to change as beaches are reconfigured by coastal processes.
(2) Although not covered by a Corps project, a small area (the Critical Zone) within the hard-stabilized southern end of Sandy Hook has occasionally been nourished by the National Park Service (NPS).
(3) Unhardened area is bounded by a terminal groin that may exert an influence over a short distance.
(4) The southern end of Island Beach State Park is affected by an inlet jetty. The entire length of the park is excluded from the "unhardened" total because it is difficult to determine where the jetty influence wanes and because dunes throughout the park are augmented with heavy use of snow fencing and old Christmas trees, practices that effectively limit overwash.
(5) Although not nourished, the taper from an adjacent nourishment covers a considerable percent of this small area.
(6) Does not includes areas that are not nourished but have been utilized as borrow areas for backpassing (*e.g.*, parts of Avalon, Wildwood, Cape May).
(7) Includes the northern 6 miles of Sandy Hook and Strathmere Natural Area; excludes all of Island Beach State Park.

Where hard stabilization structures and coastal development would otherwise eliminate any beach habitat, beach nourishment can provide suitable, though sub-optimal, nesting habitat as long as other indirect effects of these projects (*e.g.*, from recreation, predation) are carefully managed to avoid creating population sinks (USFWS 2005a; 2002). However, beach nourishment also has adverse effects to piping plovers and their habitats, potentially including disturbance during and after construction, alteration of prey resources, creation of sub-optimal habitats, increased human recreational activity, exacerbation of predation threats, and an incremental contribution toward a stabilized shoreline that precludes the formation of optimal habitats (USFWS 2005a; 2002).

Further information on piping plover habitat, section 7 consultations, and beach management plans are described in Appendix 6: Further New Jersey Information.

Summary

In New Jersey, the loss of overwash and bayside habitats was brought about primarily by the extensive system of hard stabilization structures and accompanying coastal development that was built in the 20th century. Current practices and projects, primarily beach nourishment, incrementally add to the stabilized condition of the New Jersey coast, in some cases further degrading habitat, in some cases creating or augmenting habitat. The majority of piping plovers in New Jersey exist in unstabilized habitat.

III. ENVIRONMENTAL BASELINE

Summary of Main Points

- The environmental baseline represents a snapshot of the species' conservation status in the action area at a particular point in time and includes the past and present impacts of all Federal, State, or private activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early consultation, and the impact of State or private actions that are occurring in the action area. Piping plovers have evolved to survive in a changing coastal system in which habitat is formed, mainly as a consequence of storm dynamics, and degraded. This degradation prior to people was caused by vegetation growth. Currently, such degradation stems from a combination of vegetation growth and human alterations of the landscape.

- The action area encompasses ocean beaches, intertidal areas, interdunal areas, and bayside habitats for the entirety of Fire Island because the project directly affects about 19 miles of shoreline and additionally affects the remaining 11 miles due to the littoral drift of sediments from the proposed dune construction.

- Land ownership in the action area is both public and private, both on the ocean beach and back dune areas and bay side. The scope of land uses on Fire Island encompasses recreational, commercial, residential activities, and administrative activities undertaken by Suffolk County, Town of Islip, Town of Brookhaven, two incorporated villages on Fire Island, and the NPS. There are a total of seventeen residential communities on Fire Island. The other major land uses on Fire Island are Robert Moses State Park and Smith Point County Park.

- Habitat limitation, loss, fragmentation, beach stabilization, avian and mammalian predators, recreation, and ORV use (commercial, recreational, residential, and the NPS' administrative activities) are all factors negatively affecting the species environment, distribution, reproduction and abundance on Fire Island. The U.S. Army Corps of Engineers (1999) speculated that most of the existing dune line on Fire Island has been affected by storm damage protection projects, and both public and private beach stabilization efforts have occurred on these ocean beaches since 1938 (U.S. Army Corps of Engineers 2009; NPS 2003 and 2008), illustrating the large degree of artificial stabilization that has occurred throughout the majority of piping plover habitat in the action area. Some beneficial actions have also occurred and include monitoring and protection programs implemented by the NPS FIIS, NYSOPRHP, and Suffolk County Department of Parks, Recreation, and Conservation.

- Vegetative reinforcement of dunes and their installation are common practices on Fire Island. Both activities can prevent the formation of optimal nesting and foraging habitats for plovers (Massachusetts Barrier Beach Task Force 1994; MacIvor 1990; Elias-Gerken 1994). Beach stabilization has also been conducted through the process of beach scraping which involves the use of heavy machinery to remove approximately the top 6-inch layer of sand over a wide section of the dry beach thereby reducing foraging habitat.

These activities ultimately have limited habitat area on Fire Island, by inhibiting the development of storm-created habitats and degrading foraging habitat that are both necessary for the recovery of the piping plovers. As a result, they have affected the abundance, distribution and reproduction of piping plovers on Fire Island.

- Piping plover predators on Fire Island include red fox, gull species, American crow, dogs, and feral cats. The stabilized beach system on Fire Island has limited piping plovers to narrower beaches, making them more likely to escape detection by red fox (NPS 2012). Plovers that nest on human-made dunes may also be more susceptible to detection by red fox. Black-backed gulls (*Larus marinus*), herring gulls (*Larus argentatus*), crows, and other avian predators have also been identified in these areas. Ghost crabs (*Ocypode quadrata),* also pose a risk to plover chicks; the FIIS Resource Management Staff observed adult plovers defending their young from ghost crabs in 2007 (National Park Service 2007).

- There are numerous potential sources of disturbance to plovers that may utilize the FIIS including, but not limited to, ORVs, aircraft, recreational fishing, kite-flying, bird-watching, surfing, dog-walking, fireworks events, and vehicle patrols undertaken by law enforcement agencies that operate within the FIIS. Additionally, the litter and food scraps left behind by recreational beach activities have the effect of attracting predators such as red fox and gull species to plover habitat.

- The vast majority of the 30 miles of beaches on Fire Island have been heavily impacted by habitat loss due to development, as well as, beach stabilization and recreational activities for decades, leading to the precarious conservation status of the species within the action area.

<u>Discussion</u>

A. Description of the Action Area

The environmental baseline includes the past and present impacts of all Federal, State, or private activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early consultation, and the impact of State or private actions that are occurring in the action area. As defined in 50 CFR §402.02, “action” means all activities or programs of any kind authorized, funded, or carried out, in whole, or in part, by Federal agencies in the United States or upon the high seas. The “action area” is defined as all areas to be affected directly, or indirectly, by the Federal action, and not merely the immediate areas involved in the action.

The action area encompasses Fire Island, including ocean beaches, intertidal areas, interdunal areas, and bay side habitats. The action area includes dredged material placement sites and adjacent areas where dredged material deposition is not proposed. These additional areas are included in the action area because of the potential for indirect effects (those effects that are caused by or will result from the proposed action and are later in time, but are still reasonably certain to occur) from littoral drift of sediments from the renourished reaches and thus, changes to the downdrift beaches in unnourished reaches.

Role of the Action Area in the Survival and Recovery of Piping Plovers

The action area is situated in the New York-New Jersey recovery unit where artificial coastal stabilization is the primary continuing threat, causing direct loss and degradation of habitat and indirectly causing disturbance from beach recreation and predation. Since the species' listing, the New Jersey piping plover population has fluctuated at low numbers (1989 to 2013 range = 93 to 144 pairs; mean = 120 pairs), standing at 108 pairs in 2013 (Appendix 1). With only 20 miles of unstabilized habitat (less than 16 percent of the State's shoreline) currently supporting more than 70 percent of the New Jersey piping plover population (see above discussion), intensive efforts are required just to maintain the population, with relatively little upside growth potential. Although habitat is less limited on Long Island, where changes in piping plover abundance account for most of the recovery unit's population growth through 2007 and most of the 2007 to 2013 decrease (Appendix 2), the current Long Island shoreline management regime provides limited opportunities for formation and maintenance of preferred overwash habitats (Figure 13).

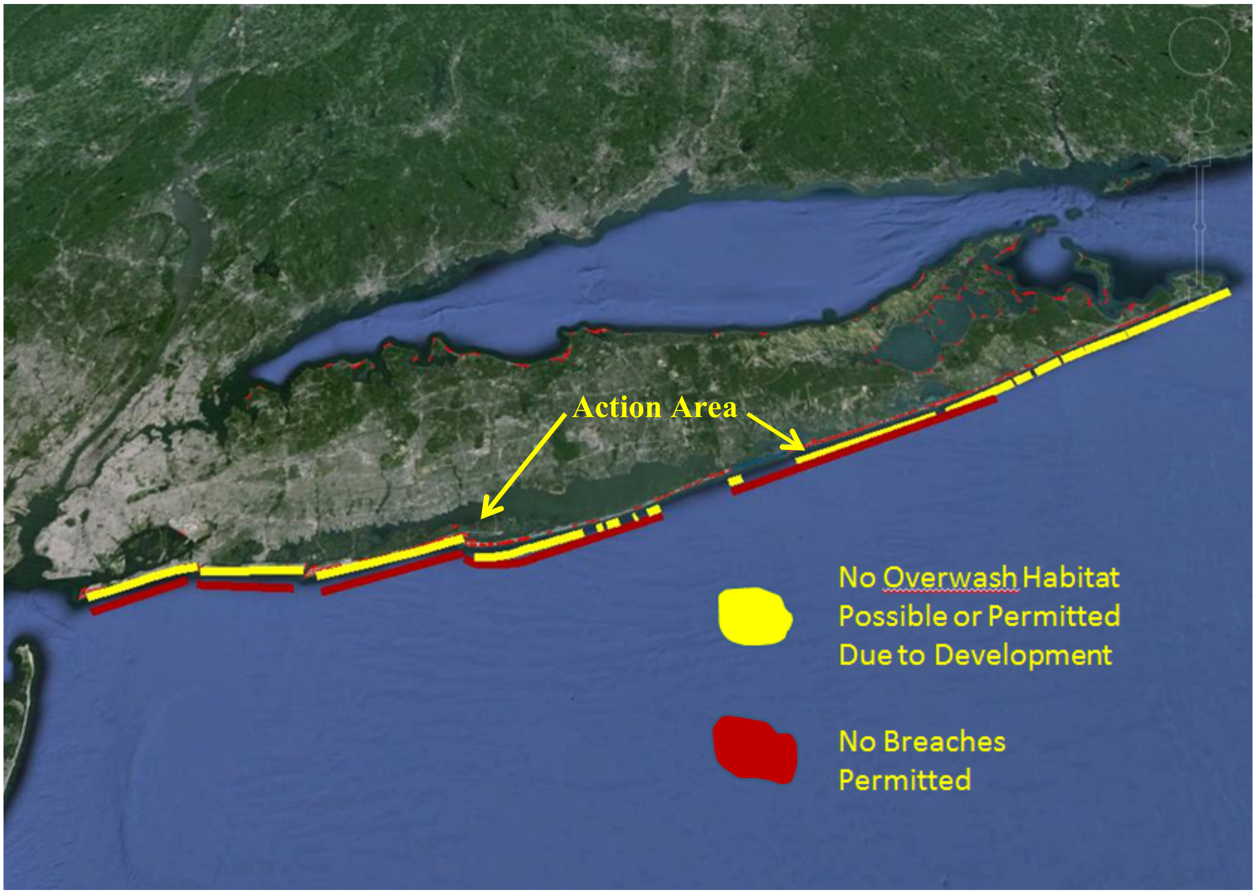


Figure 12. Long Island shoreline management regime depicting opportunities for formation and maintenance of overwash habitat.

The piping plover population in the action area (Fire Island) has supported as many as 54 pairs of piping plovers (in 2008). Although the Fire Island piping plover population declined to 27 pairs in 2013, Hurricane Sandy created approximately 162 hectares of new overwash habitat on Fire Island including at least 84 hectares of new overwash habitat located within the project area with an estimated capacity of approximately 60 pairs of piping plovers following analysis in Cohen *et al.* 2009 (Hapke *et al.* 2013). This assumes there is full bay to ocean connectivity of the newly created habitat across each of the three overwashes. However, this assumption is uncertain given recent beach management activities as discussed previously.

Furthermore, susceptibility of the project area to additional overwash during future storms (as described in the Corps' Future Without Project) creates the likelihood of more habitat formation in the action area. The action area plays a pivotal role in the recovery unit via provision of existing habitat and the potential for future habitat formation.

The environmental baseline reflects both the substantial increases in the areal extent of piping plover habitat on Fire Island due to Hurricane Sandy and the resultant losses (from just after Hurricane Sandy to when this opinion was written) of this habitat due to post-Hurricane Sandy stabilization efforts and other activities that degraded or destroyed newly formed coastal habitats. It also accounts for the impacts of previous stabilization efforts on piping plovers and their habitats, as well as a host of other activities that have been undertaken, or not undertaken as in the case of habitat restoration opportunities, which have resulted in habitat fragmentation, loss, and functional homogenization, and impacts to the species and population as a whole.

The baseline also incorporates choices by Federal and State agencies, such as the Corps and NPS, not to impair existing habitat for plovers. In particular, the breach at Old Inlet on NPS property is currently open, and NPS has decided to postpone moving forward with a consultation and proposal to fill in this breach caused by Hurricane Sandy. This decision is meant to maintain newly created habitat as beneficial habitat for piping plovers for a period longer than if the breach were closed immediately through human action. As important habitat for the Fire Island population, maintaining this area as is should augment the status of the species in this recovery unit, versus if the breach were closed. However, it is difficult to quantify the effects of this decision, it is believed to provide a net benefit to the environmental baseline for piping plovers over the life of this project.

As noted earlier in this opinion, both developed and undeveloped beaches on Fire Island experienced profound changes as a result of the storm (Hapke *et al.* 2013). The USGS undertook a rapid assessment of the areal extent and depth of overwash deposits shortly after the storm (Hapke *et al.* 2013). The greatest areal extent of overwash deposits, or 220 ac, occurred on eastern Fire Island, and were concentrated in the vicinity of Old Inlet in the Federal Wilderness Area and east of the TWA Flight 800 Memorial at Smith Point County Park (Hapke *et al.* 2013). In the central areas of Fire Island, the occurrence of overwash was relatively low (31 ac) and primarily confined to existing dune cuts that served as vehicle access points or other low spots between the dunes. In the western portion of the island, 147 ac of overwash areas were identified, with more than 52 ac formed at Fire Island Lighthouse Beach (FIIS), and 29 ac formed at Robert Moses State Park. Overwash in the FIIS community areas was limited by residential development and other infrastructure, with much of the material deposited on private property, concrete walkways, etc. During the post-storm period, much of this material was mechanically redistributed back on the beach during post-storm clean up and dune construction activities.

Three breaches also formed on Fire Island at Smith Point, Old Inlet, and eastern Fire Island Pines as a result of Hurricane Sandy. The breach at Smith Point County Park was a relatively small breach that did not appear to exhibit exchange of ocean and bay waters at low tide (Papa, personal observation), but was closed under the provisions of the BCP in December 2012. The breach at eastern Fire Island Pines did not require any action under the Corps' BCP as no exchange of bay and ocean water was observed after the storm passed and tidal levels subsided.

Land ownership in the action area is both public and private, both on the ocean beach and back dune areas and bayside. The scope of land uses on Fire Island encompasses recreational, commercial, residential activities, and administrative activities undertaken by Suffolk County, Town of Islip, Town of Brookhaven, two incorporated villages on Fire Island, and the NPS. There are a total of seventeen residential communities on Fire Island, which offers a variety of recreational activities including swimming, surfing, sun-bathing, beach-combing, clamming, nature viewing, hiking, and fishing. Thirteen communities have lifeguard-protected ocean beaches for summer recreation. The communities provide marinas for ferry dockage and slips for residents and/or transient use, restaurants, snack bars, public restrooms, souvenir shops, and overnight accommodations (National Park Service 2008b). Fire Island is home to approximately 400 year-round residents, swelling to over 20,000 summer residents.

NPS property, both minor and major tracts, exists between the FIIS Communities. Minor tracts are located between Kismet and Saltaire, and Atlantique and Corneille Estates. Major tract that provide recreational opportunities and natural habitats include Fire Island Lighthouse Beach, Sailor's Haven/Sunken Forest, Carrington tract, Talisman/ Barrett Beach, Blue Point Beach, and Watch Hill. Smaller and larger communities are interspersed with the major tracts.

The recreational facilities at Smith Point County Park and Robert Moses State Park, which are readily accessible by automobiles from the mainland of Long Island, are heavily-used, providing fishing, ORV access, boating, hunting, and swimming activities.

Smith Point County Park is the third public recreation area within the boundaries of the FIIS, although it is managed by the Suffolk County Parks Department. Smith Point County Park is a 6-mile stretch, featuring public parking and beach access, a visitor center with restrooms and snack bar, the TWA Flight 800 Memorial, and camping facilities (National Park Service 2008b).

Fire Island can be accessed from the east via the William Floyd Parkway and Smith Point Bridge, and from the west via the Robert Moses State Park Causeway Bridge. From May to October, privately-owned ferries service the FIIS communities and the Town of Islip and Town of Brookhaven beaches. The FIIS has about 4,000 buildings and residences (U.S. Army Corps of Engineers 1999) and lacks a complete set of interconnecting paved roads. An inland route composed of concrete sidewalks, wooden walkways, or sand routes, provides ORV access to the central parts of most communities; however, the ocean beach provides the primary means of travel to and from the communities especially for service vehicles (e.g., garbage-hauling vehicles).

B. Status of the Species within the Action Area

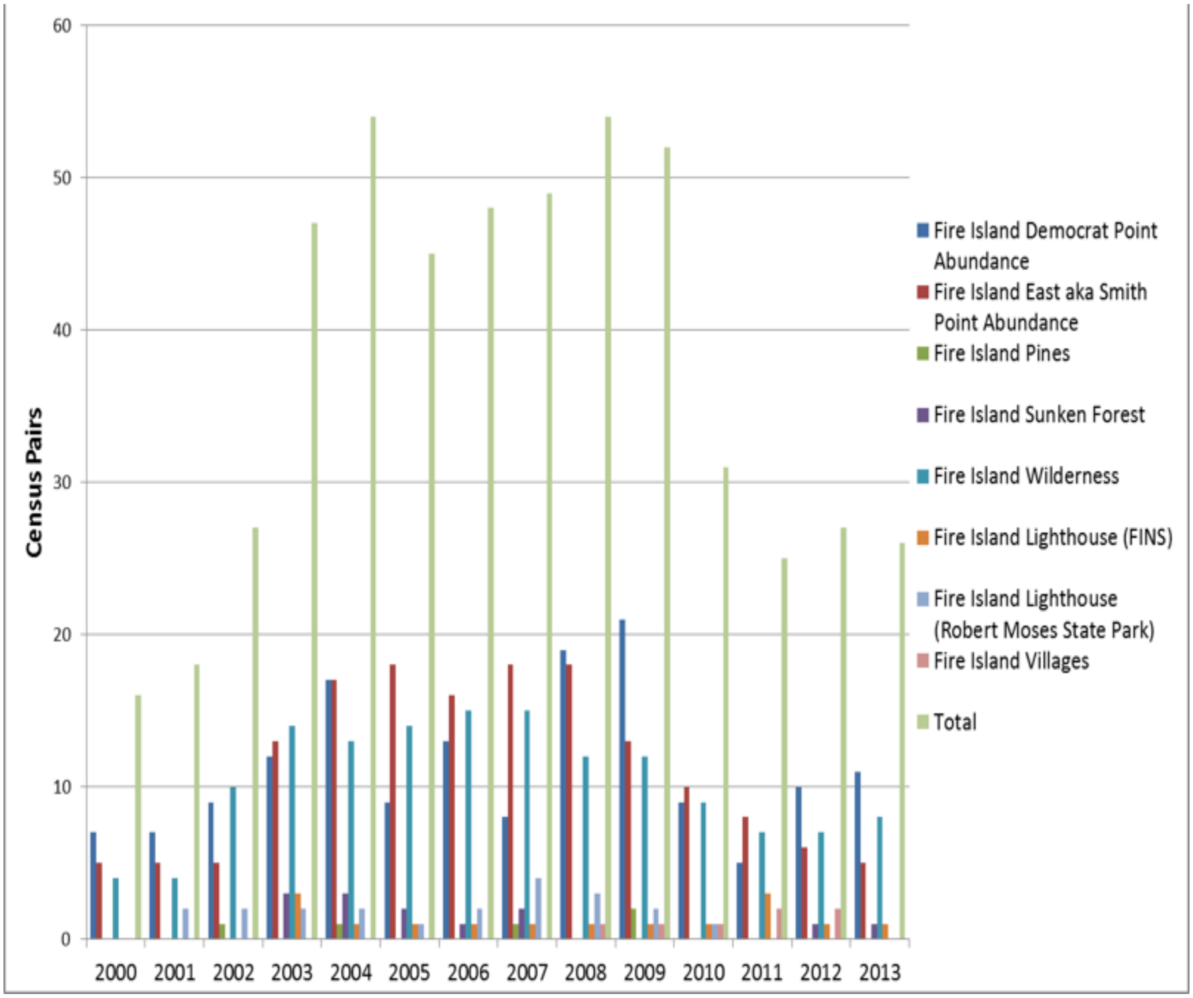
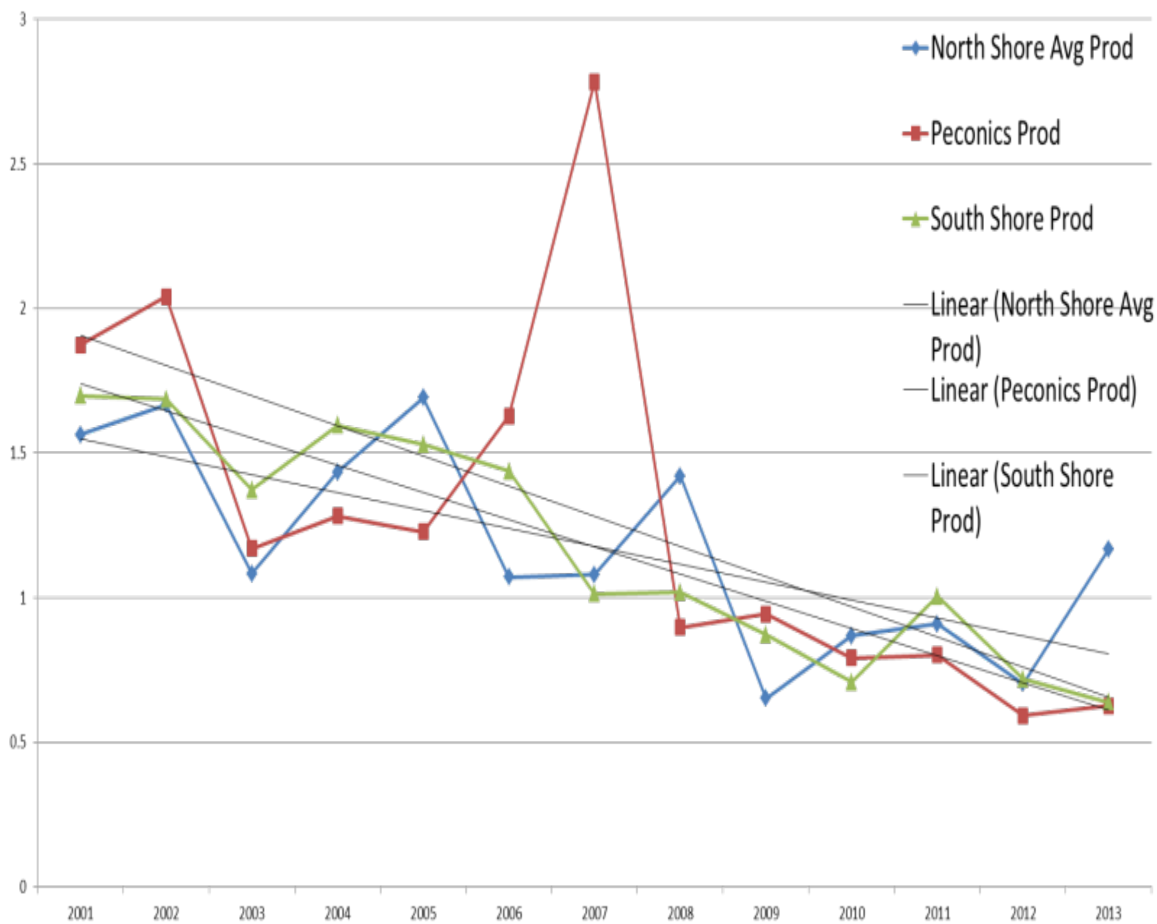


Figure 13: 2000-2013 Fire Island Window Census Pairs by Site

The plover population within the action area has increased and declined within the past 14 years (Figure 13). The total number of breeding pairs declined by 50 percent from 2009 to 2013. Further, productivity for piping plovers on Fire Island and the surrounding Long Island area has been declining for the past 14 years, probably due to a combination of reasons, e.g., increased predation, development, human use, predation and vegetation encroachment. Productivity (chicks fledged per pair) below 1.0 is considered below a replacement rate. The 1996 Recovery Plan calls for a productivity level of 1.5 to create an increasing population and achieve recovery. 2013 productivity levels for Fire Island were closer to 0.7, well below replacement. Preliminary information from 2014 indicates an increased rate of productivity, however, these data are not currently finalized.

Figure 14. Declines in productivity (chicks fledged per pair) on Long Island



Piping plover breeding activity has been documented at Fire Island Pines (2004, 2009, 2010), Cherry Grove (2002/2003), Point O'Woods (2008, 2010, 2011, 2012), Fire Island Summer Club (2010), Robbins Rest (2011, 2013), and Water Island (1997, 1999, 2008, 2012).

Most of this stretch of beach directly in front of the communities is not considered suitable nesting habitat due to high-density residential development and intensive ORV use permitted by the NPS and the Towns of Islip and Brookhaven.

C. Factors Affecting Species Environment Within the Action Area

Habitat limitation, loss, fragmentation, beach stabilization, avian and mammalian predators, recreation, and ORV use (commercial, recreational, residential, and the NPS' administrative activities) are all factors negatively affecting the species environment, distribution, reproduction and abundance on Fire Island. Beneficial actions include monitoring and protection programs implemented by the NPS FIIS, NYSOPRHP, and Suffolk County Department of Parks, Recreation, and Conservation. Suitable habitats are delineated each year and protected with symbolic fencing and monitored by staff. Vehicle closures are implemented around breeding areas when flightless chicks are present. Within each respective park, suitable habitats are mostly found where human activities are relatively less intense. However, in some areas like Robert Moses State Park and Smith Point County Park, not all suitable habitats are protected for the use by plovers.

1. Habitat loss and modification

Public and private beach stabilization efforts have occurred on the ocean beaches in the action area between 1938 and 2013 (U.S. Army Corps of Engineers 2009; NPS 2003 and 2008). Various techniques have been used including beach nourishment, geotube installation, sand fences, beach scraping, and sand bags. The U.S. Army Corps of Engineers (1999) speculated that most of the existing dune line on Fire Island has been affected by storm damage protection projects, illustrating the large degree of artificial stabilization that has affected piping plover habitat. A description of these activities is described in previous section and in Appendix 5.

Vegetative reinforcement of dunes and the installation are common practices on Fire Island. Both activities can prevent the formation of optimal nesting and foraging habitats for plovers (Massachusetts Barrier Beach Task Force 1994; MacIvor 1990; Elias-Gerken 1994). Dune building activities may prevent plovers from accessing preferred foraging and brood rearing habitats, including interdunal swales, wet meadows, and ephemeral pools (MacIvor 1990; Elias-Gerken 1994). These habitats may also serve as important feeding areas for other migratory and resident shorebirds (Massachusetts Barrier Beach Task Force 1994). Planting of beachgrass and erection of sand fencing were conducted throughout the 1990s in association with individual community nourishment and beach scraping projects, as well as the 2003 and 2008 FIIS community beach nourishment projects. The use of sand fences and Christmas trees to capture drifting sand and/or to build dunes may produce steepened dune faces, or by themselves, created physical barriers to plover movement (Strauss 1990).

Beach stabilization has also been conducted through the process of beach scraping, involving the use of heavy machinery to remove approximately the top 6-in layer of sand over a wide section of the dry beach. The material is then deposited to augment or reconstruct artificial dunes. Beach scraping activities have been permitted in 15 of the 17 communities on Fire Island (Land Use Ecological Services, Inc., and Coastal Planning and Engineering 2002; National Park Service 2008b).

2. Predation

Piping plover predators on Fire Island include red fox, gull species, American crow, feral cats, dogs, and possibly ghost crabs (*Ocypode quadrata*). Red fox is a major predator of piping plover, their nests, and chicks on Fire Island (NPS 2010, 2011, and 2012; Virginia Tech 2013). The existing population of red fox on Fire Island is unknown; however, their presence has been documented at virtually every breeding site on Fire Island. In some areas such as Robert Moses State Park, red fox have been attracted to specific areas of the park due to feeding by humans.

The stabilized beach system on Fire Island has limited piping plover to narrower beaches, making them less likely to escape detection by red fox. Plovers that nest on human-made dunes may also be more susceptible to detection by red fox (NPS 2012; NPS Assateague Island).

In addition to mammalian predators, black-backed gulls (*Larus marinus*), herring gulls (*Larus argentatus*), crows, and other avian predators have been identified in these areas. Ghost crabs also pose a risk to plover chicks and the FIIS Resource Management Staff observed adult plovers defending their young from ghost crabs in 2007 (NPS 2007). The Service is not aware of any comprehensive predator control or trapping programs being implemented by the NYSOPRHP, Suffolk County, or FIIS.

Suffolk County Parks provided an analysis of the productivity and the primary causes of nest/chick loss on Smith Point County Parks (N. Gibbons, email, September 24, 2014). Note the most common cause of piping plover chick mortality is fox predation. It should be noted that these data come from unpublished reports and the data do not explicitly state how each nest failed.

Smith Point Productivity (N. Gibbons, Suffolk County Parks, September 24, 2014)

Year	Pairs	Nests	Eggs	Chicks	Fledges	Prod.	Causes of Nest/Chick Loss
2014	8	9	36	16	12	1.5	fox
2013	5	9	30	9	3	0.6	fox, flooding
2012	7	8	36	8	1	0.14	fox, washouts
2011	8	12	45	19 +	4	0.50	fox, flooding
2010	10	15	54	41	7	0.70	fox, flooding
2009	15	18	68	40	14	0.93	fox, avian, flooding
2008	18	20	66	45	24	1.33	cat, fox, gull, flooding
2007	18	28	93	49	23	1.28	avian, cat, fox
2006	16	22	81	48	24	1.50	fox, flooding
2005	18	18	73	55	18	1.00	fox, cat
2004	17	17	64	52	32	1.88	fox, ORV
2003	13	14	51	44	29	2.23	fox, gull, heavy rain, ORV
2002	5	5	17	13	5	1.00	fox, ORV
2001	6	6	21	11	9	1.50	fox
2000	7	7	27	8	3	0.43	fox

3. Habitat Destruction, and Species Disturbance from Recreational Activities, ORVs, and Law Enforcement Vehicles

There are numerous potential sources of disturbance to plovers that may utilize the FIIS including, but not limited to, ORVs, aircraft, recreational fishing, kite-flying, bird-watching, surfing, dog-walking, fireworks events, and vehicle patrols undertaken by law enforcement agencies that operate within the FIIS.

The NYSOPRHP prohibits ORV use from Field 5 to Field 2 in Robert Moses State Park, but allows ORV use west of Field 2 through Democrat Point. Provisions are in place to prohibit ORV use on Democrat Point once chicks hatch. Like many areas on Long Island, breeding habitat on Democrat Point is limited due to establishment of recreational ORV areas. However, in 2010 two chicks were found dead in tire tracks on the ocean beach west of the Field 2 breeding area. It was determined that these chicks had moved to the west of their nest site. The adults were likely leading them to foraging areas at Democrat Point. ORV tire tracks can cause deep ruts which are impassable to chicks (Figure 15), causing them to become entrapped.

The NPS regulates ORV access within the FIIS. In 2013 the NPS issued 145 driving permits to year-round residents, 66 permits to part-time residents, 80 permits to contractors, 30 permits to businesses operating a total of 56 vehicles, 3 fleet permits to utilities (phone, water, electric) allowing 68 vehicles, 17 permits for municipal employees, and 16 discretionary permits. The NPS indicated that not all permit holders drive on the beach, and they do not maintain records of vehicles passes on the beach. Anders and Leatherman (1987) reported that on the western end of Fire Island alone, 44,175 trips per year, with an average trip distance of 3.1 miles, were recorded. This use can reduce the quality of available foraging habitat and compact and reduce any existing foraging base. These activities may also result in mortality of adults, nests, and chicks. In most areas of the FIIS, ORV use is seasonally heavy. As mentioned above, there is a history of plover mortality on the FIIS due to ORV use. In addition to the chick mortality noted above, two piping plover chicks were found crushed in tire tracks at Watch Hill and Sailor's Haven in 1991 and 1992 (Melvin *et al.* 1994).

In some areas of Fire Island, ORVs appear to be truncating the open vegetation field widths, making the beaches less attractive for plover nesting and brood-rearing. Since 2004 when monitoring in the FIIS communities was implemented as a part of the 2003 FIIS Short-term Surge Protection Project, local law enforcement and contractors were reported to have driven through protected piping plover breeding habitat in front of the communities. It was reported that breaches of the symbolic fencing became more frequent when high tides inundated most of the berm as these drivers sought areas closer to the dune to drive on (Land Use Ecological Services, Inc. 2005, 2006, 2007; Risotto, *pers. comm.*, 2008).

Figure 15. Tire tracks on Fire Island National Seashore. Photo: USFWS.

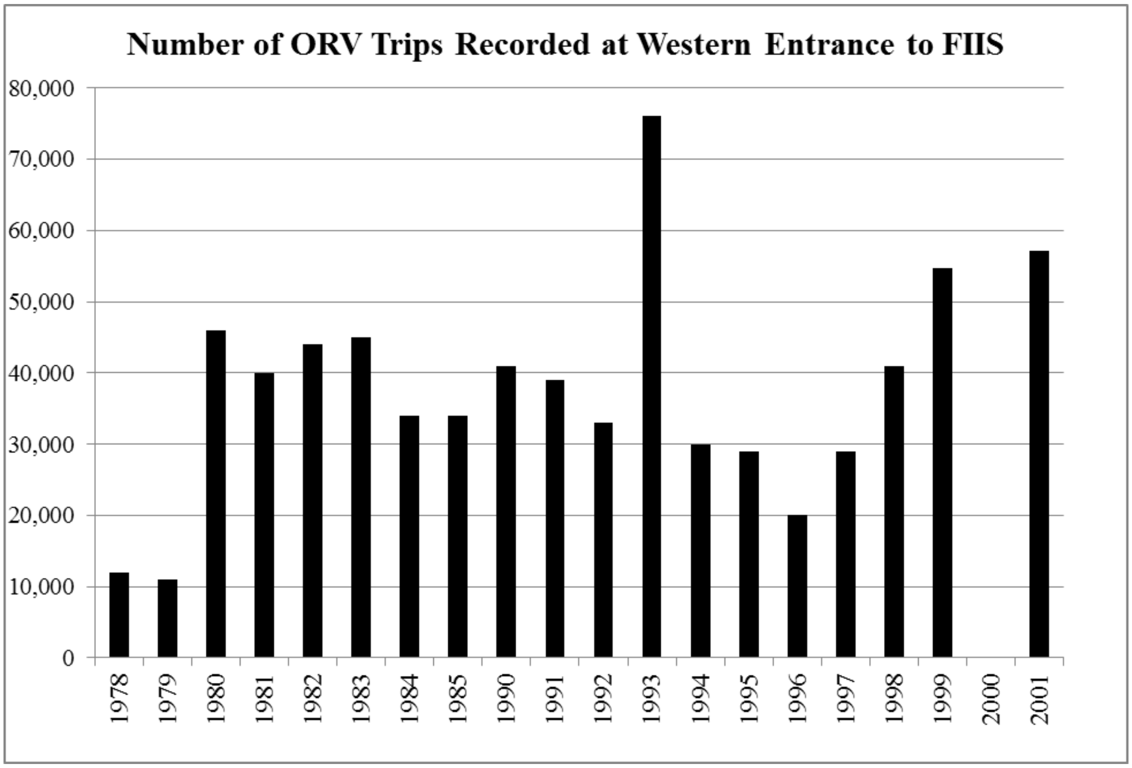


Figure 16. Number of ORV trips recorded by the NPS at the Western Entrance Road near Fire Island Lighthouse from 1978 to 2001. Data compiled from Anders and Leatherman (1987) and NPS (2001).

Beach recreation also results in pollution. Figure 17 is a photo taken during the piping plover breeding season in 2013 at Smith Point County Park and shows garbage placed along the fence line. Garbage can attract piping plover predators such as red fox and gull species. This area to the left of the fencing in the photo is the area designated as protected plover habitat by the Suffolk County Department of Parks, Recreation, and Conservation.

Figure 17. Photo showing accumulation of garbage along fence delineating recreation use areas and plover habitat at Smith Point COunty Park in 2013. Photo: A. Derose-Wilson.

Figure 18. Photo showing ORV parking areas and travel corridors as well as beach recreation on ocean beaches adjacent to plover breeding areas in 2013. Photo: A. Derose-Wilson.

4. Conclusion

It is unclear why the population on Fire Island has declined so rapidly since 2007, when its numbers were 586 (above the 575-pair recovery target for the NY-NJ Recovery Unit), to 397 pairs in 2013. This decline can be correlated to the productivity level decline witnessed since 2001 (Figure 15). It can be noted that when the productivity levels start dropping below 1.2 or 1.3 chicks per pair (a replacement level), then the population starts declining. Hence, understanding why the productivity level has been declining is a central research question, to which presently no clear answer exists. For a species dependent on such a dynamic coastal ecosystem and one that experiences a range of threats (e.g., habitat loss, predation, human disturbance) it is most likely not a single factor that has caused the decline in productivity. Some beach management practices (such as those described in the section, "Historic Post-Storm Responses to Breach and Overwash Formation") can be associated as contemporaneous to the decline, yet there were also similar management practices before and during the period of the population increase. Undoubtedly, beach management practices such as those described here and in the 1996 Piping Plover Recovery Plan can be a threat to piping plovers, yet the present data are insufficient to show that the recent declines in the NY to NJ Recovery Unit are caused by a single factor.

IV. EFFECTS OF THE ACTION

In evaluating the effects of the Federal action under consideration in this consultation, 50 CFR 402.2 and 402.13(g)(3) require the Service to evaluate both the "direct and indirect effects of an action on the species, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline." Indirect effects are those that are caused by the proposed action and are later in time, but are still reasonably certain to occur.

The *Status of the Species/Environmental Baseline* section of the opinion described the factors that affect piping plover population dynamics and distribution including beach nourishment, breach closures, shoreline development, shoreline stabilization, beach raking, oil spills and other environmental contaminants, avian and mammalian predator species, recreational impacts, ORV use, climate change, and habitat suitability.

The Service's primary task in developing a biological opinion is to determine whether the proposed action is likely to jeopardize the continued existence of any listed species. "Jeopardize the continued existence of" is defined as, "to engage in an action that would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (58 Federal Register 19958). The jeopardy/non-jeopardy determination is based on an evaluation of: (1) a species' status in the project area and range-wide; (2) the effects of the proposed action on the survival and recovery of a listed species (including interdependent and interrelated actions); (3) the aggregate effect of other Federal actions on a listed species; and, (4) the cumulative effects on a listed species (i.e., future non-Federal actions that are reasonably certain to occur in the action area).

The Service's analysis complements the analysis presented in the BA, which concluded that the impacts of the proposed project would not result in any long-term residual effects to plovers, and the proposed conservation measures would offset any potential negative effects of the project (U.S. Army Corps of Engineers 2014a). The BA did not address the indirect effects of the proposed action on the New York-New Jersey recovery unit or the coast-wide population.

All current sub-populations of breeding plovers and occupied habitat on Fire Island, totaling about 26 pairs, would be impacted by the proposed project. Because of the small number of breeding sites on Fire Island, the fragmented distribution, and vulnerability of small populations to stochastic processes (oil spills, storms, disease, etc.), the Service is concerned about the degradation or loss of breeding sites.

<u>Summary</u>

- The FIMI is one of the largest civil works projects proposed by the Corps in over 50 years for the south shore of Long Island, second only to the Corps 83-mile FIMP. As proposed, it would directly impact 19 mi., and indirectly impact an additional 11 mi., of habitat, over a period of ten years. A combination of dune and beach construction, or beach construction, is proposed for 4.4 mi. of beach habitat within Robert Moses State Park, 8.6 mi. of beach habitat within the Fire Island National Seashore, and 5.2 mi. of beach habitat in Smith Point County Park. The proposed project would directly and indirectly impact occupied piping plover breeding habitat across all of Fire Island.

- The Service has determined that the proposed project would likely result in adverse effects to the species through the destruction and modification of foraging, nesting, and brood-rearing habitats.

- Adverse effects of the proposed project include interruption and prevention of formation and maintenance of optimal habitats including wide, sparsely vegetated moist open sandy habitats, longer term reduction in prey resources (discussed in Section 3, below), increased recreational activities, the creation of habitat conditions that may facilitate increased mortality due to predators, and allowance for ORV access through breeding areas (discussed in Section 4, below).

- The purpose of the proposed project is to substantially reduce or preclude the formation of overwash/breach habitats for at least ten years. Specifically, the constructed beach (or berm) would provide storm damage protection for five years and then erode over the next five years to a point where it would not provide protection to the artificially created dune (U.S. Army Corps of Engineers 2014a). The Corps has not indicated how long it would take for the dune to erode. The Service anticipates that the dune would take at least another five years, or possibly longer, to erode. This estimate is based on the width (80 ft) and height of the dune (max height 13 ft).

- Dune vegetation planting and snow fences are proposed in the design reaches located within the FIIS Communities. These practices are intended to artificially accelerate growth of dense vegetation and dune growth in order to further stabilize the barrier island (Bocomazo *et al.* 2011). Sand fencing can affect dune topography and promote the formation of steep, uniform dunes. As a human-made structure it may also affect the movement of mesopredators (such as raccoons, red fox and feral cats), provide denning habitat for fox, and serve as perch sites for avian predators.

- The proposed project would likely facilitate and increase recreational activities on the ocean beaches with occupied piping plover breeding areas. Recreational activities that may potentially, adversely affect piping plovers include unleashed pets, fireworks, kite-flying, and increase in garbage and refuse concomitant with increased recreational activities. Unleashed pets, such as dogs and cats, can prey on piping plovers. For example, at least two nests were lost to predation by unleashed dogs in the Corps'

Westhampton Interim Storm Damage Protection Project Area, Suffolk County, NY, as reported in Houghton (2005), but this loss only accounted for 0.3 percent of the total number of nests reported in that study. Kite-flying may disturb piping plovers as it is believed that the piping plovers perceive kites as avian predators.

Effects Due to Construction Activities

The project description indicates that construction activities will not occur during the piping plover season (April 1 to September 1) in Smith Point County Park, Fire Island Lighthouse Beach and Robert Moses State Park. Within the FIIS Communities, the Corps proposes to maintain a 1,000 m buffer between piping plover breeding areas and construction activities. Note, some previous Corps activities, such as in Westhampton, were constructed with a 200 m buffer with no take associated with construction activities (P. Weppler, pers. comm. 5/20/14). The Corps also proposes to undertake activities such as surveying, etc. within 1,000 m, but with a monitor present.

The Service is concerned when major construction activities are undertaken during the piping plover nesting season due to the potential for significant disturbance and potential for mortality of plover eggs and chicks. Instances of worker and equipment incursions into breeding areas were reported during construction of the Westhampton Interim Storm Damage Protection Project, and continue to provide challenges in planning large-scale beach construction projects.

Potential direct effects of the Corps' construction and dredging activities upon piping plovers during initial construction include the following:

1) If construction starts prior to the arrival of piping plovers, dredging and construction operations in plover nesting habitat will prevent plovers from using the habitat which is currently under construction upon their arrival, forcing them to seek appropriate habitat elsewhere.

2) Dredging and construction operations that encroach to within 1000 m of established plover courtship, nesting and brood rearing areas that were undisturbed during the beginning of the breeding season have the potential to disturb both adults and chicks that use this habitat. Impacts may include territory abandonment, disruption of pair bonds, nest abandonment, elevated predation of eggs and chicks due to adults being less attentive, and increased chick mortality due to reduced foraging opportunities. These effects will adversely affect piping plover productivity.

3) Dredging and construction operations, especially the movement of equipment and vehicles on the beach (e.g. dredge pipeline, beach grading), can greatly endanger nests and chicks. Nourishment activities occurring within 1000 m of chick rearing areas will create the possibility that chicks and eggs will be accidentally crushed. Data from

Patterson (1988), Cross (1990), Coutu *et al.* (1990), Strauss (1990), and Loegering (1992) show that plover chicks may move up to 1000 m from their nest sites, commonly traveling more than 200 meters in the first week post hatching. In addition, if dredge pipeline is placed in a manner that prevents plover chicks from gaining access to foraging habitats, including ocean intertidal areas and wrack, bayside intertidal areas and wrack, and open vegetation areas, foraging opportunities during critical periods will be reduced and chick mortality may increase.

To the extent that the Corps adheres to the 1,000 m buffer in the FIIS Communities, the Service believes that the potential for impacts will be minimized, but will not be eliminated.

Fragmentation and Degradation of Preferred Breeding Habitats (Nesting and Foraging)

Preferred plover habitats that came into existence as a result of Superstorm Sandy at Smith Point County Park, Robbins Rest, Fire Island Lighthouse Beach and Robert Moses State Park, would be degraded and fragmented by the proposed project. At Smith Point County Park about 121 acres (48 ha) of newly-created habitat would be fragmented by the dune and vegetation, along with the further re-establishment of Burma Road (discussed in more detail in the *Cumulative Effects* section). Of this, 38 ha of ocean-to-bay habitats, and 11 ha of partial overwash ocean-side habitat, will be affected. A breakdown of the area of preferred habitats for the other sites is as follows: Robbins Rest: 12.4 ac; Fire Island Lighthouse Beach: 60.3 ac; Robert Moses State Park: 20.6 ac. In addition to fragmenting these habitats, the artificially constructed berm would widen and elevate the berm, thereby impacting the natural topography of the ocean and bay-side beaches.

The effect of the proposed project is to prevent the formation of natural barrier island habitats, such as blowouts, overwash fans, and large expanses of wide, low slope beaches with variable dune heights and vegetation patterns, as well as bay to ocean habitat connectivity. If allowed to form naturally, the Service would expect breeding areas to be characterized by fairly flat, low lying beaches and increased areas of moist open sandy habitats either on the bayside or from the bay to ocean. The dune and beach fill would raise both the

Figure 19. Natural breach habitat at Smith Point County Park.

berm and dune elevation of the barrier island, further decreasing habitat heterogeneity.

Recent examples of the types of new habitats that would be prevented from forming were the two breaches at Smith Point and Cupsogue County Parks. The breach at Smith Point County Park (Figure 19, above) was 500 ft wide at high tide (U.S. Army Corps of Engineers 2014b) and provided an example of preferred piping plover habitat before it was closed by the Corps at the request of NYSDEC under the BCP. The habitat was further degraded by Suffolk County via the installation of sand fencing and discarded trees (discussed eariler in the *Environmenal Baseline* section).

<u>Effects to habitat carrying capacity</u>

Based on long-term observation of plover densities on Westhampton beaches reported in Cohen *et al.* (2009), it is expected that bay to ocean overwash habitats with no impairment to connectivity would ultimately be able to support plover nesting densities of up to 1.05 pair per hectare (ha), whereas ocean side habitats without access to these habitats would likely support 0.73 pr/ha) (Cohen *et al.* 2009). Both of these estimates express the maximum expected carrying capacity of the area, acknowledging that in these dynamic beach systems, the natural processes cause piping plover habitat to degrade over time as vegetation grows and sand migrates. At Democrat Point and the West Hampton Dunes (WHD) breeding sites, plover densities were shown to be higher in proximity to moist open sandy habitats where ocean-to-bay habitat connectivity was present (Cohen 2005).

These estimates are derived from Figure 9 of Cohen *et al.* (2009, page 11) (Figure 20). In the two graphs of Figure 9, WHD is ocean-to-bay habitat and REF (reference) is ocean-sided habitat only. Both areas experienced a storm in 1993, which created habitat, yet only WHD experienced vegetation growth and human development, that the authors conclude negatively affected habitat – "Human activities first augmented effects of the storm by increasing both nesting and foraging habitat area at WHD via breach repair and beach nourishment. Nesting habitat was then diminished by home construction and beach revegetation" (page 17).

Management actions were undertaken in certain years in both WHD and REF to reduce threats from human disturbance and predators. These activities were implemented differently (i.e., to different extents and in different years) between the two areas, confounding comparisons between the sites. (see Cohen *et al.* 2009 page 6) For example, 73 percent of piping plover territorial pairs and nests were symbolicly fenced (using string) in WHD from 1993 to 2004, while 54 percent of nests were fenced in REF. Predator exclosures were placed around 9 percent of nests at WHD during 1993 to 1998 and 2003 to 2004. Predator exclosures were placed around 24 percent of nests in REF from 1993 to 1994 and 1996 to 2004. Mammalian trapping was conducted in WHD from 1996-2001, and feral cat trapping was conducted in REF in 2002 and 2004.

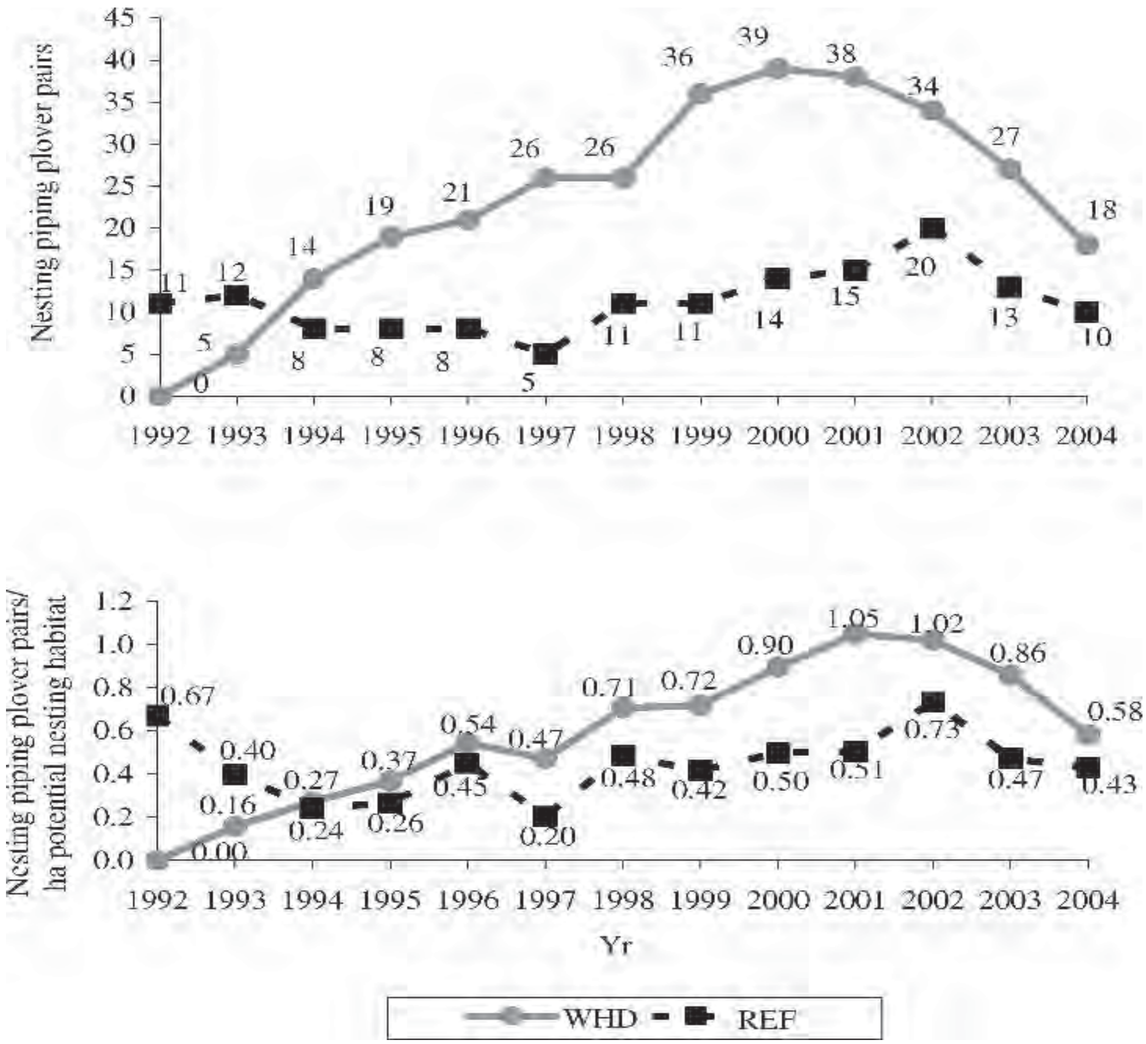


Figure 20. Piping plover nesting-pair numbers and density at West Hampton Dunes (WHD) and the reference area (REF), New York, USA, 1992–2004. Numbers adjacent to the points are the values represented by the points.

Even with the differences of management between sites, Cohen et al. 2009 represents the best available information we have on the hectares needed to support a nesting pair of piping plovers. These management differences, however, do raise concerns over placing too high a value on the precise numbers shown in Cohen *et al.'s* Figure 9. For example, is the high value achieved in 2001 in WHD attributed, at least in part, to the previous 5 years of mammalian trapping in that area? The years 1996-2001 represent many of the highest years of recorded nest survival in WHD during the study period, and the article states, "there was some evidence that removing cats and foxes increased nest survival" (page 13) and, "The proportion of unfenced nests lost to mammalian predators decreased after mammal trapping was initiated in 1996 and increased back to pretrapping levels after mammal trapping was reduced in 2001" (page 14). Given that chicks often come back to the same areas in subsequent years to nest, it is not surprising to see an increase in nesting piping plover density commensurate with the increased nest survival due, in part, to mammal trapping. As there is no comparable mammal trapping (in duration), it is difficult to fully answer this question. Such differences between the studies indicates a level of caution is warranted in affixing too high a level of certainty in the precision of the nesting pair density numbers and the comparisons between sites.

Cohen *et al.* 2009 defines nesting density as "nesting pairs/ha of potential nesting habitat" (pg. 7). The determination of "potential nesting habitat" in Cohen *et al.* 2009 was done through review of aerial photography and on-site investigation to measure elements such as upland nesting habitat (i.e., "supra-tidal open or sparsely vegetated sand >5m from development" (pg. 4)), ocean to bay connectivity, and "mean width of the ocean intertidal zone measured on ground transects at daily low tide" (pg. 6). In defining their field methods (pages 4-6), it is clear there was some assessment of the availability of nesting and foraging opportunities and the connection thereof. For example, they state that in WHD, "we considered the artificial dune to be the boundary between the ocean and bay backshores" (pg. 4). Meaning, the potential nesting habitats were split into a bay-side and an ocean-side where an artificial barrier, in this case a dune, was present, and each side was considered 0.5 pr/ha habitat. Connectivity, then, is an important element for "potential nesting habitat" and can be impaired by an artificial barrier.

It is clear that full ocean-to-bay connectivity has been impaired in the Pattersquash and New Made Island overwash areas created by Hurricane Sandy (see *Status and Trends Long Island*). Sandfencing were placed in the three overwash areas (Pattersquash, Narrow Bay, and New Made Island) and Christmas trees were placed in Narrow Bay in 2013 by Suffolk County in response to Hurricane Sandy (N. Gibbons pers comm. September 24, 2014). Much of the sandfencing was subsequently removed in Narrow Bay per the BCP. Google Earth images from June 19, 2014 show continued sandfencing in Pattersquash and New Made Island overwashes. Sandfencing, and the subsequent vegetation growth and elevational changes (e.g., scarping or accretion), have been show to impair piping plover habitat.[6] Ultimately, at Pattersquash and Narrow Bay areas, there may be a limited time when plovers may be able to traverse the dune to reach ocean and bayside foraging areas, before dense vegetation develops and erosional forces reduce the width of the beach and create dune escarpments. Both dense vegetation on the artificial dunes and dune escarpments, along with Burma Road, would create physical barriers to chick movement between bay and ocean side habitats. Factoring the erosion rates and expected loss of the ocean beach over five years, the carrying capacity of the ocean beaches in these areas would reduce over time as the ocean beaches erode. In the normal course of events, inlets would be cut through the barrier island during storms, migrate over time to the west, and eventually close by natural processes (Taney, 1961 in U.S. Army Corps of Engineers 2014b). Under natural conditions, the barrier island would experience overwashing and breaching which could widen the island and provide a range of high quality nesting and foraging habitats, and bay to ocean habitat connectivity.

6 See "*Effects of Sand Fences and Planting of Vegetation on Piping Plover Breeding Habitat and Recommendations to Avoid or Minimize Habitat Degradation*" (USFWS, V1-26 August 2013).

Interestingly, preliminary information provided by J. Fraser (email, October 2, 2014) shows use of ocean and bay sides by piping plovers nesting in Pattersquash and New Made Island. These preliminary data also show bay-side-only use by a nesting piping plover. Surprisingly, this bay-side nest did not forage on the ocean side and the Narrow Bay overwash area has the least amount of sandfencing impeding ocean-to-bay connectivity. Further, it should be noted that there was similar productivity in 2014 between the ocean-to-bay habitat and the the bay-side habitat (J. Fraser email, October 2, 2014). It should be noted again that these data are preliminary, a single year of data does not make a trend, and, as of this writing, the Service does not have access to the finalized data.

It is apparent from Cohen *et al.* 2009 that there is a gradient of habitat carrying capacity based on multiple factors, with connectivity to prey and nesting attributes being essential components. Given that the existing condition for Pattersquash and New Made Island is that some impairment to full ocean-to-bay connectivity exists due to recent human actions, it is the opinion of the Service that these habitats will not support the full nesting pair density shown in Figure 9 of Cohen *et al.* 2009 (i.e., 1.05 pr/ha). However, it seems some connectivity exists, especially given the preliminary nesting data from 2014, so considering them as single-sided habitat (the lowest value in Cohen *et al.* 2009 being 0.20 pr/ha, the highest value being 0.73 pr/ha) is also not appropriate. Hence, it is the opinion of the Service that a reasonable estimate for the maximum carrying capacity of the Pattersquash and New Made Island overwash areas is 0.75 pr/ha due to partial ocean-to-bay connectivity.

For the Narrow Bay Overwash, it is the Service's opinion that full ocean-to-bay connectivity exists given the removal of the sandfencing. So, this area is estimated to provide for a carrying capacity of 1.0 pr/ha.

For those areas deemed to be single-sided habitat (i.e., ocean-sided habitat), it is the opinion of the Service that 0.5 pr/ha is the most reasonable estimate from the data. In reviewing Cohen *et al.* 2009, 0.5 pr/ha for this type of habitat represents neither the highest or lowest values reported. For example, Cohen *et al.* 2009 indicate that single-sided habitat (in the study's case, ocean-sided habitat) was shown to support, at a maximum, 0.73 pr/ha, a lowest value of 0.20 pr/ha, and an average value of 0.44 pr/ha.

Using these metrics, the Service estimates the ability of the project area to support nearly 58 pairs of piping plovers when at full capacity (Figure 21). This estimate is without the proposed project and represents a maximum amount of nesting piping plovers that can eventually be achieved assuming productivity is sufficient to fully achieve the estimated carrying capacity.

Without Project	Est. Nesting Habitat Ha	Est. Carrying Capacity (pr/ha)	Est. Potential Pairs
Pattersquash Overwash	27	0.75	20.25
New Made Island	9.3	0.75	6.98
Narrow Bay Overwash	11.0	1.0	11.00
Robbins Rest	5.0	0.5	2.50
Fire Island Lighthouse Beach	20	0.5	10.00
RMSP Fields 2 and 3	14	0.5	7.00
Total	86.3		57.73

Figure 21.

The project itself will eliminate habitat as the berms and dunes are considered unsuitable habitat due to elevation and prey availability. The "without project" estimated nesting habitat hectares was reduced by 50 percent to reflect the reduction of available habitat (Figure 22). This reduction approximately equals the length of constructed beach fill multiplied by 90 ft. per the design specifications. This area was converted to hectares and then subtracted from total, equaling approximately 50 percent of the original habitat.

The dune also bifurcates existing habitat, causing the Pattersquash and New Made Island habitats that were estimated to support 0.75 nesting pair of piping plovers across their entire acreage, to now be estimated to support 0.5 pr/ha in the remaining areas.

With Project	Est. Nesting Habitat Ha	Ha reduction due to project	Est. Carrying Capacity (pr/ha)	Est. Potential Pairs
Pattersquash Overwash	27	13.5	0.5	6.75
New Made Island	9.3	4.65	0.5	2.33
Narrow Bay Overwash	11.0	5.5	0.5	2.75
Robbins Rest	5.0	2.5	0.5	1.25
Fire Island Lighthouse Beach	20	10	0.5	5.00
RMSP Fields 2 and 3	14	7	0.5	3.50
New Made Dredge Area Rest. Site	6	0	0.5	3.00
Great Gunn Rest. Site	33.7	0	0.5	16.85
Total	86.3	43.15		41.43

Figure 22.

The estimate of nesting pairs of piping plovers the project area can support with the proposed project is roughly 41 pairs.

The "with project" estimate includes the restoration sites of Great Gunn (33.7 ha) and New Made Dredge area (6 ha). Both of these areas are to be designed and created so as to support piping plover nesting and foraging.

As previously stated, there are past landscapes engineered for plovers from which lessons can be learned. Schupp *et al.* 2013 describes an example from the late 1990s on Assateague Island, off the coast of Maryland and Virginia. There are more recent examples from engineered sandbars created by the Corps in the Missouri River for piping plovers (Caitlin *et al.* 2011, Caitlin *et al.* 2012). These engineered sandbars had higher daily use and survival than natural sandbars, yet it is unclear how well these engineered sandbars will perform as vegetation grows and modifies the habitat. Further, in an article titled "Modeling Foraging Behavior of Piping Plovers to Evaluate Habitat Restoration Success," Maslo *et al.* (2011) found that,

> "the Lower Cape May Meadows restoration project was initially successful but did not sustain its early benefits to piping plovers. Productivity levels at Cape May exceeded the USFWS recovery goal of 1.5 chicks fledged per nesting pair for 2007 and 2008 and far exceeded the productivity levels of the 3 reference sites…Artificial tidal ponds are an effective restoration initiative to improve habitat quality of sandy beach ecosystems. Artificial tidal ponds may even be superior to naturally occurring foraging habitats if they are adaptively managed to maximize both chick protection and mobility. Moderate vegetative cover surrounding the perimeter of the artificial ponds may be critical to maximize chick foraging potential" (page 7).

All three of the sites, i.e., Assateague Island, the Missouri River, and Cape May, performed well for piping plovers for a period and then decreased in their ability to produce and support plovers. All three also experienced changes in vegetation conditions, either too much overgrowth of too much vegetation removed, during the study periods correlated with the changes in local piping plover population.

The design and management of the Great Gunn and New Made Dredge restoration sites are designed to learn from past mistakes, and to include the creation of nesting and foraging habitat, predator management, and vegetation management so as to keep sufficient cover while precluding overgrowth.

Great Gunn and New Made Dredge areas are both single-sided habitat. While it is clear that habitat on a single side (ocean or bay) can perform well (Figure 9 of Cohen *et al.* 2009 shows that a ratio of 0.73 pair/ha is possible) even in an area where vegetation and predators are not managed, it is the opinion of the Service that it is more reasonable to assume a carrying capacity of 0.5 pr/ha for Great Gunn and New Made Dredge. Both restoration sites will be designed and managed so as to create and maintain nesting and foraging habitat. Specifically, in the design of

Great Gunn two elevations have been targeted: +6 and +8 feet NAVD. The +6-foot berm will be created for piping plover foraging habitat. The area +6-foot contour will be overtopped during normal high tides to allow for water and fine sediments to accumulate creating piping plover foraging habitat. On the landward side (N) of the 6-foot berm starting 50 feet north of the 6-foot crest, a +5-foot elevation will be cut for 100 feet (N) and then tie into the 8-foot berm. Through this process, the Corps anticipates the creation of ephemeral pools throughout this area to recruit the food source the piping plovers require. The 8-foot elevation is intended to allow for nesting habitats for shorebirds. This area will be maintained and adjusted by the Suffolk County each year to ensure the features are working appropriately.

Preliminary data indicate piping plovers used areas of the New Made Dredge site for nesting and foraging in 2014 and successfully fledged young. As evidenced by this data, it is reasonable to conclude that the restored acreage, designed and managed for piping plover and that builds on existing known foraging and nesting habitat, will perform as well as other single-sided habitat.

As specified in this opinion's subsequent sections, the Corps has also committed to managing these areas for the next 10 years. The conservation measures that apply to the creation and maintenance of foraging and nesting habitat include (the Corps has also committed the funding necessary to implement these actions):

- The maintenance of vegetation at no more than 30 percent density—a management action that was not included in the Cohen *et al.* 2009 study site, which considered vegetation growth a degradation of the habitat. The Corps also committed up to $250,000 annually (up to $2.5 million over 10 years) for adaptive management of topography and vegetation, to maintain conditions that are optimal for endangered species usage.
- Monitoring to ensure these efforts are successful. These efforts include:
    - Annual physical coastal processes monitoring will be conducted at an expected annual cost of up to $250,000 per year. Physical Coastal Processes Monitoring will consist of beach surveys, and beach sediment samples. All surveys and sampling will be taken once yearly (spring), with the exact method to be determined,
    - Up to $150,000 annually for effectiveness monitoring,
    - Adaptive management requiring engagement with the Service to discuss remedies if the monitoring shows the restored sites are not performing as predicted.

Given these specific management and design commitments, and the effectiveness monitoring component to assess how well the design/management is working, the Service believes 0.5 pr/ha is a reasonable estimate for the Great Gunn and New Made Dredge site restoration areas.

Using "without" and "with" project estimates of nesting pair carrying capacity (57.75 and 41.43, respectively), it is estimated there will be approximately a loss of 16 pair's worth of nesting pair carrying capacity due to the proposed project.

Effects of Sand Placement

The Service believes the potential nesting habitat for piping plovers at Smith Point County Park, Robbins Rest, Fire Island Lighthouse Beach and Robert Moses State Park will be directly affected by sand placement.

Introductions of large volumes of sand via beach nourishment may influence the downcoast beach morphology (e.g., Kratzmann and Hapke 2012) and inlet morphology and hydrodynamics (U.S. Army Corps of Engineers 2014b). The natural morphology at Old Inlet would likely be impacted, as breaches that remain open and become new inlets have the potential to trap longshore sediment transport into ebb and flood shoals during the period that the breach remains open (U.S. Army Corps of Engineers 1999a in U.S. army Corps of Engineers 2014b). As maintained inlets also generally trap sand but at greater levels (U.S. Army Corps of Engineers 2014b), it seems reasonable to expect that there would be increased maintenance dredging operations of the Fire Island Inlet Navigation Project as large volumes of dredged material will enter the littoral drift and carried westward (U.S. Army Corps of Engineers 2014b). Future dredging actions in Fire Island Inlet and around Democrat Point could alter or destroy preferred habitat as occurred recently, in turn potentially leading to adverse changes in numbers, distribution and reproduction of the Democrat Point plover subpopulation. Overall, the degree or manner to which both inlet morphology and hydrodynamics would be impacted and the corresponding impacts to piping plover habitats has not been analyzed in the Assessment, so the effects on the species and its habitat are uncertain, but still probable.

Beach nourishment may provide nesting substrate for the species, particularly in the extremely eroded segments of the proposed project area. However, recent surveys undertaken at beach nourishment projects on Fire Island showed that these habitats supported low numbers of breeding pairs with limited to no reproductive output, and experience high levels of recreational disturbance and degradation due to off-road vehicle use (Land Use Ecological Service, 2009; National Park Service 2012). Over the last 8 years, piping plovers have only temporarily colonized (one season) artificially constructed beaches on Fire Island, with zero productivity. It is suspected that in these cases on-going disturbances due to NPS permitted ORV activities and other recreational activities contributed to the ephemeral nature of these breeding sites and the lack of breeding success.

Consequently, artificially created beaches that are not properly managed and do not provide access to foraging areas, may lead to "population sinks" by recruiting individuals to the area each season, only to yield reproduction levels less than one chick per pair which is below the level necessary to achieve a stationary population level.

While the proposed project does not include any major renourishment cycles, the Corps has indicated that maintenance activities are required by New York State or Suffolk County. The BA does not indicate the types or timing of maintenance activities within the project area, but typically these include installation of sand fencing and maintenance of berm and dune elevations. Such maintenance activities may run counter to conservation measures proposed by the Corps in the BA and described in this opinion. It is the Service's belief that the Corps has committed to these conservation measures, and that where there may be conflicts with other management actions in the area, these conservation measures will still be implemented to their full effectiveness.

In the event that plovers colonize these beaches they may experience loss of habitat area over time, if the beach erodes back to a stabilized dune. This was observed over the course of the FIIS Community Project where temporary habitat was created, attracted breeding plovers, only to erode within a year or two. Because piping plovers demonstrate breeding site fidelity to their breeding sites, they are likely to persist in attempting to breed in these areas, even if these habitats degrade and plover productivity declines in future years.

Piping plovers, which may be attracted to the site, may also have reduced productivity due to low prey resources, increased disturbance, and predation if these issues are not managed properly. For example, the decrease in breeding plovers and chick productivity in the Corps' Westhampton Interim Storm Damage Protection Project area was attributed to a reduction in available habitat due to residential redevelopment and erosion and a rise in invasive predators such as feral cats (Cohen 2005; Citizens Environmental Research Institute 2006; Cashin Associates, Inc., 2007).

Habitat loss and adverse alterations can also result from physical changes to artificially constructed dunes and beaches. Dune and beach construction presents a large-scale perturbation to the nearshore and beach coastal system until equilibrium can be achieved (Dean 1993). Related to this is the phenomenon of beach scarping, which is a common feature of the constructed beach after beach nourishment (Alegria-Arzaburu *et al.* 2013). Natural forces, which work to redistribute the sand that is placed on the beaches during nourishment projects, may create a sharp discontinuity of slopes between the upper beach and the intertidal zone, inhibiting the movement of piping plovers, especially chicks, into intertidal foraging areas. By steepening the intertidal slope, scarping may reduce the size of the intertidal foraging area, inhibit adult and chick movement into the intertidal zone, and possibly delay the formation of an upper beach wrack line, an important foraging habitat for piping plovers and their chicks.

Effects of Dune and Beach Maintenance Activities

Dune vegetation planting and snow fences are proposed in FIIS Community portion of the project area and at Smith Point County Park on the dunes in the plover breeding areas. These practices are intended to artificially accelerate growth of dense vegetation and dune growth in order to further stabilize the barrier island (Bocomazo *et al.* 2011). Sand fencing can affect dune topography and promote the formation of steep, uniform dunes. Replicate treatments using sand fences oriented parallel to the shore, parallel with perpendicular additions, and zigzag (also termed oblique or diagonal) and vegetation plantings at Timbalier Island, Louisiana and Santa Rosa Island, Florida demonstrated appreciable vertical height and volume accumulation over controls (Mendelssohn *et al.* 1991, Miller *et al.* 2001). Fences filled rapidly, with half the accumulation over three years occurring in the first six months in Florida, 64 percent in the first 14 months in Louisiana. In sand deficient systems, however, the shoreline will continue to erode back toward the dune unless the beach also is nourished (Mendelssohn *et al.* 1991, Freestone and Nordstrom 2001). This effect will likely limit the amount of available preferred habitat for these species and will likely create degraded habitat conditions.

Cessation of sand fence installation and beach-raking in Avalon, New Jersey resulted in greater dune volume and beach volume, but lower dune crests compared with "managed" sites with sand fences and beach-raking (Nordstrom *et al.* 2012). Suspension of raking and sand fence installation allowed the dunes to build seaward creating greater and more natural topographic variability as well as diversity of plant species. Furthermore, the new fences at "managed" sites had to be placed close to the dune to retain space for beach recreation (Nordstrom *et al.* 2012). The Corps proposes to plant beach grass at densities of 18 in on center in the project area in an effort to stabilize the artificial dunes. Vegetation does serve to trap sand (USACE 1967), but, initially it plays a smaller role than sand fences in sand accumulation (Mendelssohn *et al.* 1991, Miller *et al.* 2001). Over time, however, vegetation will continue to accumulate sand through upward and lateral growth (Miller *et al.* 2001).

Study-specific management recommendations to conserve ephemeral pools, bay tidal flats, sparse vegetation, gently-sloping foredunes, and overwashes are contained in Loegering and Fraser (1995), Elias *et al.* (2000), Fraser *et al.* (2005), and Cohen *et al.* (2009). Conversely, activities that accelerate the formation of heavily vegetated berms and dunes that block overwash and replace gently sloping and sparsely vegetated foredunes adversely affect piping plovers and their habitats. Jones (1997) stated that the use of sand fencing or discarded Christmas trees will degrade piping plover nesting habitat if these installations create dune slopes >10 percent. Cohen *et al.* (2008) noted that once beach grass becomes dense, it may have to be thinned each growing season to retain characteristics of suitable piping plover nesting habitat. Maslo *et al.* (2011) conclude that recovery and persistence of piping plovers will depend on conservation and restoration of breeding habitats with very low slopes, dune heights, and vegetative cover. Piping plovers at the Corps Westhampton Interim Project area placed most of their nests on the bay side of the beach in the first years following the breach and its closing, but redevelopment and revegetation of the bayside shifted nesting to the ocean beach (Cohen *et al.* 2009). Sand fences and vegetation plantings similarly accelerate loss of sparsely vegetated foredune habitats, forcing piping plovers and human beach-goers to compete for the same narrowing swath of seaward beach.

Other consequences of artificial beach stabilization include exacerbating conflicts with beach recreation as sand fences and vegetation plantings narrow the remaining seaward beach at the same time that they impede landward or cross-island movement of sand.

While the proposed project affords protection to, and perpetuates, upland development by buffering structures from ocean storm and wave attack, the Service recognizes that no new hard stabilization structures are permitted in the proposed project.

Impacts to Foraging Habitats and Prey Resources

Piping plovers feed on invertebrates, such as marine worms, fly larvae, beetles, crustaceans, and mollusks (Bent 1929; Cairns 1977; Nicholls 1989). Prey can generally be divided into two categories: terrestrial invertebrates (chiefly, dipterans and other insects, including diurnally burrowing Talitrid amphipods [*Amphipoda* spp.]) (Gibbs 1986) and intertidal, infaunal invertebrates. On oceanfront habitats, terrestrial invertebrates tend to be concentrated in the wrack line (Loegering and Fraser 1995; Hoopes *et al.* 1992), a habitat used by foraging plover adults and chicks (Goldin 1993; Hoopes 1993; Hoopes *et al.* 1992). Availability of wrack is especially important at sites where ephemeral pool and bayside foraging areas are not available (Elias *et al.* 2000).

A number of studies have investigated plover use of these prey resources on other Atlantic coastal beaches. On three southern NJ beaches, Staine and Burger (1994) found that polychaete (Scoieiepis spp.) abundance is highest in piping plover foraging areas and concluded that polychaetes (especially *Scoieiepis squamata*) are the plovers' main source of food, where they were present. Hoopes *et al.* (1992), Gibbs (1986), and Cairns (1977) also documented that piping plovers feed on polychaetes. Loegering (1992) found amphipods and mole crabs (*Emerita taipoida*) abundant in the saturated intertidal zone of the ocean beach on Assateague Island National Seashore in MD, with amphipods comprising approximately 95 percent of samples from these areas. Loegering (1992) and Loegering and Fraser (1995) observed that older chicks and adults often feed in this saturated zone, suggesting that amphipods constitute a prey resource. In an evaluation of invertebrate prey resources conducted by the Corps in Ocean City, Cape May County, NJ, dominant taxa included amphipods, coquina clams (*Donax* spp.), and polychaetes (Scott 2002).

The proposed project will likely impact foraging habitats and prey resources in the intertidal, foreshore, backshore and bayside habitats. The Corps' design profile illustrates the changes in burial depths of the existing ocean beach habitats between the pre and post project conditions, indicating that these habitats would be buried with a minimum of 5 ft of dredged material. The BA states, "construction activities would temporarily impact beach invertebrates and prey base of plovers as well as the potential habitat and seed bank of amaranth. Intertidal zone prey base would be affected, as project activities would place material below the high tide line. These impacts will be short term and minimal due to time of year placement and the amount of intertidal area along LI." The BA then discounts this as a significant impact stating that the other unaffected intertidal habitats are available to the species for foraging. However, based on the Corps' plan layout and best available information concerning prey recolonization of disturbed marine environments (Land Use Ecological Services, Inc., 2005, Peterson *et al.* 2000) the Service has concluded that these impacts are neither short-term nor localized considering the length of the project area (19 mi) and the duration of effect (10 years). The Service finds that the BA's conclusion does not factor in the species foraging behaviors or age-specific factors: adults would be unlikely to travel to distant foraging areas from their established breeding grounds and flightless chicks would not be able to reach ocean beaches that were unaffected by nourishment.

The recovery of marine invertebrate prey resources will vary depending on the timing of the fill activity relative to the periods of highest biological activity in these zones of the beach, as well as compatibility of the dredged material with the existing beach substrate. Areas receiving sand in autumn will likely have a longer prey resource recovery period than areas receiving fill in the winter and early spring. In 2003, the time period for benthic recolonization was approximately 12 to 18 months for the FIIS Community project area (Land Use Ecological Services, Inc., 2005).

The Corps (1999) examined the effects of beach nourishment on oceanside intertidal benthos in Monmouth County, NJ. They found that the recovery time of the intertidal infaunal community was as short as two months following renourishment carried out between early August and early October. Recovery time following renourishment in mid- to late-October was reported to take between 2.0 to 6.5 months. However, studies conducted in Florida, NC, and SC show that re-colonization rates by benthic invertebrates are variable and dependent on the time of year in which the nourishment occurs, beginning within days and taking up to one year for full recovery of some species (Reilly and Bellis 1983; Bacca and Lankford 1988; Lynch 1994; Peterson *et al.* 2000). Further, the macrofaunal community after re-colonization may differ considerably from the original community. Once established, it may be difficult for species of the original community to displace the new colonizers (Hurme and Pullen 1988). Despite the example cited by the Corps, time frames for intertidal invertebrate recruitment and re-establishment following beach nourishment are generally reported as taking between 12 and 18 months (National Resource Council 1995) and this time frame is consistent with the findings of Land Use Ecological Services, Inc. (2005) for the FIIS beaches.

While the completed project could increase the quantity of available ocean beach nesting habitat in the FIIS Communities, artificially created dunes and beaches would lack features such as overwash habitats, tidal pools, bayside flats, and sand spits (e.g., Jones *et al.* 2007; Peterson *et al.* 2000), which provide a forage base for breeding adults and their chicks. Any positive benefits of the proposed project in terms of reproductive output may not be realized until re-colonization of benthic organisms occurs and natural coastal processes begin to "reshape" the constructed features (Land Use Ecological Services, Inc., and Coastal Planning and Engineering 2002).

When the project commences, it is expected the infaunal community will not recover for at least 6.5 months. Construction between mid-October and January, therefore, may result in reduced productivity, or possibly abandonment of piping plover nesting areas because of reduced prey resource availability (U.S. Army Corps of Engineers 2001a). The proposed project would be expected to impact prey resources for breeding adults and their chicks at least one breeding season.

Except where curtailed by mechanical beach raking or delayed by scarping, partial to complete physical recovery of the organic material that comprises the wrack line can be expected within one year following sand nourishment, depending on the timing of the construction activity. However, the recovery rates of the terrestrial insect prey resource associated with the wrack line are unknown, but they might be expected to be low during the winter period of low invertebrate activity and more rapid during warmer weather. The continuation and possible increase of ORV use within Smith Point County Park and throughout the FIIS following implementation of the proposed project, suggests that the abundances of prey resources in wrack habitat would be reduced via mortality, displacement or lowered total amount of wrack, but additional research is needed to evaluate recolonization rates under varying driving conditions (Kluft and Ginsburg 2009).

Impacts Due to Recreational Activities

By widening beaches, the proposed project is expected to facilitate and increase recreational activities on the ocean beaches within occupied piping plover breeding areas. Recreational activities that may potentially, adversely affect piping plovers include unleashed pets, fireworks, kite-flying, and increase in garbage and refuse concomitant with increased recreational activities. Unleashed pets, such as dogs and cats, can prey on piping plovers. For example, at least two nests were lost to predation by unleashed dogs in the Corps' Westhampton Interim Storm Damage Protection Project Area, Suffolk County, NY, as reported in Houghton (2005). Kite flying is also a popular recreational activity leading to disturbance of plovers, as it is believed that plovers perceive kites as avian predators, such as hawks, gulls or crows. Adult plovers may abandon their nest site entirely, be flushed off their nest and therefore be unable to defend the nest from actual predators, or similarly be unable to defend their chicks from actual predators in these instances (U.S. Fish and Wildlife Service 1996).

Indirect effects of disturbance to piping plovers also occur by limiting breeding habitat to ocean-side habitats that are simultaneously made more attractive for recreational activities by beach stabilization projects. This would place additional demands on the NPS, Towns of Islip and Brookhaven, Smith Point County Park, and Robert Moses State Park in managing the potential conflicts between endangered species and recreational uses of these sites (see National Park Service 2003a). In New Jersey, Burger (1994) studied plover foraging behavior and habitat use at ocean, dune, and back-bay habitats. The primary focus of that study was the effect of human disturbance on habitat selection, showing that habitat selection and foraging behavior correlated inversely with the number of people present.

The level of recreational impacts within piping plover nesting areas is expected to increase in the near term. Wide beaches with little human disturbance at the time piping plovers initiate nesting (March to April) often experience heavy recreational pressure later in the nesting season (May through August), adversely affecting reproductive success by disturbing nesting birds. Moderate levels of human use, however, can create sufficient disturbance to cause abandonment of nests, interfere with foraging, cause broods to be separated from adults, or attract predators. Studies have found a negative correlation between the number of people present within 160 ft. of piping plovers and time spent foraging (Burger 1991). Plovers may spend only 50 percent of their foraging time actually feeding in habitats with many people present compared to 90 percent in less disturbed areas (Burger 1994). Flemming *et al.* (1988) found productivity correlated to level of disturbance, with 1.8 chicks fledged per pair in areas of low disturbance compared to 0.5 chicks fledged per pair in areas of high disturbance. However, Hoopes *et al.* (1992) found no correlation between rates of disturbance and productivity rates, and attributed this to intensive management of recreation within his study area, including restrictions on dogs and ORVs and use of symbolic fences to protect nests and provide refuge areas for chicks.

Overall, the degree to which increases in recreational activity result in mortality or disturbances to plovers and their chicks depends on the degree to which the protection measures are implemented. The conservation measures described, funded and committed to by the Corps are intended to minimize and mitigate the adverse effects from recreational activities.

Impacts of Increases in Predator Populations or Search Efficiency

The proposed project would potentially create habitat, affect the movements of, and influence the search behaviors of mammalian (red fox, raccoon, feral cats) and avian predators (crows, raptors, gulls) of the piping plover. Modeling by Seymour *et al.* (2004) using red fox movement data from northern England indicated that risk of fox predation on ground-nesting bird species in long, linear habitats increased with narrowing habitat width, and was sensitive to changes in habitat width of even a few meters.

Wider, irregular barrier island features may allow piping plovers to be more efficient in eluding predators, by reducing the degree of spatial overlap of their habitats. The installation of sand fences and other elevated features such as the proposed dune may be used as perches for avian predators and increase their search efficiency (e.g., Andersson *et al.* 2009).

The degree to which increases in predator habitat result in mortality or disturbances to plovers and their chicks depends on the degree to which the protection measures are implemented. We would expect some territory desertion, delayed or interrupted courtship, disturbance to incubation with some loss of nests or delayed hatch times, disturbance to foraging chicks with delayed fledging, and lower productivity. Predators are also a cause of chick mortality. Therefore, these effects, if left unmanaged, will contribute to the anticipated lowered productivity levels attendant with creating suboptimal habitats within the action area, resulting in some mortality of eggs and chicks over 10 years.

The conservation measures described, funded and committed to by the Corps are intended to minimize and mitigate the adverse effects from predators.

V. CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, Tribal, local, or private actions that are reasonably certain to occur in the area considered in this Opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section, because they require separate consultation pursuant to Section 7 of the Act.

Summary

Cumulative effects include the effects of future State, Tribal, local, or private actions that are reasonably certain to occur in the area considered in this Opinion. These actions include private projects to stabilize beaches, increase recreation, or build ORV roads. Local entities are expected to continue to stabilize their beaches by installing sand fences and planting beach grass. Suffolk County plans to further reconstruct Burma Road and to maintain sand fences and vegetation along the road. Both NYSOPRHP and Suffolk County Parks are expected to continue to issue thousands of ORV beach access permits. These actions are expected to destroy or degrade plover habitats, disturb plover adults and chicks, and increase vulnerability to predation, ultimately curtailing plover population expansion.

Discussion

Private projects to stabilize beaches, increase recreation, or build ORV roads are expected to degrade or destroy beach habitats such that plover population expansion is curtailed.

Suffolk County is planning to further restore Burma Road in Smith Point County Park which would result in adverse effects as described above. This, along with unregulated recreational activities such as boat landing and unrestricted pedestrian access will disturb adults and prevent chick from accessing bay side foraging habitats. Large scale habitat fragmentation is expected to occur at Smith Point County Park as the Suffolk County Department of Parks, Recreation and Conservation further establish Burma Road as an ORV route within overwash habitat and piping plover breeding areas. This will destroy and degrade about 2.0 mi of plover habitat. As part of this action they will maintain and install further sand fences and plant beach grass, further stabilizing the beaches, and adversely affecting plovers and their habitats.

NYSDEC would be expected to continue to be able to issue tidal wetland permits for ocean and bay side stabilization activities, such as bulkhead construction, dune stabilization through sand bags and geotubes, and beach scraping. However, it is uncertain the extent to which this action is expected to continue into the future to meet the needs of the developed FIIS communities, as well as NPS, NYSOPRHP, and Suffolk County infrastructure needs as the FIMI project may address some of these future needs.

The NYSOPRHP will likely continue to stabilize their beaches using material from dredging projects or upland sources. Some of these actions will require permits from the Corps Regulatory Branch and would therefore undergo separate ESA consultation. However, some beach maintenance actions that fall outside the Corps regulatory jurisdiction would continue. These would involve beach scraping and the construction of dunes, the installation of sand fences and the planting of beach grass.

Local entities would be expected to continue to install sand fences and plant beach grass as part of their effort of beach stabilization. Suffolk County Parks has installed miles of sand fences at Smith Point, in the process degrading, fragmenting, and ultimately destroying preferred piping plover habitat, in the process negatively affecting the species' distribution, abundance, and reproduction.

Both NYSOPRHP and Suffolk County Parks would continue to issue thousands of ORV permits for use on their beaches. They would continue to degrade and fragment plover habitat on large stretches of beaches, and affect the species' distribution, abundance and reproduction.

VI. CONTRIBUTIONS OF CONSERVATION MEASURES TOWARD MINIMIZING ADVERSE EFFECTS

In the drafting of this opinion, it became clear that the proposed project would, through each estimate, reduce the overall nesting area for future piping plovers. Clearly, piping plovers need nesting area to recover, and multiple past examples have shown that local plover populations improve in response to new storm-created habitat, such as was produced by Hurricane Sandy. However, it is also clear that plover productivity on Fire Island, and the surrounding Long Island areas, is failing and is not on a path to recovering the species (Figure 15), probably due to a mix of management-related elements, such as predator and vegetation management.

In discussions on this draft Opinion with the Corps, Suffolk County and State, the Service discussed ways to increase the quantity and productivity of the available habitat. As discussed, there are many competing uses for Fire Island, e.g., recreation, storm protection, plover habitat, which constrain the opportunities to produce and maintain plover habitat. Piping plovers appear to be a species adapted to a storm-influenced ecosystem in which storms come, habitat is formed, habitat degrades over time, and then new storms and subsequent new habitat arrive. As described in this Opinion, there is an 80-year history of anthropogenic efforts to impede these naturally dynamic processes making the choices today post Hurricane Sandy especially important. Further, as outlined in the Cumulative Effects section, future effects are expected.

If increasing the likelihood of piping plovers surviving and recovering in this heavily human-influenced ecosystem is the goal, the Service understands the need to operate in the current context of these competing uses. Burma Road does currently exist. Human recreation will continue. Predators will continue to be a threat. And, dynamic tensions between maintaining open bay to ocean habitat for plovers will conflict with human interests to build dunes and so as to protect human life and property from storms.

Achieving recovery for the plover is dependent on cooperation from State, County and Federal partners, and other local landowners, and possibly on the creation of new habitat alternatives, such as engineered habitat. It may be as real and detrimental an outcome for the plover if the Service were to not work cooperatively with State, County and Federal partners, and other local landowners, thereby not fully engaging their ability to promote recovery, than if significant plover habitat quantity and quality was degraded.

The Service met several times with the Corps, State and County in face-to-face meetings to discuss possible ways forward that used the best available science and comported with the requirements of the ESA. Based on these discussions, the Corps' Biological Assessment was modified (see Appendix 4) to include more habitat managed for piping plover, and more management actions, encompassing the entire project area, to reduce threats to the plover. Habitat managed for piping plovers to mitigate effects of this project was increased from 15.7 ha offered by the County in the Great Gunn area (eastern end of Fire Island), to nearly 34 ha. This area is ocean-side only (i.e., is not connected to the bay side), but will be designed and maintained to create ephemeral pools so as to provide nesting and augmented foraging habitat. These habitats will be designed to achieve the higher densities of plovers found on the south shore of Long Island (e.g., Long Beach-Lido Beach, Jones Beach West, Jones Beach East - Cedar Beach). These areas are mostly characterized by wide, flat beaches with ephemeral pools or wide areas of moist sandy habitats. Further, an additional 6 ha dredge site restoration on the bay side (south of New Made Island) will be implemented. These 6 ha will be designed and managed to provide nesting and foraging habitat for plovers using insights from Loegering and Fraser (1995), Elias *et al.* (2000), Fraser *et al.* (2005), and Cohen *et al.* (2009), Maslo *et al.* (2011).

Restored and managed habitat for plovers may be essential for the long-term recovery of plovers in the NY and NJ recovery unit, and these engineered and created areas and subsequent monitoring will provide essential information to help us learn how best to restore these habitats.

<u>Necessary Funding</u>

Starting before the initiation of construction and over the life of this project (10 years), the Corps will fund, up to $10,500,000 for the life of the project with no more than $1,500,000 annually to implement these conservation measures. These funds will be used by the Service, or other Service approved entities as appropriate, to design and implement the measures stipulated below.

<u>Conservation Measures</u>

The Service appreciates the commitments by the Corps to fund and participate in the design and implementation of a similar suite of conservation measures:

1. better coordinated stewardship and plover monitoring across the entirety of Fire Island.
2. better coordinated and implemented predator management across the entirety of Fire Island.
3. vegetation management so as to keep the area as plover habitat on the restored and created habitat
4. vegetation management so as to keep the area as plover habitat in the three main overwashes – Pattersquash, Smith Point Breach and New Made Island
5. the creation of restored habitat Great Gunn (33.7 ha) and New Made Dredge site (6 ha) for foraging habitat
6. commitment to assist with the design and implementation of coordinated effectiveness monitoring, designed and coordinated through an interagency team to be set up in 2014.

To improve the quality and productivity of the available habitat, it was also agreed to initiate:

- An Interagency Team: The Corps will create (prior to the initiation of the first phase of construction) and participate in an interagency team (to include the Service or its agents) that will design and implement the predator and vegetation management, and plover and effectiveness monitoring.
    - The monitoring includes
        - physical monitoring of beach processes (up to $250,000 annually)7,
        - effectiveness monitoring (up to $150,000 annually),
        - biological monitoring and stewardship of endangered species along the beach from inlet to inlet (up to $450,000 annually).
    - The adaptive management measures include:
        - predator management for endangered species (up to $200,000 annually),
        - topographic management and devegetation of critical areas for endangered species (up to $250,000 annually).

- Coordinated Monitoring. The monitoring program will take place from inlet to inlet to supplement (not replace) existing programs with the intent to add consistency to the monitoring and reporting. The program splits the plover reproductive activities into two phases: nest and incubation activities, from which breeding population size is estimated, and hatching and fledging activities from which reproductive success is estimated. A set of habitat maps will be provided annually to illustrate the location of nests and the outcome of each breeding attempt. The monitoring program will also note the ongoing influences by the project features. When nests are located, they are either inconspicuously marked or surveyed with GPS to facilitate relocation for monitoring and predator exclosure installation. The monitoring program will also complete a single annual census, standardized on the East Coast to occur during the first 10 days in June.

7 The amounts total more than $1.5 million annually as not each category of action will require the full funding identified each year.

The census numbers gathered during the designated window permits a count for the entire population on site, including non-breeding individuals. Results are compared to the nesting population to address any anomalies. NPS has offered to lead this inlet to inlet monitoring effort. Such a coordinated monitoring effort has not been attempted before on Fire Island.

  - Annual reporting of the plover monitoring is due to the Service by May 1 of each year.

- Coordinated Predator Management. All agencies agreed to mammalian predator management (10yrs) inlet to inlet which will be a Federally funded program through Corps funds, and that implementation will be coordinated between all agencies and the affected land owners/managers. Such a level of predator management has not previously been coordinated on Fire Island. Currently, there is no coordinated inlet-to-inlet predator management strategy on Fire Island (N. Gibbons, Suffolk County Parks, pers. comm. September 24, 2014; C. Soller, NPS FIIS, pers. comm. September 24, 2014). On Federal properties, there is a commitment of exclosures and stewardship, within available authorities. While there are limitations on trapping and killing predators in the absence of more detailed studies and assessments, it was agreed further discussion toward a removal plan is needed. The primary management effort to reduce wildlife impacts to nesting plovers is the use of nest site predator exclosures, an effective non-lethal method of protection. It necessitates that staffing is adequate to find plover nests in a timely manner. It also requires personnel time to construct exclosures at the nest sites. There are not effective management options to address wildlife impacts on plovers during the courtship or brood rearing phases of the breeding cycle under the current program. The secondary management tool to be used to reduce wildlife impacts is predator control. It was acknowledged that compliance and permitting for predator control needs to be established.
  - The coordinated predator management strategy will be drafted prior to completion of the first phase of construction, though it is understood this will be a living document informed by public dialogue and shifting public concerns.

- Coordinated Stewardship/Visitor Management. Attempts will be made to eliminate or reduce human disturbance to plovers during all phases of breeding. Plover habitat utilization and human use patterns are well established, facilitating installation of appropriate area closures. A 200 meter disturbance buffer is used to protect most breeding habitats. In areas where plover breeding activity occurs in close proximity to human use areas, an assessment will be made of the sensitivity of the birds on site. When possible, an attempt is made to maintain some level of recreational opportunities. When in doubt, visitor use is curtailed to ensure that breeding activities are protected. Park staff, researchers, operation and maintenance and emergency vehicles with a legitimate need to work in or travel through plover breeding areas will receive training to reduce the potential risk to the plovers. Staff and cooperators with irregular needs to access sensitive areas are provided escorts. Law enforcement officers are offered training to accommodate the need to patrol the beach and inlet areas.

- ORV Use. All agencies recognized that there are Federal ORV guidelines in place that are currently followed within Fire Island National Seashore and Smith Point County Park. Both agencies agreed that the ORV guidelines will continue to be followed in the future. It was acknowledged that nesting distance from the beach, breeding bird behaviors and reaction to humans or vehicles vary from year to year. Dependent on foraging habitat condition at the time of brood rearing, chicks may or may not use the bay or ocean intertidal zone for foraging. Unpredictable behavior and habitat use has resulted in a stepped progression of visitor management actions in the past. Normally, observations are made of birds in courtship to identify management areas. As soon as nests are initiated, an assessment is made to determine the sensitivity of both breeding adults to human use. When birds react negatively to human disturbance, the normal travel corridor is reduced in width in an attempt to accommodate passage of vehicles and pedestrians. If traffic or pedestrian use cannot be accommodated, a full area closure is placed in effect. A similar assessment and closure progression is made for brood habitat needs if the nest successfully hatches. On the non-beach sides surrounding ORV area nests the standard 200 meter buffer distance is used to protect plover breeding activity.

- De-vegetation Maintenance/Dune and Burma Road Re-alignment/Habitat Restoration and Creation. The three overwash areas, the Great Gunn restoration site, and the New Made Dredge restoration site will be managed to inhibit vegetation growth from impairing the quality of these available habitats. The Corps will build these areas to specifications agreed to by the Service and the County will maintain the vegetation per the specifications. This includes devegetating the area, as necessary, to allow no more than 30 percent vegetation cover at any one time during the 10-year life of the project. In addition, the dunes will be planted (with non-invasive species), Burma Road will be fenced and vegetated. These efforts will allow vegetation to stabilize the dunes and the road passable for human use. Sand fencing and vegetation along the road will also reduce the risk of plover chicks getting taken by vehicles, yet these efforts due bifurcate the habitat and impeded bay to ocean connectivity. Further, in certain areas, the road was moved south (ocean-side) to allow for more foraging and nesting habitat on the bayside.
    - The Corps will ensure the restored acreage on Great Gunn (33.7 ha) and New Made Dredge Site (6 ha) will be designed and managed to contain foraging habitat. Design specifications will be determined in consultation with the Service.
    - Regarding possible hazardous, radioactive and toxic taste issues on the 6 ha dredge disposal site restoration south of New Made Island, the Corps will

review available site documentation (e.g., County dredging records) and identify the source areas. If there is a need to further characterize the site, additional sampling and analysis will occur.
    - The project will keep the material on site and will include a minimum of a 24-inch sand cap to provide the proper plover habitat. The excavated material will be transported to the other end of the disposal area which is not expected to be plover habitat.

- Effectiveness Monitoring. It was discussed that the conservation/protection measures and habitat restoration for threatened and endangered species are often guided by anecdotal evidence and there is a need to better utilize time and resources on effective strategies. The project will monitor and evaluate the effectiveness of the above mentioned measures and then provide revised recommendations if need be relating to the restoration of breeding habitat and the optimization of reproductive success.

    - An effectiveness monitoring plan will be drafted prior to completion of the first phase of construction by the interagency team.

- Adaptive Management. If, based on the biological and effectiveness monitoring, it is determined the restoration areas are not performing as expected for piping plovers, modifications to the design or management of the restoration sites may be warranted. If underperformance on these sites is reported through the effectiveness or plover monitoring, the Corps will, as soon as reasonably possible, coordinate with the Service on additional actions needed to augment or support the piping plovers in these areas.

The Corps has committed to these conservation measures in the BA. Further, they have demonstrated their commitment by allocating $10.5 million for the 10-year span of the project to ensure these conservation actions are implemented. This commitment leads the Service to conclude that these actions are reasonably certain to occur. These actions will significantly assist with the mitigation and minimization of the effects of the proposed action by:

- Offsetting the loss of nesting carrying capacity through the restoration of nesting sites that include increased access to foraging areas,
- Augmenting priority 1 recovery actions such as predator, vegetation control, and coordinated efforts to address human disturbance, e.g., from ORV use,
- and, coordinated biological and effectiveness monitoring to assess the status of the plovers annually, including on the restored areas.

VII. CONCLUSION

In accordance with policy and regulation, the jeopardy analysis in this Biological Opinion relies on four components:

(1) the *Status of the Species*, which evaluates the piping plover range-wide condition, the factors responsible for that condition, and its survival and recovery needs;

(2) the *Environmental Baseline*, which evaluates the condition of the piping plover in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the piping plover;

(3) the *Effects of the Action*, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the piping plover and

(4) *Cumulative Effects*, which evaluates the effects of future, non-Federal activities in the action area on the piping plover.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed Federal action in the context of the current status of the piping plover, taking into account any cumulative effects, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of these species in the wild.

The jeopardy analysis in this biological opinion places an emphasis on consideration of the range-wide survival and recovery needs of these species and the role of the action area in their survival and recovery as the context for evaluating the significance of the effects of the proposed Federal action, taken together with cumulative effects, for purposes of making the jeopardy determination.

The action area for this consultation is located in a portion of the New York-New Jersey recovery unit for the threatened Atlantic Coast population of the piping plover. This and three other recovery units were defined in the final recovery plan for this species (U.S. Fish and Wildlife Service 1996). Recovery units, by definition, comprise areas that are essential to the conservation of the listed species.

The Service is concerned significantly about the status and future of this recovery unit. It is also concerned about the further loss of any existing habitat, whether it is or is not fully occupied. Piping plovers have evolved dependent on a dynamic beach ecosystem in which habitat is constantly becoming available through coastal processes, including storms, and declining in quality through other coastal processes, as well as human action (e.g., storm stabilization actions, recreation and pets) and vegetation growth.

It is the Service's belief that it is insufficient to simply base our jeopardy analysis on the estimation of nesting pair carrying capacity. While the areal extent of possible habitat is important, so are the threats the plovers experience on those acres. Addressing the threat of habitat loss alone is not sufficient to recover this species, as expressed in the 1996 Recovery Plan and the 2009 5-Year Review. It should also be ensured that the acres that have carrying capacity are not experiencing other threats, such as predation and human disturbance, which are "priority 1" recovery actions in the 1996 Recovery Plan.

However, it is difficult to quantify how many piping plovers a concerted predator management, vegetation management, and human disturbance program will save or create over the proposed project's 10-year timeframe. As an indicator of what might be possible with these programs, the Bouchard Barge 120 Oil Spill Final Restoration Plan[8] - expects a 20 percent increase in productivity with an enhanced management plan that involves predator management, law enforcement and stewardship. In that plan, the Trustees (USFWS, National Oceanic and Atmospheric Administration, Massachusetts Executive Office of Energy and Environmental Affairs, and the Rhode Island Department of Environmental Management),

> "relied on their experience implementing piping plover restoration for other spills such as the 1996 North Cape oil spill in Rhode Island, and the Trustees' efforts to protect and recover the species as outlined in the USFWS recovery plan to identify suitable alternatives. Based on evidence that a plover restoration program would result in a 20 percent increase in productivity, the Trustees determined that implementing the plover restoration program at 50 plover nests for five years would generate a restoration benefit equivalent to the estimated loss" (page 14).

In an article titled, "Effect of Great-Horned Owl Trapping on Chick Survival in Piping Plovers," Caitlin *et al.* (2011) state,

> "Cumulative survival increased 1.15-fold following owl removal but only was significant in 2008. Cohen *et al.* (2009) conducted the only other study of which we are aware that used comparable methods to investigate effects of predator removal on piping plover chick survival. Cohen *et al.* (2009) found that when mammalian predators were removed over a number of years, the probability of fledging increased by approximately 13% per predator trapped. Differences in the response to predator trapping can reflect a difference in predator communities or the habitat and highlight the difficulties in comparing chick survival rates among disparate predator communities and habitats. For example, in contrast to Cohen et al. (2009), Ivan and Murphy (2005) found no appreciable increase in chick survival associated with exclusion of mammalian predators from alkali wetland areas in the Great Plains. Regardless, both Cohen et al. (2009) and our study show that removal of the most significant chick predators can have a positive effect on survival, but our results show that this effect can vary by year" (page 460).

That article goes on to state,

> "Our results suggest that owl trapping can be an effective method for improving piping plover hatchling survival on the Missouri River in some years…Because our results varied by years, it should be noted that owl trapping may not always produce significant

8 http://www.fws.gov/newengland/pdfs/FinalBouchardRPEApipingplover_ percent 20122012.pdf

increases in reproductive output. Because habitat is probably the most important limiting factor for piping plovers on the Missouri River…predator control should be conducted in concert with habitat enhancement and creation projects to ensure that increased productivity can lead to increases in breeding populations" (page 461-462).

While the Service estimates the project will take 16 piping plover pairs (i.e., 57.75 "without project" pairs minus 41.43 "with project" pairs) through the elimination of their habitat, it believes the other threat reduction activities, such as predator and vegetation management, will reduce the effects of those loses to some degree through increased productivity per nest. This reduction of effects will come not in the form of increased habitat available for nesting, rather it will manifest by increasing the productivity (i.e., chicks fledged per pair) of those piping plovers that do nest. Catlin *et al.* (2011) found a 1.15-fold (or 15 percent) increase in piping plover chick survival following great-horned owl removal in the Missouri River, and Cohen *et al.* (2009) found that "when mammalian predators were removed over a number of years, the probability of fledging increased by approximately 13% per predator trapped (in Catlin *et al.* 2011, page 460).

It is unclear whether without FIMI and the commitments by the Corps the carrying capacity of the existing habitat would ever be reached, due to the other threats on the landscape, including predators and human disturbance. According to the data provided by Suffolk County, predation is the central cause of chick mortality on Fire Island, implying a greater than 20 percent increase in productivity is possible with a comprehensive predator management strategy. Cohen *et al.* 2009 state, "Predation may have negated any survival benefit of chick access to high-quality foraging habitat" (page 18). Achieving full carrying capacity is dependent on sufficient productivity to fill the unoccupied habitat.

However, calculating the specific benefit of the agreed-to conservation measures on chick survival is difficult and studies such as Catlin *et al.* 2011 demonstrate that results can vary across years. It is the Service's belief that even if the predicted 15-20 percent increase in chick survival due to the conservation measures occurs in half (5) of the project's 10-year lifespan, it will provide a significant increase, helping to reverse the downward trend seen over most of the past 13 years (Figure 14). For example, if we estimate that the conservation measures will increase chick survival and therefore nest productivity by 17.5 percent per year for 5 of the 10 years of the project's lifespan (assuming the other years chick survival remains stable), then the productivity in the NY area nearly doubles from the 2013 number of a bit over 0.70 to 1.4 chicks per pair. This increase in chick survival will clearly help augment the Fire Island piping plover population by increasing the number of plovers fledged per pair each year. Again, though, calculating the specific number of piping plovers generated from these conservation measures is difficult given the multiple variables involved.

So, as a conservative measure giving benefit of the doubt to the species, the Service is calculating its take statement and jeopardy analysis only on the estimate of 16 piping plover pairs taken through habitat loss over the project's 10-year timeframe (see "Effects to Carrying Capacity"). This estimate is derived by using a "without project" starting estimate of 57.75

piping plover pairs minus the "with project" estimate of 41.43 pairs. This number does not represent nesting piping plovers lost immediately, rather it represents animals that are precluded from existing in the future as the habitat necessary for their creation is eliminated.

The Service believes the conservation measures described in this Opinion are essential to reducing the effects of this loss of 16 pairs, even if this benefit is unquantified. Through consistent implementation, these conservation measures can play a key role in reversing the downward trend of piping plover productivity and chick survival, which is essential for increasing the population of this recovery unit. While unquantified, the Service is depending on these benefits to chick survival and productivity to reduce the effects of the FIMI project.

Recovery Units and Jeopardy Determination

In making a jeopardy determination, the Service must ultimately look to the effects of the action on the species. The 1996 Recovery Plan states, "Any appreciable reduction in the likelihood of survival of a recovery unit will also reduce the probability of persistence of the entire population" (page 34). A 2006 USFWS memo states, "While a proposed Federal action may have significant adverse consequences to one or more "recovery units," this would only result in a jeopardy determination if these adverse consequences reduce appreciably the likelihood of both survival and recovery of the listed entity" (USFWS, March 6, 2006).

One way to understand how the loss of 16 nesting pairs of piping plovers affects the recovery unit and species, is to amortize this amount over the project's 10-year duration. This analysis is reasonable as the loss of the 16 piping plover pairs will not occur immediately upon initiation of the project. The habitat will be affected simultaneously with the construction, yet it is over the course of the entire project period that the 16 nesting pairs are impeded in their nesting. Based on this approach, the project will cause the loss of 1.6 piping plover nesting pairs per year. This number represents a loss of 0.8 percent of the NY-NJ Recovery Unit on an annual basis (3.2 piping plovers divided by 397, the 2013 number of surveyed plovers in the recovery unit). Loss of 1.6 piping plover nesting pairs per year in this recovery unit also represents a loss 0.08 percent of the entire range of the species on an annual basis (using 2013 numbers of approximately 1800 piping plovers rangewide).

Another way to understand the loss of 16 pairs of piping plovers is to assess the status of the population at the end of the 10-period. It is estimated that at the end of the project period, there will be 41.43 pairs of piping plover, assuming full use of the available habitat, in the proposed project area on Fire Island. This number of pairs is 158 percent of the 2013 status of 26 pairs. It is also approaching the population numbers experienced in the 2000s (i.e., from 45 to 54 pairs), a period that included a time during which the recovery unit target of 575 pairs was achieved (2007).

While the loss of 16 pairs of piping plovers over the 10-year life of the project does diminish the overall number of estimated pairs that may nest, it is the opinion of the Service, that such a loss does not appreciably reduce the representation (i.e., the genetic diversity of the taxon), resilience (i.e., the ability to withstand demographic and environmental variation), or redundancy (i.e., sufficient populations to provide a margin of safety) of the recovery unit or the species.

After reviewing the current status of piping plover, the environmental baseline for the action area, the direct, indirect, and cumulative effects of the proposed project, and the proposed project conservation measures, it is the Service's biological opinion that, while authorization of the proposed project may result in the destruction of individuals, the alteration of existing habitat, and preclusion of new habitat from partial overwashes and dune blowouts, it is not likely to jeopardize the continued existence of piping plovers range-wide. This conclusion is based upon the likelihood of the proposed conservation measures ameliorating some of the project effects.

VIII. Incidental Take Statement

This Incidental Take Statement only applies if the proposed action is implemented and the conservation measures (including the described funding) are implemented fully as described in this opinion.

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. Harm is further defined by Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by the Corps and become binding conditions of any grant or permit issued to the (applicant), as appropriate, for the exemption in section 7(o)(2) to apply. The Corps has a continuing duty to regulate the activity covered by this incidental take statement. If the Corps (1) fails to assume and implement the terms and conditions or (2) fails to require the applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Corps must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement. [50 CFR §402.14(i)(3)]

Sections 7(b)(4) and 7(o)(2) of the Act generally do not apply to listed plant species. However, limited protection of listed plants from take is provided to the extent that the Act prohibits the removal and reduction to possession of Federally listed endangered plants or the malicious damage of such plants on areas under Federal jurisdiction, or the destruction of endangered plants on non-Federal areas in violation of State law or regulation or in the course of any violation of a State criminal trespass law.

The Service believes that the project as described in the BA (amended, May, 21, 2014) will take up to 16 pairs of piping plover through the modification of habitat. This estimate is derived by using a "without project" starting estimate of 57.75 pairs minus the "with project" estimate of 41.43 pairs. It is believed that the loss of nesting habitat carrying capacity will be offset to some degree through the implementation of the multiple conservation measures committed to in this opinion.

VIII. Reasonable and Prudent Measures

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize impacts of incidental take of piping plovers:

- Ensure that all project engineers, contractors, and construction staff are fully informed of and compliant with all conservation measures contained in the project description, RPMs, and terms and conditions; and
- 50 CFR 402.14(i)(3) requires Federal agency or applicant to report the progress of the action and its impact on the species to the Service as specified in the incidental take statement.

IX. Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, the Corps must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are nondiscretionary.

- Exercise care in handling any specimens of dead piping plover adults, young, or non-viable eggs to preserve biological material in the best possible state. In conjunction with the preservation of any specimens, the finder is responsible for ensuring that evidence intrinsic to determining the cause of death of the specimen is not unnecessarily disturbed. Finding dead of non-viable specimens does not imply enforcement proceedings pursuant to the ESA. Reporting dead specimens is required for the Service to determine if take is reached or exceeded and to ensure that the terms and conditions are appropriate and effective.

Upon locating a dead piping plover, initial notification must be made to the following Service Law Enforcement office:

Resident Agent in Charge
U.S. Fish and Wildlife Service
Office of Law Enforcement
70 East Sunrise Highway, Ste. 419
Valley Stream, NY 11581
516-825-3950

The Service believes that no more than 16 pairs of piping plover will be incidentally taken as a result of the proposed action. The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. The Federal agency must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the reasonable and prudent measures.

X. Reinitiation Notice

This concludes formal consultation on the action(s) outlined in the BA. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

CONFERENCE OPINION

Rufa Red Knot

Conference Opinion for the Proposed Red Knot and its Proposed Critical Habitat

II. STATUS OF THE SPECIES/CRITICAL HABITAT

A. Species/Critical Habitat Description

The red knot (*Calidris canutus*) was added to the list of Federal candidate species in 2006. A proposed rule to list the rufa subspecies (*C. c. rufa*), the subject of this Opinion, as threatened under the Endangered Species Act (ESA) was published on September 30, 2013, and a final decision is expected in the fall of 2014. Red knots are federally protected under the Migratory Bird Treaty Act, and are New Jersey State-listed as endangered. The red knot is currently not listed as endangered or threatened in New York State.

The Service is proposing red knot critical habitat designations for several parcels on Long Island, due to their importance in providing important stop-over/roosting and forage habitats during spring and fall migrations. While the remaining critical habitat parcels are well west of the action area, one parcel is adjacently east of the project action area. This proposed critical habitat is outside the action area and is updrift (of the east-to-west littoral drift) of any proposed action beach nourishment activities. As such, the Service has determined that the proposed action will not adversely modify any proposed red knot critical habitat. Red knot critical habitat will, therefore, not be considered further in this Conference Opinion.

Red knots were heavily hunted for both market and sport during the 19th and early 20th centuries (Harrington 2001, p. 22) in the Northeast and the mid-Atlantic. Red knot population declines were noted by several authors of the day, whose writings recorded a period of intensive hunting followed by the introduction of regulations and at least partial population recovery. As early as 1829, Wilson (1829, p. 140) described the red knot as a favorite among hunters and bringing a good market price. Giraud (1844, p. 225) described red knot hunting in the South Bay of Long Island. Noting confusion over species common names, Roosevelt (1866, pp. 91-96) reported that hunting of "bay snipe" (a name applied to several shorebird species including red knot) primarily occurred from Cape Cod to New Jersey, rarely south of Virginia. Specific to red knots, Roosevelt (1866, p. 151) noted they were "killed indiscriminately . . . with the other bay-birds." Hinting at shorebird population declines, Roosevelt (1866, pp. 95-96) found that "the sport [of bay snipe shooting] has greatly diminished of late . . . a few years ago . . . it was no unusual thing to expend 25 pounds of shot in a day, where now the sportsman that could use up 5 would be fortunate."

Taxonomy

Calidris canutus is classified in the Class Aves, Order Charadriiformes, Family Scolopacidae, Subfamily Scolopacinae (American Ornithologists Union (AOU) 2012a). Six subspecies are recognized, each with distinctive morphological traits (i.e., body size and plumage characteristics), migration routes, and annual cycles. Each subspecies is believed to occupy a distinct breeding area in various parts of the Arctic (Buehler and Baker 2005, pp. 498–499; Tomkovich 2001, pp. 259-262; Piersma and Baker 2000, p. 109; Piersma and Davidson 1992, p. 191; Tomkovich 1992, pp. 20-22), but some subspecies overlap in certain wintering and migration areas (Conservation of Arctic Flora and Fauna (CAFF) 2010, p. 33).

Calidris canutus canutus, C. c. piersma, and *C. c. rogersi* do not occur in North America. The subspecies *C.c. islandica* breeds in the northeastern Canadian High Arctic and Greenland, migrates through Iceland and Norway, and winters in western Europe (Committee on the Status of Endangered Wildlife in Canada (COSEWIC) 2007, p. 4). *C. c. rufa* breeds in the central Canadian Arctic (just south of the *C. c. islandica* breeding grounds) and winters along the Atlantic coast and the Gulf of Mexico coast (Gulf coast) of North America, in the Caribbean, and along the north and southeast coasts of South America including the island of Tierra del Fuego at the southern tip of Argentina and Chile.

B. Life History

Species Description

The rufa red knot is a medium-sized shorebird about 9 to 11 inches (in) (23 to 28 centimeters (cm)) in length. The red knot migrates annually between its breeding grounds in the Canadian Arctic and several wintering regions, including the Southeast United States (Southeast), the Northeast Gulf of Mexico, northern Brazil, and Tierra del Fuego at the southern tip of South America. During both the northbound (spring) and southbound (fall) migrations, red knots use key staging and stopover areas to rest and feed.

The red knot is a large, bulky sandpiper with a short, straight, black bill. During the breeding season, the legs are dark brown to black, and the breast and belly are a characteristic russet color that ranges from salmon-red to brick-red. Males are generally brighter shades of red, with a more distinct line through the eye. When not breeding, both sexes look alike – plain gray above and dirty white below with faint, dark streaking. As with most shorebirds, the long-winged, strong-flying knots fly in groups, sometimes with other species. Red knots feed on invertebrates, especially small clams, mussels, and snails, but also crustaceans, marine worms, and horseshoe crab eggs. On the breeding grounds, knots mainly eat insects.

Small numbers of red knots may occur in New Jersey year-round, while large numbers of birds rely on New Jersey's coastal stopover habitats during the spring (mid-May through early June) and fall (late-July through November) migration periods. Smaller numbers of knots may spend all or part of the winter in New Jersey. Red knots also rely on New York's coastal stopover habitats during the spring and fall migration periods. As stated above, several stopover habitats in New York are being proposed for critical habitat designations.

Breeding

Based on estimated survival rates for a stable population, few red knots live for more than about 7 years (Niles *et al.* 2008, p. 28). Age of first breeding is uncertain, but for most birds is probably at least 2 years (Harrington 2001, p. 21). Red knots generally nest in dry, slightly elevated tundra locations, often on windswept slopes with little vegetation. Breeding territories are located inland, but near arctic coasts, and foraging areas are located near nest sites in freshwater wetlands (Niles *et al.* 2008, p. 27; Harrington 2001, p. 8). On the breeding grounds, the red knot's diet consists mostly of terrestrial invertebrates such as insects (Harrington 2001, p. 11). Breeding occurs in June (Niles *et al.* 2008, pp. 25-26). Breeding success of High Arctic shorebirds such as *Calidris canutus* varies dramatically among years in a somewhat cyclical manner.

C. Population Dynamics and Demographic Status

In the United States, red knot populations declined sharply in the late 1800s and early 1900s due to excessive sport and market hunting, followed by hunting restrictions and signs of population recovery by the mid-1900s (Urner and Storer 1949, pp. 178-183; Stone 1937, p. 465; Bent 1927, p. 132). However, it is unclear whether the red knot population fully recovered its historical numbers (Harrington 2001, p. 22) following the period of unregulated hunting.

More recently, long-term survey data from two key areas (Tierra del Fuego wintering area and Delaware Bay spring stopover site) both show a roughly 75 percent decline in red knot numbers since the 1980s (A. Dey pers. comm. October 12, 2012; G. Morrison pers. comm. August 31, 2012; Dey *et al.* 2011a, pp. 2-3; Clark *et al.* 2009, p. 88; Morrison *et al.*. 2004, p. 65; Morrison and Ross 1989, Vol. 2, pp. 226, 252; Kochenberger 1983, p. 1; Dunne *et al.* 1982, p. 67; Wander and Dunne, 1982, p. 60). Survey data are also available for the Brazil, Northwest Gulf of Mexico, and Southeast-Caribbean wintering areas, but are insufficient to infer trends.

Migratory Patterns

The primary wintering areas for the rufa red knot include the southern tip of South America, northern Brazil, the Caribbean, and the southeastern and Gulf coasts of the U.S. The rufa red knot breeds in the tundra of the central Canadian Arctic. Some of these robin-sized shorebirds fly more than 9,300 miles from south to north every spring and reverse the trip every autumn, making the rufa red knot one of the longest-distance migrating animals. Migrating red knots can complete non-stop flights of 1,500 miles or more, converging on critical stopover areas to rest and refuel along the way. Large flocks of red knots arrive at stopover areas along the Delaware Bay and New York/New Jersey's Atlantic coast each spring, with many of the birds having flown directly from northern Brazil. The spring migration is timed to coincide with the spawning season for the horseshoe crab (*Limulus polyphemus*). Horseshoe crab eggs provide a rich, easily digestible food source for migrating birds. Mussel beds on New Jersey's southern Atlantic coast and intertidal/wrack line areas on New York's coast are also important forage habitats for migrating knots. Birds arrive at stopover areas with depleted energy reserves and must quickly rebuild their body fat to complete their migration to Arctic breeding areas. During their brief 10- to 14-day spring stay in the mid-Atlantic, red knots can nearly double their body weight.

Spring Distribution and Timing

Atlantic Coast

Major spring stopover areas along the Atlantic coast include Río Gallegos, Península Valdés, and San Antonio Oeste (Patagonia, Argentina); Lagoa do Peixe (eastern Brazil, State of Rio Grande do Sul); Maranhão (northern Brazil); the Virginia barrier islands (United States); and Delaware Bay (Delaware, New Jersey and New York, United States) (Cohen *et al.*. 2009, p. 939; Niles *et al.*. 2008, p. 19; González 2005, p. 14). However, large and small groups of red knots, sometimes numbering in the thousands, may occur in suitable habitats all along the Atlantic and Gulf coasts from Argentina to Massachusetts (Niles *et al.*. 2008, p. 29). In Massachusetts, red knots use sandy beaches and tidal mudflats during fall migration. In New York and the Atlantic coast of New Jersey, knots use sandy beaches during spring and fall migration (Niles *et al.*. 2008, p. 30).

From geolocators, examples of spring migratory tracks are available for three red knots that wintered in South America. One flew about 4,000 mi (6,400 km) over water from northeast Brazil in 6 days. Another flew about 5,000 mi (8,000 km) from the southern Atlantic coast of Brazil (near Uruguay) over land and water (the eastern Caribbean) in 6 days. Both touched down in North Carolina, and then used Delaware Bay as the final stopover before departing for the arctic breeding grounds (Niles *et al.*. 2010a, p. 126). A third red knot, which had wintered in Tierra del Fuego, followed an overland route through the interior of South America, departing near the Venezuela-Colombia border. This bird then flew over the Caribbean to Florida, and finally to Delaware Bay (Niles 2011a).

In Delaware Bay, red knots preferentially feed in microhabitats where horseshoe crab eggs are concentrated, such as at horseshoe crab nests (Fraser *et al.*. 2010, p. 99), at shoreline discontinuities (e.g., creek mouths) (Botton *et al.*. 1994, p. 614), and in the wrack line (Nordstrom *et al.*. 2006a, p. 438; Karpanty *et al.*. 2011, pp. 990, 992). (The wrack line is the beach zone just above the high tide line where seaweed and other organic debris are deposited by the tides.) Wrack may also be a significant foraging microhabitat outside Delaware Bay, for example where mussel spat (i.e., juvenile stages) are attached to deposits of tide-cast material. Wrack material also concentrates certain invertebrates such as amphipods, insects, and marine worms (Kluft and Ginsberg 2009, p. vi), which are secondary prey species for red knots (see Migration and Wintering Food, below).

For many shorebirds, the supra-tidal (above the high tide) sandy habitats of inlets provide important areas for roosting, especially at higher tides when intertidal habitats are inundated (Harrington 2008, pp. 4–5). Along the Atlantic coast, dynamic and ephemeral features are important red knot habitats, including sand spits, islets, shoals, and sandbars, often associated with inlets (Harrington 2008, p. 2; Winn and Harrington in Guilfoyle *et al.*. 2006, pp. 8–10; Harrington in Guilfoyle *et al.*. 2007, pp. 18–19). From South Carolina to Florida, red knots are found in significantly higher numbers at inlets than at other coastal sites (Harrington 2008, pp. 4–5).

The Service is not aware of comprehensive monitoring of red knots on Long Island, New York. Some data is available from individual birders or associated with horseshoe crab monitoring. At Plum Beach in Brooklyn, NY, recorded red knot abundances during horseshoe crab surveys in 2009 and 2010 decreased from 31 (peak of 28 on May 29) in 2009 to 2 (on May 31) in 2010 (New York City Audubon 2010). Individual birders have documented red knot presence at Overlook County Park (May 2013 – 5 red knots) and Cupsogue County Park (June 2007 – 150 red knots) (Ebird website- http://ebird.org/ebird/subnational2/US-NY-103/hotspots)

Threats

Current threats to the red knot include sea level rise; coastal development; shoreline stabilization; dredging; reduced food availability at stopover areas; disturbance by vehicles, people, dogs, aircraft, and boats; and climate change.

The remainder of this section (Threats) is excerpted from Endangered and Threatened Wildlife and Plants: Proposed Threatened Status for the Rufa Redknot (*Calidris canutus rufa*); Proposed Rule (USFWS 2013).

U.S. Shoreline Stabilization and Coastal Development

Much of the U.S. coast within the range of the red knot is already extensively developed. Direct loss of shorebird habitats occurred over the past century as substantial commercial and residential developments were constructed in and adjacent to ocean and estuarine beaches along the Atlantic and Gulf coasts. In addition, red knot habitat was also lost indirectly, as sediment supplies were reduced and stabilization structures were constructed to protect developed areas.

Sea level rise and human activities within coastal watersheds can lead to long-term reductions in sediment supply to the coast. Damming of rivers, bulkheading highlands, and armoring coastal bluffs have reduced erosion in natural source areas and, consequently, the sediment loads reaching coastal areas. Although it is difficult to quantify, the cumulative reduction in sediment supply from human activities may contribute substantially to the long-term shoreline erosion rate. Along coastlines subject to sediment deficits, the amount of sediment supplied to the coast is less than that lost to storms and coastal sinks (inlet channels, bays, and upland deposits), leading to long-term shoreline recession (Coastal Protection and Restoration Authority of Louisiana 2012, p. 18; Florida Oceans and Coastal Council 2010, p. 7; U.S. Climate Change Science Program [CCSP] 2009b, pp. 48-49, 52-53; Defeo *et al.*. 2009, p. 6; Morton *et al.*. 2004, pp. 24-25; Morton 2003, pp. 11-14; Herrington 2003, p. 38; Greene 2002, p. 3).

In addition to reduced sediment supplies, other factors such as stabilized inlets, shoreline stabilization structures, and coastal development can exacerbate long-term erosion (Herrington 2003, p. 38). Coastal development and shoreline stabilization can be mutually reinforcing. Coastal development often encourages shoreline stabilization because stabilization projects cost less than the value of the buildings and infrastructure. Conversely, shoreline stabilization sometimes encourages coastal development by making a previously high-risk area seem safer for development (CCSP 2009b, p. 87). Protection of developed areas is the driving force behind ongoing shoreline stabilization efforts. Large-scale shoreline stabilization projects became common in the past 100 years with the increasing availability of heavy machinery. Shoreline stabilization methods change in response to changing new technologies, coastal conditions, and preferences of residents, planners, and engineers. Along the Atlantic and Gulf coasts, an early preference for shore-perpendicular structures (e.g., groins) was followed by a period of construction of shore-parallel structures (e.g., seawalls), and then a period of beach nourishment, which is now favored (Morton *et al.* 2004, p. 4; Nordstrom 2000, pp. 13-14).

Past and ongoing stabilization projects fundamentally alter the naturally dynamic coastal processes that create and maintain beach strand and bayside habitats, including those habitat components of which red knots rely. Past loss of stopover and wintering habitat likely reduces the resilience of the red knot by making it more dependent on those habitats that remain, and more vulnerable to threats (e.g., disturbance, predation, reduced quality or abundance of prey, increased intraspecific and interspecific competition) within those restricted habitats. (See Factors C and E, below, for discussions of these threats, many of which are intensified in and near developed areas.)

Shoreline Stabilization–Hard Structures

Hard structures constructed of stone, concrete, wood, steel, or geotextiles have been used for centuries as a coastal defense strategy (Defeo *et al.*. 2009, p. 6). The most common hard stabilization structures fall into two groups: structures that run parallel to the shoreline (e.g., seawalls, revetments, bulkheads) and structures that run perpendicular to the shoreline (e.g., groins, jetties). Groins are often clustered in groin fields and are intended to protect a finite section of beach, while jetties are normally constructed at inlets to keep sand out of navigation channels and provide calm-water access to harbor facilities (U.S. Army Corps of Engineers (USACE) 2002, pp. I-3-13, 21). Descriptions of the different types of stabilization structures can be found in Rice (2009, pp. 10-13), Herrington (2003, pp. 66-89), and USACE (2002, Parts V and VI).

Prior to the 1950s, the general practice in the United States was to use hard structures to protect developments from beach erosion or storm damages (USACE 2002, p. I-3-21). The pace of constructing new hard stabilization structures has since slowed considerably (USACE 2002, p. V-3-9). Many states within the range of the red knot now discourage or restrict construction of new, hard oceanfront protection structures, although hardening of bayside shorelines is generally still allowed (Kana 2011, p. 31; Greene 2002, p. 4; Titus 2000, pp. 742-743). Most existing hard oceanfront structures continue to be maintained and some new structures continue to be built. Eleven new groin projects were approved in Florida from 2000 to 2009 (USFWS 2009, p. 36). Since 2006, a new terminal groin has been constructed at one South Carolina site, three groins have been approved, but not yet constructed in conjunction with a beach nourishment project, and a proposed new terminal groin is under review (M. Bimbi pers. comm. January 31, 2013). The state of North Carolina prohibited use of hard erosion control structures in 1985, but 2011 legislation authorized an exception for construction of up to four new terminal groins (Rice 2012a, p. 7).

While some states have restricted new construction, hard structures are still among the alternatives in the Federal shore protection program (USACE 2002, pp. V-3-3, 7). Hard shoreline stabilization projects are typically designed to protect property (and its human inhabitants), not beaches (Kana 2011, p. 31; Pilkey and Howard 1981, p. 2). Hard structures affect beaches in several ways. For example, when a hard structure is put in place, erosion of the oceanfront sand continues, but the fixed back-beach line remains, resulting in a loss of beach area (USACE 2002, p. I-3-21). In addition, hard structures reduce the regional supply of beach sediment by restricting natural sand movement, further increasing erosion problems (Morton *et al.*. 2004, p. 25; Morton 2003, pp. 19-20; Greene 2002, p. 3). Through effects on waves and currents, sediment transport rates, Aeolian (wind) processes, and sand exchanges with dunes and offshore bars, hard structures change the erosion-accretion dynamics of beaches and constrain the natural migration of shorelines (CCSP 2009b, pp. 73, 81-82; 99-100; Defeo *et al.* 2009, p. 6; Morton 2003, pp. 19-20; Scavia *et al.* 2002, p. 152; Nordstrom 2000, pp. 98-107, 115-118).

There is ample evidence of accelerated erosion rates, pronounced breaks in shoreline orientation, and truncation of the beach profile downdrift of perpendicular structures—and of reduced beach widths (relative to unprotected segments) where parallel structures have been in place over long periods of time (Hafner 2012, pp. 11-14; CCSP 2009b, pp. 99-100; Morton 2003, pp. 20-21; Scavia *et al.* 2002, p. 159; USACE 2002, pp. V-3-3, 7; Nordstrom 2000, pp. 98-107; Pilkey and Wright 1988, pp. 41, 57-59). In addition, marinas and port facilities built out from the shore can have effects similar to hard stabilization structures (Nordstrom 2000, pp. 118-119).

Structural development along the shoreline and manipulation of natural inlets upset the naturally dynamic coastal processes and result in loss or degradation of beach habitat (Melvin *et al.*. 1991, pp. 24-25). As beaches narrow, the reduced habitat can directly lower the diversity and abundance of biota (life forms), especially in the upper intertidal zone. Shorebirds may be impacted both by reduced habitat area for roosting and foraging, and by declining intertidal prey resources, as has been documented in California (Defeo *et al.*. 2009, p. 6; Dugan and Hubbard 2006, p. 10). In an estuary in England, Stillman *et al.*. (2005, pp. 203-204) found that a two to eight percent reduction in intertidal area (the magnitude expected through sea level rise and industrial developments including extensive stabilization structures) decreased the predicted survival rates of five out of nine shorebird species evaluated (although not of *Calidris canutus*).

In Delaware Bay, hard structures also cause or accelerate loss of horseshoe crab spawning habitat (CCSP 2009b, p. 82; Botton *et al.*. *in* Shuster *et al.*. 2003, p. 16; Botton *et al.*. 1988, entire), and shorebird habitat has been, and may continue to be, lost where bulkheads have been built (Clark *in* Farrell and Martin 1997, p. 24). In addition to directly eliminating red knot habitat, hard structures interfere with creation of new shorebird habitats by interrupting the natural processes of overwash and inlet formation. Where hard stabilization is installed, the eventual loss of the beach and its associated habitats is virtually assured (Rice 2009, p. 3), absent beach nourishment, which may also impact red knots as discussed below. Where they are maintained, hard structures are likely to significantly increase the amount of red knot habitat lost as sea levels continue to rise.

In a few isolated locations, however, hard structures may enhance red knot habitat, or may provide artificial habitat. In Delaware Bay, for example, Botton *et al.* (1994, p. 614) found that, in the same manner as natural shoreline discontinuities like creek mouths, jetties and other artificial obstructions can act to concentrate drifting horseshoe crab eggs and, thereby, attract shorebirds. Another example comes from the Delaware side of the bay, where a seawall and jetty at Mispillion Harbor protect the confluence of the Mispillion River and Cedar Creek. These structures create a low energy environment in the harbor that seem to provide highly suitable conditions for horseshoe crab spawning over a wider variation of weather and sea conditions than anywhere else in the bay (G. Breese pers. comm. March 25, 2013). Horseshoe crab egg densities at Mispillion Harbor are consistently an order of magnitude higher than at other bay beaches (Dey *et al.*. 2011a, p. 8) and this site consistently supports upwards of 15 to 20 percent of all the knots recorded in Delaware Bay (Lathrop 2005, p. 4). In Florida, A. Schwarzer (pers. comm. March 25, 2013) observed multiple instances of red knots using artificial structures such as docks, piers, jetties, causeways, and construction barriers; the Service has no information regarding the frequency, regularity, timing, or significance of this use of artificial habitats.

Notwithstanding localized red knot use of artificial structures, and the isolated case of hard structures improving foraging habitat at Mispillion Harbor, the nearly universal effect of such structures is degradation or loss of red knot habitat.

Shoreline Stabilization

Several types of sediment transport are employed to stabilize shorelines, protect development, maintain navigation channels, and provide for recreation (Gebert 2012, pp. 14, 16; Kana 2011, pp. 31-33; USACE 2002, p. I-3-7). The effects of these projects are typically expected to be relatively short in duration, usually less than 10 years, but often these actions are carried out every few years in the same area, resulting in a more lasting impact on habitat suitability for shorebirds. Mechanical sediment transport practices include beach nourishment, sediment backpassing, sand scraping, and dredging; each practice is discussed below.

Beach Nourishment

Beach nourishment is an engineering practice of deliberately adding sand (or gravel or cobbles) to an eroding beach, or the construction of a beach where only a small beach, or no beach, previously existed (National Research Council [NRC] 1995, pp. 23-24). Since the 1970s, 90 percent of the Federal appropriation for shore protection has been for beach nourishment (USACE 2002, p. I-3-21), which has become the preferred course of action to address shoreline erosion in the United States (Kana 2011, p. 33; Morton and Miller 2005, p. 1; Greene 2002, p. 5). Beach nourishment requires an abundant source of sand that is compatible with native beach material. The sand is trucked to the target beach or hydraulically pumped using dredges (Hafner 2012, p. 21). Sand for beach nourishment operations can be obtained from dry land-based sources; estuaries, lagoons, or inlets on the backside of the beach; sandy shoals in inlets and navigation channels; nearshore ocean waters; or offshore ocean waters, with the last two being the most common sources (Greene 2002, p. 6).

Where shorebird habitat has been severely reduced or eliminated by hard stabilization structures, beach nourishment may be the only means available to replace any habitat for as long as the hard structures are maintained (Nordstrom and Mauriello 2001, entire), although such habitat will persist only with regular nourishment episodes (typically on the order of every 2 to 6 years). In Delaware Bay, beach nourishment has been recommended to prevent loss of spawning habitat for horseshoe crabs (Kalasz 2008, p. 34; Carter *et al.*. *in* Guilfoyle *et al.*. 2007, p. 71; Atlantic States Marine Fisheries Commission (ASMFC) 1998, p. 28), and is being pursued as a means of restoring shorebird habitat in Delaware Bay following Hurricane Sandy (Niles *et al.*. 2013, entire; USACE 2012, entire). Beach nourishment was part of a 2009 project to maintain important shorebird foraging habitat at Mispillion Harbor, Delaware (Kalasz pers. comm. March 29, 2013; Siok and Wilson 2011, entire). However, red knots may be directly disturbed if beach nourishment takes place while the birds are present. On New Jersey's Atlantic coast, beach nourishment has typically been scheduled for the fall when red knots are present because of various constraints at other times of year. In addition to causing disturbance during construction, beach nourishment often increases recreational use of the widened beaches that, without careful management, can increase disturbance of red knots. Beach nourishment can also temporarily depress, and sometimes permanently alter, the invertebrate prey base on which shorebirds depend. These effects (disturbance, reduced food resources) are discussed further under Factor E below.

In addition to disturbing the birds and impacting the prey base, beach nourishment can affect the quality and quantity of red knot habitat (M. Bimbi pers. comm. November 1, 2012; Greene 2002, p. 5). The artificial beach created by nourishment may provide only suboptimal habitat for red knots, as a steeper beach profile is created when sand is stacked on the beach during the nourishment process. In some cases, nourishment is accompanied by planting of dense beach grasses, which can directly degrade habitat, as red knots require sparse vegetation to avoid predation. By precluding overwash and Aeolian transport, especially where large artificial dunes are constructed, beach nourishment can also lead to further erosion on the bayside and promote bayside vegetation growth, both of which can degrade the red knot's preferred foraging and roosting habitats (sparsely vegetated flats in or adjacent to intertidal areas). Preclusion of overwash also impedes formation of new red knot habitats. Beach nourishment can also encourage further development, bringing further habitat impacts, reducing future alternative management options such as a retreat from the coast, and perpetuating the developed and stabilized conditions that may ultimately lead to inundation where beaches are prevented from migrating (M. Bimbi pers. comm. November 1, 2012; Greene 2002, p. 5).

Following placement of sediments much coarser than those native to the beach, Peterson *et al.* (2006, p. 219) found that the area of intertidal-shallow subtidal shorebird foraging habitat was reduced by 14 to 29 percent at a site in North Carolina. Presence of coarse shell material armored the substrate surface against shorebird probing, further reducing foraging habitat by 33 percent, and probably also inhibiting manipulation of prey when encountered by a bird's bill (Peterson *et al.*. 2006, p. 219). (In addition to this physical change from adding coarse sediment, nourishment that places sediment dissimilar to the native beach also substantially increases impacts to the red knot's invertebrate prey base; see Factor E—Reduced Food Availability—Sediment Placement.) Lott (2009, p. viii) found a strong negative correlation between sand placement projects and the presence of piping plovers (*Charadrius melodus*) (nonbreeding) and snowy plovers (*Charadrius alexandrinus*) (breeding and nonbreeding) in Florida.

Shoreline Stabilization and Coastal Development–Summary

About 40 percent of the U.S. coastline within the range of the red knot is already developed, and much of this developed area is stabilized by a combination of existing hard structures and ongoing beach nourishment programs. In those portions of the range for which data are available (New Jersey and North Carolina to Texas), about 40 percent of inlets, a preferred red knot habitat, are hard-stabilized, dredged, or both. Hard stabilization structures and dredging degrade and often eliminate existing red knot habitats, and in many cases prevent the formation of new shorebird habitats. Beach nourishment may temporarily maintain suboptimal shorebird habitats where they would otherwise be lost as a result of hard structures, but beach nourishment also has adverse effects to red knots and their habitats. Demographic and economic pressures remain strong to continue existing programs of shoreline stabilization and to develop additional areas, with an estimated 20 to 33 percent of the coast still available for development. However, the Service expects existing beach nourishment programs will likely face eventual constraints of budget and sediment availability as sea level rises. In those times and places that artificial beach maintenance is abandoned, the remaining alternatives would likely be limited to either a retreat from the coast or increased use of hard structures to protect development. The quantity of red knot habitat would be markedly decreased by a proliferation of hard structures. Red knot habitat would be significantly increased by retreat, but only where hard stabilization structures do not exist or where they get dismantled. The cumulative loss of habitat across the nonbreeding range could affect the ability of red knots to complete their annual cycles, possibly affecting fitness and survival, and is thereby likely to negatively influence the long-term survival of the rufa red knot.

Invasive Vegetation

Defeo *et al.* (2009, p. 6) cited biological invasions of both plants and animals as global threats to sandy beaches, with the potential to alter food webs, nutrient cycling, and invertebrate assemblages. Although the extent of the threat is uncertain, this may be due to poor survey coverage more than an absence of invasions. The propensity of invasive species to spread, and their tenacity once established, make them a persistent problem that is only partially countered by increasing awareness and willingness of beach managers to undertake control efforts (USFWS 2012a, p. 27). Like most invasive species, exotic coastal plants tend to reproduce and spread quickly and exhibit dense growth habits, often outcompeting native plants. If left uncontrolled, invasive plants can cause a habitat shift from open or sparsely vegetated sand to dense vegetation, resulting in loss or degradation of red knot roosting habitat that is especially important during high tides and migration periods. Many invasive species are either affecting or have the potential to affect coastal beaches (USFWS 2012a, p. 27), and thus red knot habitat.

Japanese (or Asiatic) sand sedge (*Carex kobomugi*) is a 4- to 12-in (10- to 30-cm) tall perennial sedge adapted to coastal beaches and dunes (Plant Conservation Alliance 2005, p. 1; Invasive Plant Atlas of New England undated). The species occurs from Massachusetts to North Carolina

(U.S. Department of Agriculture (USDA) 2013) and spreads primarily by vegetative means through production of underground rhizomes (horizontal stems) (Plant Conservation Alliance 2005, p. 2). Japanese sand sedge forms dense stands on coastal dunes, outcompeting native vegetation and increasing vulnerability to erosion (Plant Conservation Alliance 2005, p. 1; Invasive Plant Atlas of New England undated). In the 2000s, Wootton (2009) documented rapid (exponential) growth in the spread of Japanese sand sedge at two New Jersey sites that are known to support shorebirds.

In summary, red knots require open habitats that allow them to see potential predators and that are away from tall perches used by avian predators. Invasive species, particularly woody species, degrade or eliminate the suitability of red knot roosting and foraging habitats by forming dense stands of vegetation. Although not a primary cause of habitat loss, invasive species can be a regionally important contributor to the overall loss and degradation of the red knot's nonbreeding habitat.

Predation–Nonbreeding Areas

In wintering and migration areas, the most common predators of red knots are peregrine falcons (*Falco peregrinus*), harriers (*Circus* spp.), accipiters (Family Accipitridae), merlins (*F. columbarius*), shorteared owls (*Asio flammeus*), and greater black-backed gulls (*Larus marinus*) (Niles *et al.* 2008, p. 28). In addition to greater black-backed gulls, other large gulls (e.g., herring gulls (*Larus argentatus*)) are anecdotally known to prey on shorebirds (Breese 2010, p. 3). Predation by a great horned owl (*Bubo virginianus*) has been documented in Florida (A. Schwarzer pers. comm. June 17, 2013). Nearly all documented predation of wintering red knots in Florida has been by avian, not terrestrial, predators (A. Schwarzer pers. comm. June 17, 2013). However, in migration areas like Delaware Bay, terrestrial predators such as red foxes (*Vulpes vulpes*) and feral cats (*Felis catus*) may be a threat to red knots by causing disturbance, but direct mortality from these predators may be low (Niles *et al.* 2008, p. 101).

Peregrine falcons have been seen frequently along beaches in Texas, where dunes would provide good cover for peregrines preying on red knots foraging along the narrow beachfront (Niles *et al.*. 2009, p. 2). Peregrines are known to hunt shorebirds in the red knot's Virginia and Delaware Bay stopover areas (Niles 2010a; Niles *et al.* 2008, p. 106), and peregrine predation on red knots has been observed in Florida (A. Schwarzer pers. comm. June 17, 2013).

Red knots' selection of high-tide roosting areas on the coast appears to be strongly influenced by raptor predation, something well demonstrated in other shorebirds (Niles *et al.*. 2008, p. 28). Red knots require roosting habitats away from vegetation and structures that could harbor predators (Niles *et al.*. 2008, p. 63). Red knots' usage of foraging habitat can also be affected by the presence of predators, possibly affecting the birds' ability to prepare for their final flights to the arctic breeding grounds (Watts 2009b) (e.g., if the knots are pushed out of those areas with the highest prey density or quality). In 2010, horseshoe crab egg densities were very high in Mispillion Harbor, Delaware, but red knot use was low because peregrine falcons were regularly hunting shorebirds in that area (Niles 2010a). Growing numbers of peregrine falcons on the Delaware Bay and New Jersey's Atlantic coasts are decreasing the suitability of a number of important shorebird areas (Niles 2010a). Analyzing survey data from the Virginia stopover area, Watts (2009b) found the density of red knots far (greater than 3.7 mi (6 km)) from peregrine nests was nearly eight times higher than close (0 to 1.9 mi (0 to 3 km)) to peregrine nests. In addition, red knot density in Virginia was significantly higher close to peregrine nests during those years when peregrine territories were not active compared to years when they were (Watts 2009b). Similar results were found for other *Calidris canutus* subspecies in the Dutch Wadden Sea where the spatial distribution of *C. canutus* was best explained by both food availability and avoidance of predators (Piersma *et al.*. 1993, p. 331).

We conclude that, outside of the breeding grounds (which are discussed below), predation is not directly impacting red knot populations despite some direct mortality. At key stopover sites, however, localized predation pressures are likely to exacerbate other threats to red knot populations, such as habitat loss, food shortages, and asynchronies between the birds' stopover period and the occurrence of favorable food and weather conditions. Predation pressures worsen these threats by pushing red knots out of otherwise suitable foraging and roosting habitats, causing disturbance, and possibly causing changes to stopover duration or other aspects of the migration strategy.

Reduced Food Availability

Commercial harvest of horseshoe crabs has been implicated as a causal factor in the decline of the rufa red knot by decreasing the availability of horseshoe crab eggs in the Delaware Bay stopover (Niles *et al.*. 2008, pp. 1-2). Notwithstanding the importance of the horseshoe crab and Delaware Bay, other lines of evidence suggest that the rufa red knot also faces threats to its food resources throughout its range. The following discussion addresses known or likely threats to the abundance or quality of red knot prey. Potential food shortages caused by asynchronies ("mismatches") in the red knot's annual cycle are discussed in the next section. Also see Factor A–Agriculture and Aquaculture, above, regarding clam farming practices in Canada that impact red knot prey resources by modifying suitable foraging habitat via sediment sifting. Although threats to food quality and quantity are widespread, red knots in localized areas have shown some ability to switch prey when the preferred prey species became reduced (Escudero *et al.*. 2012, pp. 359, 362; Musmeci *et al.*. 2011, entire), suggesting some adaptive capacity to cope with this threat.

Food Availability

The quantity and quality of red knot prey may also be affected by the placement of sediment for beach nourishment or disposal of dredged material (see Factor A above for a discussion of the extent of these practices in the United States and their effects on red knot habitat). Invertebrates may be crushed or buried during project construction. Although some benthic species can burrow through a thin layer of additional sediment, thicker layers (over 35 in (90 cm)) smother the benthic fauna (Greene 2002, p. 24). By means of this vertical burrowing, recolonization from adjacent areas, or both, the benthic faunal communities typically recover. Recovery can take as little as 2 weeks or as long as 2 years, but usually averages 2 to 7 months (Greene 2002, p. 25; Peterson and Manning 2001, p. 1). Although many studies have concluded that invertebrate communities recovered following sand placement, study methods have often been insufficient to detect even large changes (e.g., in abundance or species composition), due to high natural variability and small sample sizes (Peterson and Bishop 2005, p. 893). Therefore, uncertainty remains about the effects of sand placement on invertebrate communities and how these impacts may affect red knots.

The invertebrate community structure and size class distribution following sediment placement may differ considerably from the original community (Zajac and Whitlatch 2003, p. 101; Peterson and Manning 2001, p. 1; Hurme and Pullen 1988, p. 127). Recovery may be slow or incomplete if placed sediments are a poor grain size match to the native beach substrate (Bricker 2012, pp. 31-33; Peterson *et al.*. 2006, p. 219; Greene 2002, pp. 23-25; Peterson *et al.*. 2000, p. 368; Hurme and Pullen 1988, p. 129) or if placement occurs during a seasonal low point in invertebrate abundance (Burlas 2001, p. 2-20). Recovery is also affected by the beach position and thickness of the deposited material (Schlacher *et al.*. 2012, p. 411). If the profile of the nourished beach and the imported sediments do not match the original conditions, recovery of the benthos is unlikely (Defeo *et al.*. 2009, p. 4). Reduced prey quantity and accessibility caused by a poor sediment size match have been shown to affect shorebirds, causing temporary but large (70 to 90 percent) declines in local shorebird abundance (Peterson *et al.*. 2006, pp. 205, 219).

Beach nourishment is a regular practice on the Delaware side of Delaware Bay and can affect spawning habitat for horseshoe crabs. Although beach nourishment generally preserves habitat value better than hard stabilization structures, nourishment can enhance, maintain, or decrease habitat value depending on beach geometry and sediment matrix (Smith *et al.*. 2002a, p. 5). In a field study in 2001 and 2002, Smith *et al.*. (2002a, p. 45) found a stable or increasing amount of spawning activity at beaches that were recently nourished while spawning activity at control beaches declined. These authors also found that beach characteristics affect horseshoe crab egg development and viability. Avissar (2006, p. 427) modeled nourished versus control beaches and found that nourishment may compromise egg development and viability. Despite possible drawbacks, beach nourishment has been recommended to prevent the loss of spawning habitat for horseshoe crabs (Kalasz 2008, p. 34; Carter *et al.*. *in* Guilfoyle *et al.*. 2007, p. 71; ASMFC 1998, p. 28) and is being pursued as a means of restoring shorebird habitat in Delaware Bay following Hurricane Sandy (Niles *et al.*. 2013, entire; USACE 2012, entire). In areas of

Delaware Bay with hard stabilization structures or high erosion rates, beach nourishment may be the only option for maintaining habitat.

Food Availability–Recreational Activities

Recreational activities can likewise affect the availability of shorebird food resources by causing direct mortality of prey. Studies from the United States and other parts of the world have documented recreational impacts to beach invertebrates, primarily from the use of off-road vehicles (ORVs), but even heavy pedestrian traffic can have effects. Few studies have examined the potential link between these invertebrate impacts and shorebirds. However, several studies on the effects of recreation on invertebrates are considered the best available information as they involve species and habitats similar to those used by red knots.

In many areas, habitat for the piping plover overlaps considerably with red knot habitats. A preliminary review of ORV use at piping plover wintering locations (from North Carolina to Texas) suggests that ORV impacts may be most widespread in North Carolina and Texas (USFWS 2009, p. 46). Although red knots normally feed low on the beach, they may also utilize the wrack line (see the "Migration and Wintering Habitat" section of the Rufa Red Knot Ecology and Abundance supplemental document, and Factor A–Beach Cleaning). Kluft and Ginsberg (2009, p. vi) found that ORVs killed and displaced invertebrates and lowered the total amount of wrack, in turn lowering the overall abundance of wrack dwellers. In the intertidal zone, invertebrate abundance is greatest in the top 12 in (30 cm) of sediment (Carley *et al.*. 2010, p. 9). Intertidal fauna are burrowing organisms, typically 2 to 4 in (5 to 10 cm) deep; burrowing may ameliorate direct crushing. However, shear stress of ORVs can penetrate up to 12 in (30 cm) into the sand (Schlacher and Thompson 2007, p. 580).

Some early studies found minimal impacts to intertidal beach invertebrates from ORV use (Steinback and Ginsberg 2009, pp. 4-6; Van der Merwe and Van der Merwe 1991, p. 211; Wolcott and Wolcott 1984, p. 225). However, some attempts to determine whether ORVs had an impact on intertidal fauna have been unsuccessful because the naturally high variability of these invertebrate communities masked any effects of vehicle damage (Stephenson 1999, p. 16). Based on a review of the literature through 1999, Stephenson (1999, p. 33) concluded that vehicle impacts on the biota of the foreshore (intertidal zone) of sandy beaches have appeared to be minimal, at least when the vehicle use occurred during the day when studies typically take place, but very few elements of the foreshore biota had been examined.

Other studies have found higher impacts to benthic invertebrates from driving (Sheppard *et al.*. 2009, p. 113; Schlacher *et al.*. 2008b, pp. 345, 348; Schlacher *et al.*. 2008c, pp. 878, 882; Wheeler 1979, p. iii), although it can be difficult to discern results specific to the wet sand zone where red knots typically forage. Due to the compactness of sediments low on the beach profile, driving in this zone is thought to minimize impacts to the invertebrate community. However, the relative vulnerability of species in this zone is not well known; driving low on the beach may expose a larger proportion of the total intertidal fauna to vehicles (Schlacher and Thompson 2007, p. 581). The severity of direct impacts (e.g., crushing) depends on the compactness of the sand, the sensitivity of individual species, and the depth at which they are buried in the sand (Schlacher *et al.*. 2008b, p. 348; Schlacher *et al.*. 2008c, p. 886). At least one study documented a positive response of shorebird populations following the exclusion of ORVs (Defeo *et al.*. 2009, p. 3; Williams *et al.*. 2004, p. 79), although the response could have been due to decreased disturbance (discussed below) as well as (or instead of) increased prey availability following the closure.

Food Availability–Horseshoe Crab Harvest

Reduced food availability at the Delaware Bay stopover site due to commercial harvest and subsequent population decline of the horseshoe crab is considered a primary causal factor in the decline of the rufa subspecies in the 2000s (Escudero *et al.*. 2012, p. 362; McGowan *et al.*. 2011a, pp. 12-14; CAFF 2010, p. 3; Niles *et al.*. 2008, pp. 1-2; COSEWIC 2007, p. vi; González *et al.*. 2006, p. 114; Baker *et al.*. 2004, p. 875; Morrison *et al.*. 2004, p. 67), although other possible causes or contributing factors have been postulated (Fraser *et al.*. 2013, p. 13; Schwarzer *et al.*. 2012, pp. 725, 730-731; Escudero *et al.*. 2012, p. 362; Espoz *et al.*. 2008, p. 74; Niles *et al.*. 2008, p. 101; also see Asynchronies, below). Due to harvest restrictions and other conservation actions, horseshoe crab populations showed some signs of recovery in the early 2000s, with apparent signs of red knot stabilization (survey counts, rates of weight gain) occurring a few years later (as might be expected due to biological lag times). Since about 2005, however, horseshoe crab population growth has stagnated for unknown reasons.

Under the current management framework (known as Adaptive Resource Management, or ARM), the present horseshoe crab harvest is not considered a threat to the red knot because harvest levels are tied to red knot populations via scientific modeling. Most data suggest that the volume of horseshoe crab eggs is currently sufficient to support the Delaware Bay's stopover population of red knots at its present size. However, because of the uncertain trajectory of horseshoe crab population growth, it is not yet known if the egg resource will continue to adequately support red knot populations over the next 5 to 10 years. In addition, implementation of the ARM could be impeded by insufficient funding for the shorebird and horseshoe crab monitoring programs that are necessary for the functioning of the ARM models.

Many studies have established that red knots stopping over in Delaware Bay during spring migration achieve remarkable and important weight gains to complete their migrations to the breeding grounds by feeding almost exclusively on a superabundance of horseshoe crab eggs (see the “Wintering and Migration Food” section of the Rufa Red Knot Ecology and Abundance supplemental document). A temporal correlation occurred between increased horseshoe crab harvests in the 1990s and declining red knot counts in both Delaware Bay and Tierra del Fuego by the 2000s. Other shorebird species that rely on Delaware Bay also declined over this period (Mizrahi and Peters *in* Tanacredi *et al.*. 2009, p. 78), although some shorebird declines began before the peak expansion of the horseshoe crab fishery (Botton *et al.*. *in* Shuster *et al.*. 2003, p. 24).

The causal chain from horseshoe crab harvest to red knot populations has several links, each with different lines of supporting evidence and various levels of uncertainty: (a) horseshoe crab harvest levels and Delaware Bay horseshoe crab populations (Link A); (b) horseshoe crab populations and red knot weight gain during the spring stopover (Link B); and (c) red knot weight gain and subsequent rates of survival, reproduction, or both (Link C). The weight of evidence supporting each of these linkages is discussed below. Despite the various levels of uncertainty, the weight of evidence supports these linkages, points to past harvest as a key factor in the decline of the red knot, and underscores the importance of continued horseshoe crab management to meet the needs of the red knot.

Human Disturbance

In some wintering and stopover areas, red knots and recreational users (e.g., pedestrians, ORVs, dog walkers, boaters) are concentrated on the same beaches (Niles *et al.*. 2008, pp. 105-107; Tarr 2008, p. 134). Recreational activities affect red knots both directly and indirectly. These activities can cause habitat damage (Schlacher and Thompson 2008, p. 234; Anders and Leatherman 1987, p. 183), cause shorebirds to abandon otherwise preferred habitats, negatively affect the birds' energy balances, and reduce the amount of available prey (see Reduced Food Availability, above). Effects to red knots from vehicle and pedestrian disturbance can also occur during construction of shoreline stabilization projects including beach nourishment. Red knots can also be disturbed by motorized and nonmotorized boats, fishing, kite surfing, aircraft, and research activities (K. Kalasz pers. comm. November 17, 2011; Niles *et al.*. 2008, p. 106; Peters and Otis, 2007, p. 196; Harrington 2005b, pp. 14-15; 19-21; Meyer *et al.*. 1999, p. 17; Burger 1986, p. 124) and by beach raking (also called grooming or cleaning, see Factor A above). In Delaware Bay, red knots could also potentially be disturbed by hand-harvest of horseshoe crabs (see Reduced Food Availability, above) during the spring migration stopover period, but under the current management of this fishery State waters from New Jersey to coastal Virginia are closed to horseshoe crab harvest and landing from January 1 to June 7 each year (ASMFC 2012a, p. 4); thus, disturbance from horseshoe crab harvest is no longer occurring. Active management can be effective at reducing and minimizing the adverse effects of recreational disturbance (Burger and Niles in press, entire; Forys 2011, entire; Burger *et al.*. 2004, entire), but such management is not occurring throughout the red knot's range.

Disturbance–Timing and Extent

Although the timing, frequency, and duration of human and dog presence throughout the red knot's U.S. range are not fully known, periods of recreational use tend to coincide with the knot's spring and fall migration periods (Western Hemisphere Shorebird Reserve Network [WHSRN] 2012; Maddock *et al.*. 2009, entire; Mizrahi 2002, p. 2; Johnson and Baldassarre 1988, p. 220; Burger 1986, p. 124). Burger (1986, p. 128) found that red knots and other shorebirds at two sites in New Jersey reacted more strongly to disturbance (i.e., flew away from the beach where they were foraging or roosting) during peak migration periods (May and August) than in other months.

Human disturbance within otherwise suitable red knot migration and winter foraging or roosting areas was reported by biologists as negatively affecting red knots in Massachusetts, Virginia, North Carolina, South Carolina, Georgia, and Florida (USFWS 2011b, p. 29). Some disturbance issues also remain in New Jersey (both Delaware Bay and the Atlantic coast) despite ongoing, and largely successful, management efforts since 2003 (New Jersey Department of Environmental Protection [NJDEP] 2013; USFWS 2011b, p. 29; Niles *et al.*. 2008, pp. 105-106). Delaware also has a management program in place to limit disturbance (Kalasz 2008, pp. 36-38). In Florida, the most immediate and tangible threat to migrating and wintering red knots is apparently chronic disturbance (Niles *et al.*. 2008, p. 106; Niles *et al.*. 2006, entire) that may be affecting the ability of birds to maintain adequate weights in some areas (Niles 2009, p. 8).

Disturbance–Precluded Use of Preferred Habitats

Where shorebirds are habitually disturbed, they may be pushed out of otherwise preferred roosting and foraging habitats (Colwell *et al.*. 2003, p. 492; Lafferty 2001a, p. 322; Luís *et al.*. 2001, p. 72; Burton *et al.*. 1996, pp. 193, 197-200; Burger *et al.*. 1995, p. 62). Roosting knots are particularly vulnerable to disturbance because birds tend to concentrate in a few small areas during high tides; availability of suitable roosting habitats is already constrained by predation pressures and energetic costs such as traveling between roosting and foraging areas (L. Niles pers. comm. November 19, 2012; Rogers *et al.*. 2006a, p. 563; Colwell *et al.*. 2003, p. 491; Rogers 2003, p. 74).

Exclusion of shorebirds from preferred habitats due to disturbance has been noted throughout the red knot's nonbreeding range. For example, Pfister *et al.*. (1992, p. 115) found sharper declines in red knot abundance at a disturbed site in Massachusetts than at comparable, but less disturbed areas. On the Atlantic coast of New Jersey, findings by Mizrahi (2002, p. 2) generally suggest a negative relationship between human and shorebird densities; specifically, sites that allowed swimming had the greatest densities of people and the fewest shorebirds. At two sites on the Atlantic coast of New Jersey, Burger and Niles (in press) found that disturbed shorebird flocks often did not return to the same place or even general location along the beach once they were disturbed, with return rates at one site of only eight percent for monospecific red knot flocks. In Delaware Bay, Karpanty *et al.*. (2006, p. 1707) found that potential disturbance reduced the probability of finding red knots on a given beach, although the effect of disturbance was secondary to the influence of prey resources. In Florida, sanderlings seemed to concentrate where there were the fewest people (Burger and Gochfeld 1991, p. 263). From 1979 to 2007, the mean abundance of red knots on Mustang Island, Texas, decreased 54 percent, while the mean number of people on the beach increased fivefold (Foster *et al.*. 2009, p. 1079). In 2008, Escudero *et al.*. (2012, p. 358) found that human disturbance pushed red knots off prime foraging areas near Río Grande in Argentinean Tierra del Fuego, and that disturbance was the main factor affecting roost site selection.

Although not specific to red knot, Forgues (2010, p. ii) found the abundance of shorebirds declined with increased ORV frequency, as did the number and size of roosts. Study sites with high ORV activity and relatively high invertebrate abundance suggest that shorebirds may be excluded from prime food sources due to disturbance from ORV activity itself (Forgues 2010, p. 7). Tarr (2008, p. 133) found that disturbance from ORVs decreased shorebird abundance and altered shorebird habitat use. In experimental plots, shorebirds decreased their use of the wet sand microhabitat and increased their use of the swash zone in response to vehicle disturbance (Tarr 2008, p. 144).

Oil Spills and Leaks

The red knot has the potential to be exposed to oil spills and leaks throughout its migration and wintering range. Oil, as well as spill response activities, can directly and indirectly affect both the bird and its habitat through several pathways. Red knots can be exposed to petroleum products via spills from shipping vessels, leaks or spills from offshore oil rigs or undersea pipelines, leaks or spills from onshore facilities such as petroleum refineries and petrochemical plants, and beach-stranded barrels and containers that can fall from moving cargo ships or offshore rigs. Several key red knot wintering or stopover areas also contain large-scale petroleum extraction, transportation, or both activities. With regard to potential effects on red knot habitats, the geographic location of a spill, weather conditions (e.g., prevailing winds), and type of oil spilled are as important, if not more so, than the volume of the discharge.

Oil Spills–Summary

Red knots are exposed to large-scale petroleum extraction and transportation operations in many key wintering and stopover habitats including Tierra del Fuego, Patagonia, the Gulf of Mexico, Delaware Bay, and the Gulf of St. Lawrence. To date, documented effects to red knots from oil spills and leaks have been minimal; however, information regarding any oiling of red knots during the Deepwater Horizon spill has not yet been released. We conclude that high potential exists for small or medium spills to impact moderate numbers of red knots or their habitats, such that one or more such events is likely over the next few decades, based on the proximity of key red knot habitats to high-volume oil operations. Risk of a spill may decrease with improved spill contingency planning, infrastructure safety upgrades, and improved spill response and recovery methods. However, these decreases in risk (e.g., per barrel extracted or transported) could be offset if the total volume of petroleum extraction and transport continues to grow. A major spill affecting habitats in a key red knot concentration area (e.g., Tierra del Fuego, Gulf coasts of Florida or Texas, Delaware Bay, Mingan Archipelago) while knots are present is less likely but would be expected to cause population-level impacts.

Contaminants

Red knots are exposed to a variety of contaminants across their nonbreeding range. Exposure risks exist in localized red knot habitats in Canada, but best available data suggest shorebirds in Canada are not impacted by background levels of contamination. Levels of trace heavy metals in red knot feathers from the Delaware Bay have been somewhat high, but generally similar to levels reported from other studies of shorebirds. One preliminary study suggests organochlorines and trace metals are not elevated in Delaware Bay shorebirds, although this finding cannot be confirmed without updated testing. Levels of metals in horseshoe crabs are generally low in the Delaware Bay region and not likely impacting red knots or recovery of the crab population.

Horseshoe crab reproduction does not appear impacted by the mosquito control chemical methoprene (at least through the first juvenile molt) or by ambient water quality in mid-Atlantic estuaries. Shorebirds have been impacted by pesticide exposure, but use of the specific chemical that caused a piping plover death in Florida has subsequently been banned in the United States. Exposure of shorebirds to agricultural pollutants in rice fields may occur regionally in parts of South America, but red knot usage of rice field habitats was low in the several countries surveyed. Finally, localized urban pollution has been shown to impact South American red knot habitats, but the Service is unaware of any documented health effects or population-level impacts. Thus, the Service concludes that environmental contaminants are not a threat to the red knot. However, see Cumulative Effects, below, regarding an unlikely, but potentially high-impact synergistic effect among avian influenza, environmental contaminants, and climate change in Delaware Bay.

Conservation Efforts

Many components are being partially managed through conservation efforts. For example, the reduced availability of horseshoe crab eggs from the past overharvest of crabs in Delaware Bay is currently being managed through the ASMFC's ARM framework (see Reduced Food Availability, above, and supplemental document). This conservation effort more than others is likely having the greatest effect on the red knot subspecies as a whole because a large majority of the birds move through Delaware Bay during spring migration and depend on a superabundant supply of horseshoe crab eggs for refueling. Other factors potentially influencing horseshoe crab egg availability are outside the scope of the ARM, but some are being managed. For example, enforcement is ongoing to minimize poaching, and steps are being implemented to prevent the importation of nonnative horseshoe crab species that could impact native populations. Despite the ARM and other conservation efforts, horseshoe crab population growth has stagnated for unknown reasons, some of which (e.g., possible ecological shifts) may not be manageable. See regarding threats to, and conservation efforts to maintain, horseshoe crab spawning habitat.

Some threats to the red knot's other prey species (mainly mollusks) are being partially addressed. For example, the Service is working with partners to minimize the effects of shoreline stabilization projects on the invertebrate prey base for shorebirds (e.g., Rice 2009, entire), and management of ORVs is protecting the invertebrate prey resource in some areas. Other likely threats to the red knot's mollusk prey base (e.g., ocean acidification; warming coastal waters; marine diseases, parasites, and invasive species) cannot be managed at this time, although efforts to minimize ballast water discharges in coastal areas likely reduce the potential for introduction of new invasive species.

Other smaller-scale conservation efforts implemented to reduce Factor E threats include beach recreation management to reduce human disturbance, gull species population monitoring and management in Delaware Bay, research into HAB control, oil spill response plan development and implementation, sewage treatment in Río Gallegos (Argentina), and national and state wind turbine siting and operation guidelines. In contrast, no known conservation actions are available to address asynchronies during the annual cycle.

III. ENVIRONMENTAL BASELINE

Section III of the Piping Plover Biological Opinion describing the beach stabilization activities and dredging activities that have impacted intertidal foraging habitats on Long Island is incorporated by reference.

Status of the species within the action area

As stated above, the Service is not aware of comprehensive monitoring of red knots on Long Island, New York, or within the action area. Some data are available from individual birders or associated with horseshoe crab monitoring. Individual birders have documented red knot presence at: Democrat Point (west end of Fire Island-August 2012 – 2 red knots), Robert Moses State Park (August 2013 – 8 red knots), and Smith Point County Park (September of 2011 – 4 red knots) (Ebird website-http://ebird.org/ebird/subnational2/US-NY-103/hotspots)

Horseshoe Crab Presence in Action Area

Red knot presence is expected to be present within the action area specifically during spring and fall migrations where concentrations of horseshoe crab spawning occurs.

Although the Service is not aware of comprehensive horseshoe crab and/or red knot surveys being conducted within the FIMI area, the New York State Department of Environmental Conservation [NYSDEC] and Cornell University Cooperative Extension are monitoring horseshoe crab spawning activity at select sites on Long Island, including two sites within the Fire Island to Montauk Point [FIMP] study area, Captree Island (within the FIMI), and Pikes Beach (east of the FIMI within the FIMP) Westhampton (Cornell University Cooperative Extension website: http://counties.cce.cornell.edu/suffolk/Vanderbilt/Horseshoe-research.htm). The NYSDEC has indicated that Pikes Beach is a heavily utilized area for horseshoe crab spawning (Sclafani pers. comm. 2007), but has identified the majority of the bay shoreline of Fire Island as potential spawning habitat (Sclafani *et al.*. 2009). One hundred and thirteen horseshoe crabs were observed spawning at Captree Island in 2007, where peak spawning occurred on June 3 (Sclafani *et al.*. 2009). Similar habitats along bay intertidal flats and/or marshes are expected to have horseshoe crab spawning activity and associated red knot foraging.

The National Park Service has also conducted intermittent horseshoe crab surveys at select Fire Island bay shoreline locations during spawning in May and June during the years of 2011-2013. Peak male and female (combined) crab numbers include: 307 at the FIIS Lighthouse area in 2011, 126 in the FIIS Wilderness in 2011, 577 at Davis Park in 2011, and 9727 at FIIS Talisman area in 2012 (Rafferty *et al.*. 2013).

IV. EFFECTS OF THE ACTION

Effects of Recreation

Recreational activities within the action area include, but are not limited to, recreational ORV driving, beach bathing, kite surfing, boating and boat landing on the bay shoreline, clamming, and fishing. The proposed action will create wider ocean beaches and possibly particular bay beaches (as part of the piping plover habitat restoration/creation effort) that will likely increase the amount of recreational activities within suitable red knot foraging and roosting areas where red knots are likely to occur (ocean and bay intertidal and wrack line areas). This increase in recreational activities could increase the amount of disturbance to foraging and roosting red knots as well as alter the wrack line foraging habitat along the ocean shoreline. However, the proposed action will avoid important bay shore horseshoe crab spawning/red knot foraging areas at the FIIS Lighthouse tract, FIIS Wilderness Area, FIIS at Davis Park, and FIIS at Talisman, as well as Democrat Point, a location where red knots were documented to occur.

Further information on the effects of the potential increase in recreation are excerpted from Endangered and Threatened Wildlife and Plants: Proposed Threatened Status for the Rufa Redknot (*Calidris canutus rufa*); Proposed Rule (USFWS 2013):

Recreational activities affect red knots both directly and indirectly. These activities can cause habitat damage (Schlacher and Thompson 2008, p. 234; Anders and Leatherman 1987, p. 183), cause shorebirds to abandon otherwise preferred habitats, negatively affect the birds' energy balances, and reduce the amount of available prey. Effects to red knots from vehicle and pedestrian disturbance can also occur during construction of shoreline stabilization projects including beach nourishment. Red knots can also be disturbed by motorized and nonmotorized boats, fishing, kite surfing, aircraft, and research activities (K. Kalasz pers. comm. November 17, 2011; Niles *et al.* 2008, p. 106; Peters and Otis, 2007, p. 196; Harrington 2005b, pp. 14-15; 19- 21; Meyer *et al.* 1999, p. 17; Burger 1986, p. 124) and by beach raking (also called grooming or cleaning).

Recreational activities can likewise affect the availability of shorebird food resources by causing direct mortality of prey. Studies from the United States and other parts of the world have documented recreational impacts to beach invertebrates, primarily from the use of ORVs, but even heavy pedestrian traffic can have effects. Few studies have examined the potential link between these invertebrate impacts and shorebirds. However, several studies on the effects of recreation on invertebrates are considered the best available information, as they involve species and habitats similar to those used by red knots.

Although pedestrians exert relatively low ground pressures, extremely heavy foot traffic can cause direct crushing of intertidal invertebrates. In many areas, habitat for the piping plover overlaps considerably with red knot habitats. A preliminary review of ORV use at piping plover wintering locations (from North Carolina to Texas) suggests that ORV impacts may be most widespread in North Carolina and Texas (USFWS 2009, p. 46). Although red knots normally feed low on the beach, they may also utilize the wrack line. Kluft and Ginsberg (2009, p. vi) found that ORVs killed and displaced invertebrates and lowered the total amount of wrack, in turn lowering the overall abundance of wrack dwellers. In the intertidal zone, invertebrate abundance is greatest in the top 12 in (30 cm) of sediment (Carley *et al.*. 2010, p. 9). Intertidal fauna are burrowing organisms, typically 2 to 4 in (5 to 10 cm) deep; burrowing may ameliorate direct crushing. However, shear stress of ORVs can penetrate up to 12 in (30 cm) into the sand (Schlacher and Thompson 2007, p. 580). Some early studies found minimal impacts to intertidal beach invertebrates from ORV use (Steinback and Ginsberg 2009, pp. 4-6; van der Merwe and van der Merwe 1991, p. 211; Wolcott and Wolcott 1984, p. 225). However, some attempts to determine whether ORVs had an impact on intertidal fauna have been unsuccessful because the naturally high variability of these invertebrate communities masked any effects of vehicle damage (Stephenson 1999, p. 16).

Other studies have found higher impacts to benthic invertebrates from driving (Sheppard *et al.*. 2009, p. 113; Schlacher *et al.*. 2008b, pp. 345, 348; Schlacher *et al.*. 2008c, pp. 878, 882; Wheeler 1979, p. iii), although it can be difficult to discern results specific to the wet sand zone where red knots typically forage. The severity of direct impacts (e.g., crushing) depends on the compactness of the sand, the sensitivity of individual species, and the depth at which they are buried in the sand (Schlacher *et al.*. 2008b, p. 348; Schlacher *et al.*. 2008c, p. 886).

The extent to which mortality of beach invertebrates from recreational activities propagates through food webs is unresolved (Defeo *et al.*. 2009, p. 3). However, the Service concludes that these activities likely cause at least localized reductions in red knot prey availability.

Effects of Predation

A stated in Section III above, localized predation can exacerbate other threats to red knot populations. Red fox use dunes, proposed to occur along the ocean shoreline, as denning sites and forages on the ocean beach, in the interdunal area, and in the bayside habitat. Hunting efficiency of foxes and other predators may be increased by confining red knot forage areas to narrow, predictable bands of linear ocean and bay habitats. Past and ongoing stabilization projects fundamentally alter the naturally dynamic coastal processes that create and maintain beach strand and bayside habitats, including those habitat components on which knots rely. Past loss of stopover habitat likely reduces the resilience of the red knot by making it more dependent on those habitats that remain, and more vulnerable to threats, including predation, within those restricted habitats (USFWS 2013).

Effects of Prey Resource Burial

The proposed beach nourishment project would bury ocean beach and particular bayside invertebrate prey species and wrack line foraging habitat of the red knot. Although this impact would be temporary as the benthic community will recover, this recovery could take up to two years (Greene 2002, Peterson and Manning 2001). However, as stated above, the proposed action will avoid the important bay shore horseshoe crab spawning/red knot foraging areas at the FIIS Lighthouse tract, FIIS Wilderness Area, FIIS at Davis Park, and FIIS at Talisman, as well as Democrat Point, a location where red knots were documented to occur.

Further information on the effects of prey resource burial are excerpted from Endangered and Threatened Wildlife and Plants: Proposed Threatened Status for the Rufa Redknot (*Calidris canutus rufa*); Proposed Rule (USFWS 2013):

The quantity and quality of red knot prey may also be affected by the placement of sediment for beach nourishment or disposal of dredged material. Invertebrates may be crushed or buried during project construction. Although some benthic species can burrow through a thin layer of additional sediment, thicker layers (over 35 in (90 cm)) smother the benthic fauna (Greene 2002, p. 24). By means of this vertical burrowing, recolonization from adjacent areas, or both, the benthic faunal communities typically recover. Recovery can take as little as 2 weeks or as long as 2 years, but usually averages 2 to 7 months (Greene 2002, p. 25; Peterson and Manning 2001, p. 1).

Recovery may be slow or incomplete if placed sediments are a poor grain size match to the native beach substrate (Bricker 2012, pp. 31-33; Peterson *et al.*. 2006, p. 219; Greene 2002, pp. 23-25; Peterson *et al.*. 2000, p. 368; Hurme and Pullen 1988, p. 129), or if placement occurs during a seasonal low point in invertebrate abundance (Burlas 2001, p. 2-20). If the profile of the nourished beach and the imported sediments do not match the original conditions, recovery of the benthos is unlikely (Defeo *et al.*. 2009, p. 4). Reduced prey quantity and accessibility caused by a poor sediment size match have been shown to affect shorebirds, causing temporary, but large (70 to 90 percent) declines in local shorebird abundance (Peterson *et al.*. 2006, pp. 205, 219).

Beach nourishment can affect spawning habitat for horseshoe crabs. Although beach nourishment generally preserves habitat value better than hard stabilization structures, nourishment can enhance, maintain, or decrease habitat value depending on beach geometry and sediment matrix (Smith *et al.*. 2002a, p. 5). In a field study in 2001 and 2002, Smith *et al.*. (2002a, p. 45) found a stable or increasing amount of spawning activity at beaches that were recently nourished while spawning activity at control beaches declined. These authors also found that beach characteristics affect horseshoe crab egg development and viability. Avissar (2006, p. 427) modeled nourished versus control beaches and found that nourishment may compromise egg development and viability. Despite possible drawbacks, beach nourishment has been recommended to prevent loss of spawning habitat for horseshoe crabs (Kalasz 2008, p. 34; Carter *et al.*. *in* Guilfoyle *et al.*. 2007, p. 71; ASMFC 1998, p. 28) and is being pursued as a means of restoring shorebird habitat in Delaware Bay following Hurricane Sandy (Niles *et al.*. 2013, entire; USACE 2012, entire).

Direct Effects of Working When Red Knots Are Present

The proposed action is proposed to initiate in the fall of 2014 and continue for two consecutive years. Red knots are expected to occur in the action area during the spring (April-June) and fall (August-October) months. Construction activities are likely to disturb foraging and roosting red knots along the ocean shoreline where they may occur and, in particular, bayside habitats where piping plover habitat restoration/creation may occur. However, as stated above, the proposed action will avoid the important bay shore horseshoe crab spawning/red knot foraging areas at the FIIS Lighthouse tract, FIIS Wilderness Area, FIIS at Davis Park, and FIIS at Talisman, as well as Democrat Point, a location where red knots were documented to occur.

Further information on the effects of working when red knots may be present are excerpted from Endangered and Threatened Wildlife and Plants: Proposed Threatened Status for the Rufa Redknot (*Calidris canutus rufa*); Proposed Rule (USFWS 2013):

Red knots may be directly disturbed if beach nourishment takes place while the birds are present. Beach nourishment has typically been scheduled for the fall when red knots are present because of various constraints at other times of year. In addition to causing disturbance during construction, beach nourishment often increases recreational use of the widened beaches that, without careful management, can increase disturbance of red knots. Beach nourishment can also temporarily depress, and sometimes permanently alter, the invertebrate prey base on which shorebirds depend.

In addition to disturbing the birds and impacting the prey base, beach nourishment can affect the quality and quantity of red knot habitat (M. Bimbi pers. comm. November 1, 2012; Greene 2002, p. 5). The artificial beach created by nourishment may provide only suboptimal habitat for red knots, as a steeper beach profile is created when sand is stacked on the beach during the nourishment process. In some cases, nourishment is accompanied by planting of dense beach grasses, which can directly degrade habitat, as red knots require sparse vegetation to avoid predation.

Preclusion of Habitat Formation

The proposed beach nourishment project will place 7,000,000 cubic yards of sand along the ocean shoreline, as well as additional amounts for plover habitat restoration/creation at particular bay shoreline areas. The construction of berms and dunes along the ocean shoreline are designed to limit or prevent overwash and breaching, two natural processes that create and or maintain suitable bayside red knot foraging and roosting habitat.

It is the Service's understanding at the time of the preparation of this report, that plover habitat restoration/creation will include creation of additional bayside shoreline and management of vegetation to maintain semi-open conditions, in particular bayside areas that the red knot prefers. These practices could potentially address some of the preclusion of habitat impacts to the red knot. Additionally, important bay shore horseshoe crab spawning/red knot foraging areas at the FIIS Lighthouse tract, FIIS Wilderness Area, FIIS at Davis Park, and FIIS at Talisman occur in areas where ocean-to-bay overwash is not expected to occur in the without-project condition (due to the width and height of the barrier island in these areas). The proposed action is, therefore, not expected to significantly affect these important habitats. The proposed action will also not significantly affect the natural processes at Democrat Point, a location where red knots were documented to occur.

Further information on the effects of preclusion of habitat formation is excerpted from Endangered and Threatened Wildlife and Plants: Proposed Threatened Status for the Rufa Redknot (*Calidris canutus rufa*); Proposed Rule (USFWS 2013):

By precluding overwash and Aeolian transport, especially where large artificial dunes are constructed, beach nourishment can also lead to further erosion on the bayside and promote bayside vegetation growth, both of which can degrade the red knot's preferred foraging and roosting habitats (sparsely vegetated flats in or adjacent to intertidal areas). Preclusion of overwash also impedes formation of new red knot habitats. Beach nourishment can also encourage further development, bringing further habitat impacts, reducing future alternative management options such as a retreat from the coast, and perpetuating the developed and stabilized conditions that may ultimately lead to inundation where beaches are prevented from migrating (M. Bimbi pers. comm. November 1, 2012; Greene 2002, p. 5).

V. CUMULATIVE EFFECTS

Other than beach nourishment projects that would require Federal (Corps) authorization, local/State actions that are reasonably certain to occur in the project area that could potentially affect the red knot include beach cleaning, installation of sand fencing, recreational use of migratory stopover areas, and horseshoe crab harvesting.

Beach cleaning

Mechanized beach raking/cleaning is a beach management practice that does occur within the action area, specifically at Robert Moses State Park (RMSP) and Smith Point County Park. Although red knots normally feed low on the beach, they may also utilize the wrack line. The beach cleaning/raking displaces/removes invertebrates and the total amount of wrack, in turn lowering the overall abundance of wrack-dwelling species on which the red knot feeds.

Sand Fencing

Installation of snow fencing or the planting of beach grass are common practices in attempting to stabilize nourished beaches and have occurred on other sites on Long Island without Federal (Service, USACOE) or state (NYSDEC) coordination/authorization.

Vegetation planting and snow fence placement, in association with beach nourishment, will artificially accelerate growth of dense vegetation that precludes use of habitat by red knot and degrades the habitat for this species as red knots require sparse vegetation to avoid predation (USFWS 2013). This effect will limit the amount of available suitable habitat for these species and will create suboptimal habitat conditions.

Recreational Use of Migratory Stopover Areas

New York State Office of Parks, Recreation and Historic Preservation and Suffolk County authorize ORV and pedestrian access on Fire Island ocean beaches at RMSP and Smith Point County Park, respectively. Service personnel have observed heavy (hundreds of vehicles) traffic within suitable ocean beach habitats in these areas. Refer to Section IV above for more information on the impacts of recreation on the red knot.

Horseshoe Crab Harvesting

Refer to the "Food Availability–Horseshoe Crab Harvest" portion of Section II above for a general discussion of horseshoe crab harvesting. The Service is not aware of any available specific data on horseshoe crab harvesting within the action area. While some harvesting of horseshoe crabs likely occurs, it does not appear to be significant since it is not permitted within the FIIS boundaries (NPS 2011).

Conservation Measures

The following habitat-related conservation measures are recommended to address direct, indirect, and cumulative effects of the proposed action and to further the recovery of the red knot:

A. Avoid dredging submerged and emergent shoals to preserve beach dynamics and shorebird habitat.

B. Experiment with creation of habitat features such as ephemeral tide pools or brackish ponds using beach nourishment sediments.

C .Include "notches" (breaks in dunes or berms) in proposed sand placement projects to preserve natural overwash processes, especially on public lands.

D. Prior to placement of dredged material, clearly mark avoidance areas to prevent accidental spillover into areas intended for protection.

E. Place only clean sand that is a close grain size match to the native beach material.

F. Avoid or reduce damage to wrack during project construction by requiring that vehicles drive above or below the primary wrack line.

G. Protect wrack by ceasing or reducing wrack removal during beach-cleaning activities.

H. Conduct pre- and post-project surveys of the prey base in important habitats to document the extent of harm to habitat, as well as to inform evaluation and improved design of future projects.

I. Incorporate provisions prohibiting introduction of (and requiring removal of existing) invasive plant species that degrade beach and dune habitats.

J. Minimize beach nourishment activities that may bury prey at those times of year when red knots are present, especially at stopover locations used for relatively short periods when maximizing rapid weight gain may be most important for the birds. Where possible, schedule beach nourishment to allow sufficient time for habitat and benthic prey recovery/adjustment before birds return.

K. Place symbolic fencing around roosting areas during the time of year when red knots are present.

L. Reduce disturbance by prohibiting dogs on the beach during the time of year when red knots are present.

M. Minimize disturbance from boaters landing on shoals, spits, or baysides. Post signs and distribute maps and outreach materials. During periods when high use by birds and humans coincide, provide stewards to educate beach users about measures to reduce disturbance to rufa red knots and other shorebirds.

N. Minimize disturbance from shoreline stabilization, dredging, and other activities involving heavy equipment at those times of year when red knots are present, especially at stopover locations that the knots use for relatively short periods when maximizing rapid weight gain may be most important for the birds.

O. Maintain the beach berm in a wide, open, sparsely vegetated condition, especially in areas with a history of use for roosting.

P. Develop and implement a site-specific monitoring plan to document knot usage before, during, and after construction, and to document the birds' reactions to the activity.

VI. CONCLUSION

After reviewing the current status of the red knot, the environmental baseline for the action area, the direct, indirect, and cumulative effects of the proposed project, and the proposed project conservation measures, it is the Service's biological opinion that, while authorization of the proposed project may result in the alteration of existing habitat and preclusion of new habitat, it is not likely to jeopardize the continued existence of the red knot range-wide. The proposed action would occur along the ocean shoreline and avoid important bayside stop-over/foraging areas and red knots can forage along the ocean shorelines in areas adjacent to construction activities. Additionally, the incorporation of the above-described conservation measures will help ameliorate project impacts.

Sections 7(b)(4) and 7(o)(2) of the ESA do not apply to the incidental take of species prior to listing and, therefore, no Incidental Take Statement and, subsequently, no reasonable and prudent measures, nor terms and conditions, will be provided in this opinion.

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Appendix 1. Estimated abundance of Atlantic Coast piping plovers, 1986 – 2011 and preliminary 2012 and 2013 estimates.

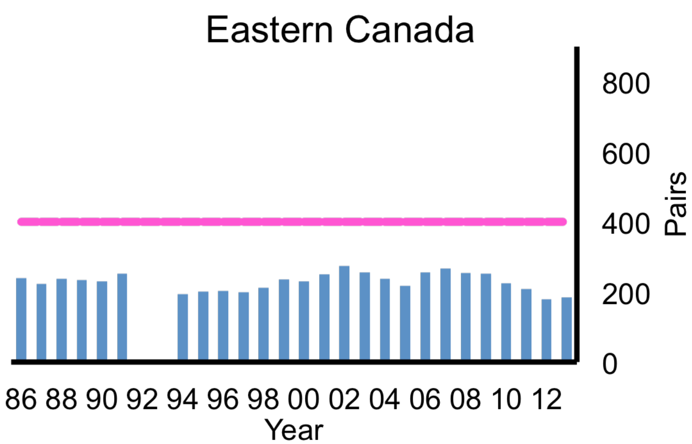
State/RECOVERY UNIT	Pairs																											
	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012*	2013*
Maine	15	12	20	16	17	18	24	32	35	40	60	47	60	56	50	55	66	61	55	49	40	35	24	27	30	33	42	44
New Hampshire												5	5	6	6	7	7	7	4	3	3	3	3	5	4	4	6	7
Massachusetts	139	126	134	137	140	160	213	289	352	441	454	483	495	501	496	495	538	511	488	467	482	558	566	593	591	656	(690)	(670)
Rhode Island	10	17	19	19	28	26	20	31	32	40	50	51	46	39	49	52	58	71	70	69	72	73	77	84	85	86	90	92
Connecticut	20	24	27	34	43	36	40	24	30	31	26	26	21	22	22	32	31	37	40	34	37	36	41	44	43	52	51	45
NEW ENGLAND	184	179	200	206	228	240	297	376	449	552	590	612	627	624	623	641	700	687	657	622	634	705	711	753	753	831	(879)	(858)
New York	106	135	172	191	197	191	187	193	209	249	256	256	245	243	289	309	369	386	384	374	422	457	443	437	390	318	342	(289)
New Jersey	102	93	105	128	126	126	134	127	124	132	127	115	93	107	112	122	138	144	135	111	116	129	111	105	108	111	121	108
NY-NJ	208	228	277	319	323	317	321	320	333	381	383	371	338	350	401	431	507	530	519	485	538	586	554	542	498	429	463	(397)
Delaware	8	7	3	3	6	5	2	2	4	5	6	4	6	4	3	6	6	6	7	8	9	9	10	10	9	8	7	6
Maryland	17	23	25	20	14	17	24	19	32	44	61	60	56	58	60	60	60	59	66	63	64	64	49	45	44	36	41	45
Virginia	100	100	103	121	125	131	97	106	96	118	87	88	95	89	96	119	120	114	152	192	202	199	208	193	192	188	259	251
North Carolina	30	30	40	55	55	40	49	53	54	50	35	52	46	31	24	23	23	24	20	37	46	61	64	54	61	62	70	56
South Carolina	3		0		1	1		1			0					0						0						
SOUTHERN	158	160	171	199	201	194	172	181	186	217	189	204	203	182	183	208	209	203	245	300	321	333	331	302	306	294	377	358
U.S. TOTAL	550	567	648	724	752	751	790	877	968	1150	1162	1187	1168	1156	1207	1280	1416	1420	1421	1407	1493	1624	1596	1597	1557	1554	(1719)	1613
EASTERN CANADA**	240	223	238	233	230	252	223	223	194	200	202	199	211	236	230	250	274	256	237	217	256	266	253	252	225	209	179	184
ATLANTIC COAST TOTAL	790	790	886	957	982	1003	1013	1100	1162	1350	1364	1386	1379	1392	1437	1530	1690	1676	1658	1624	1749	1890	1849	1849	1782	1763	(1898)	(1797)

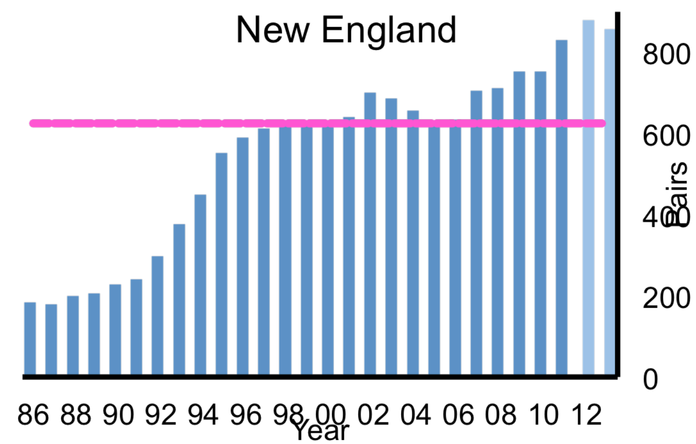
* Figures in parentheses are preliminary estimates, subject to revision

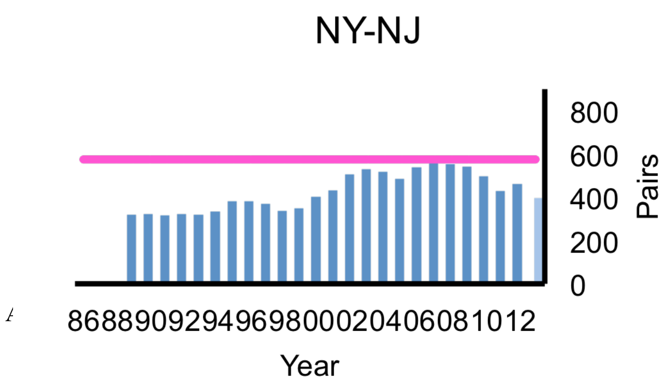
** Includes 1-5 pairs on the French Islands of St. Pierre and Miquelon, reported by Canadian Wildlife Service

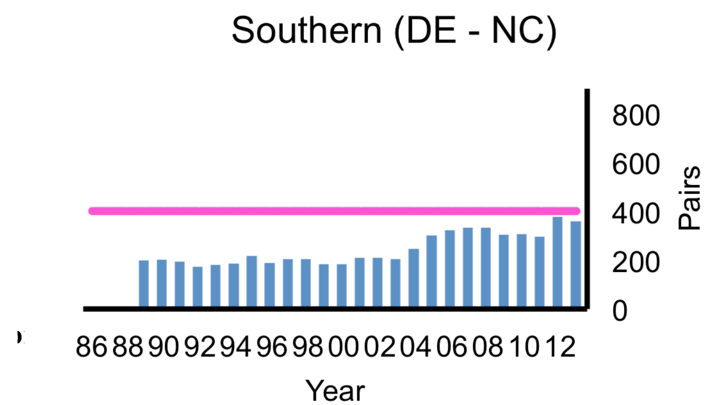
Appendix 2. Estimated abundance of breeding piping plovers by recovery unit, 1986-2013.

Lighter colored bars denote preliminary estimates. Dashed lines denote subpopulation abundance goal.









Appendix 3. Productivity per Recovery Unit from 1987 to 2013.

State/RECOVERY UNIT	Chicks fledged/pair																									
	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012*	2013*
Maine	1.75	0.75	2.38	1.53	2.50	2.00	2.38	2.00	2.38	1.63	1.98	1.47	1.63	1.60	1.98	1.39	1.28	1.45	0.55	1.35	1.06	1.75	1.70	1.63	2.12	1.52	1.93
New Hampshire											0.60	2.40	2.67	2.33	2.14	0.14	1.00	1.00	0.00	0.67	0.33	2.00	0.40	1.50	2.00	0.67	1.71
Massachusetts	1.10	1.29	1.59	1.38	1.72	2.03	1.92	1.81	1.62	1.35	1.33	1.50	1.60	1.09	1.49	1.14	1.26	1.38	1.14	1.33	1.25	1.41	0.91	1.50	1.18	(0.75)	(0.80)
Rhode Island	1.12	1.58	1.47	0.88	0.77	1.55	1.80	2.00	1.68	1.56	1.34	1.13	1.79	1.20	1.50	1.95	1.03	1.50	1.43	1.03	1.48	1.68	1.46	1.76	1.49	1.06	0.98
Connecticut	1.29	1.70	1.79	1.63	1.39	1.45	0.38	1.47	1.35	1.31	1.69	1.05	1.45	1.86	1.22	1.87	1.30	1.35	1.62	2.14	1.92	2.49	1.68	1.91	1.37	1.18	1.82
NEW ENGLAND	1.19	1.32	1.68	1.38	1.62	1.91	1.85	1.81	1.67	1.40	1.39	1.46	1.62	1.18	1.53	1.26	1.24	1.40	1.15	1.34	1.30	1.51	1.04	1.56	1.27	(0.84)	(0.94)
New York	0.90	1.24	1.02	0.80	1.09	0.98	1.24	1.34	0.97	1.14	1.36	1.09	1.35	1.11	1.27	1.62	1.15	1.46	1.44	1.55	1.15	1.21	0.93	0.79	1.07	0.72	(0.71)
New Jersey	0.85	0.94	1.12	0.93	0.98	1.07	0.93	1.16	0.98	1.00	0.39	1.09	1.34	1.40	1.29	1.17	0.92	0.61	0.77	0.84	0.67	0.64	1.05	1.39	1.18	0.72	0.85
NY-NJ	0.86	1.03	1.08	0.88	1.04	1.02	1.08	1.25	0.97	1.07	1.02	1.09	1.35	1.19	1.28	1.49	1.07	1.23	1.28	1.36	1.03	1.10	0.96	0.92	1.09	0.72	(0.74)
Delaware		0.00	2.33	2.00	1.60	1.00	0.50	2.50	2.00	0.50	1.00	0.83	1.50	1.67	1.50	1.17	2.33	1.14	1.50	1.44	1.33	0.30	1.30	1.56	1.00	1.00	1.17
Maryland	1.17	0.52	0.90	0.79	0.41	1.00	1.79	2.41	1.73	1.49	1.02	1.30	1.09	0.80	0.92	1.85	1.56	1.86	1.25	1.06	0.78	0.41	1.42	1.09	1.25	1.02	0.76
Virginia		1.02	1.16	0.65	0.88	0.59	1.45	1.66	1.00	1.54	0.71	1.01	1.21	1.42	1.52	1.19	1.90	2.23	1.52	1.19	1.16	0.87	1.19	1.35	1.36	0.95	1.15
North Carolina			0.59	0.43	0.07	0.41	0.74	0.36	0.45	0.86	0.23	0.61	0.48	0.54	0.50	0.17	0.46	0.65	0.92	0.87	0.26	0.30	0.70	0.77	0.77	0.59	0.96
SOUTHERN	1.17	0.85	0.88	0.72	0.68	0.62	1.18	1.37	1.05	1.34	0.68	0.99	1.04	1.09	1.22	1.27	1.63	1.95	1.38	1.12	0.92	0.67	1.14	1.20	1.21	0.89	1.07
U.S. average	1.04	1.11	1.28	1.06	1.22	1.35	1.47	1.56	1.35	1.30	1.16	1.27	1.45	1.17	1.40	1.34	1.24	1.43	1.24	1.30	1.13	1.19	1.03	1.27	1.21	(0.82)	(0.91)
EASTERN CANADA**		1.65	1.58	1.62	1.07	1.55	0.69	1.25	1.69	1.72	2.10	1.84	1.74	1.47	1.77	1.18	1.62	1.93	1.82	1.82	1.14	1.47	1.22	1.59	1.19	1.38	1.36

* Figures in parentheses are preliminary estimates, subject to revision
** Includes St. Pierre and Miquelon, by Canadian Wildlife Service

Appendix 4. Corps letter amending BA of March 4, 2014.

DEPARTMENT OF THE ARMY
NEW YORK DISTRICT, CORPS OF ENGINEERS
JACOB K. JAVITS FEDERAL BUILDING
NEW YORK, N.Y. 10278-0090

REPLY TO
ATTENTION OF

May 20, 2014

Mr. David Stilwell
Field Supervisor
U.S. Fish and Wildlife Service
3817 Luker Road
Cortland, New York 13045

Subject: Fire Island Inlet to Moriches Inlet Stabilization Project (FIMI)

Dear Mr. Stilwell,

The US Army Corps of Engineers and the Department of the Interior have held a series of meetings and conference calls over the past several months on the above referenced project to discuss project elements as they relate to ongoing formal consultation pursuant to Section 7 of the Federal Endangered Species Act of 1973, as amended (l6 U.S.C. 1531 et seq.; Act). The Corp and Interior had requested this collaboration to finalize the outstanding project description issues that may affect the piping plover (*Charadrius melodus*; threatened) and the seabeach amaranth (*Amaranthus pumilis;* threatened). This letter formulates the agreed upon actions to offset any impacts to the endangered species within the project area.

Participants at these meetings and conference calls included representatives from the U.S. Army Corps of Engineers, Department of Interior, U.S. Fish and Wildlife Service (USFWS), National Park Service - Fire Island National Seashore, New York State Department of Environmental Conservation (NYSDEC) and Suffolk County. The discussion focused on the following topics (with their respective summaries):

1. Monitoring Program. The monitoring program will take place from Inlet to inlet to supplement (not replace) existing programs with the intent to add consistency to the monitoring and reporting. The program splits the plover reproductive activities into two phases: nest and incubation activities, from which breeding population size is estimated, and hatching and fledging activities from which reproductive success is estimated. A set of habitat maps will be provided annually to illustrate the location of nests and the outcome of each breeding attempt. The monitoring program will also note the ongoing influences by the project features. When nests are located, they are either inconspicuously marked or surveyed with GPS to facilitate relocation for monitoring and predator exclosure installation. The monitoring program will also complete a single annual census, standardized on the East Coast to occur during the first 10 days in June. The census numbers gathered during the designated window permits a count for the entire population on site, including non-breeding individuals. Results are compared to the nesting population to address any anomalies.

2. Predator management. All agencies agreed to mammalian predator management (10yrs) inlet to inlet which will be a Federally-funded program, and that implementation will be coordinated between all agencies and the affected land owners/managers. On Federal properties, there is a commitment of exclosures and stewardship, within available authorities, recognizing there are limitation on trapping and killing predators in the absence of more detailed studies and assessments. The primary management effort to reduce wildlife impacts to nesting plovers is the use of nest site predator exclosures, an effective non-lethal method of protection. It necessitates that staffing is adequate to find plover nests in a timely manner. It also requires personnel time to construct exclosures at the nest sites. There are not effective management options to address wildlife impacts on plovers during the courtship or brood rearing phases of the breeding cycle under the current program. The secondary management tool to be used to reduce wildlife impacts is predator control. It was acknowledged that compliance and permitting for predator control needs to be established.

3. Stewardship/Visitor Management. Attempts will be made to eliminate or reduce human disturbance to plovers during all phases of breeding. Plover habitat utilization and human use patterns are well established, facilitating installation of appropriate area closures. A 200 meter disturbance buffer is used to protect most breeding habitats. In areas where plover breeding activity occurs in close proximity to human use areas, an assessment will be made of the sensitivity of the birds on site. When possible, an attempt is made to maintain some level of recreational opportunities. When in doubt, visitor use is curtailed to ensure that breeding activities are protected. Park staff, researchers, operation and maintenance and emergency vehicles with a legitimate need to work in or travel through plover breeding areas will receive training to reduce the potential risk to the plovers. Staff and cooperators with irregular needs to access sensitive areas are provided escorts. Law enforcement officers are offered training to accommodate the need to patrol the beach and inlet areas.

4. Off Road Vehicle (ORV) Use. All agencies recognized that there are Federal ORV guidelines in place that are currently followed within Fire Island National Seashore and Smith Point County Park. Both agencies agreed that the ORV guidelines will continue to be followed in the future. It was acknowledged that nesting distance from the beach, breeding bird behaviors and reaction to humans or vehicles vary from year to year. Dependent on foraging habitat condition at the time of brood rearing, chicks may or may not use the bay or ocean intertidal zone for foraging. Unpredictable behavior and habitat use has resulted in a stepped progression of visitor management actions in the past. Normally, observations are made of birds in courtship to identify management areas. As soon as nests are initiated, an assessment is made to determine the sensitivity of both breeding adults to human use. When birds react negatively to human disturbance, the normal travel corridor is reduced in width in an attempt to accommodate passage of vehicles and pedestrians. If traffic or pedestrian use cannot be accommodated, a full area closure is placed in effect. A similar assessment and closure progression is made for brood habitat needs if the nest successfully hatches. On the non-beach sides surrounding ORV area nests the standard 200 meter buffer distance is used to protect plover breeding activity.
5. De-vegetation Maintenance/Dune and Burma Road Re-alignment/Habitat Restoration and Creation. After much discussion, the participants agreed on the following plan modifications which are shown in table 1. The final plan layout is also attached.

6. Monitoring Effectiveness. It was discussed that the conservation/protection measures and habitat restoration for threatened and endangered species are often guided by anecdotal evidence and there is a need to better utilize time and resources on effective strategies. The project will monitor and evaluate the effectiveness of the above mentioned measures and then provide revised recommendations if need be relating to the restoration of breeding habitat and the optimization of reproductive success. An interagency team will be assembled to define a strategy and identify the key questions to be addressed. It was noted that resources will be leveraged from other initiatives to compliment the project funds.

The District appreciates your continued commitment to this project and anticipates a draft Biological opinion on May 23, 2014. If you should have any questions, please contact Mr. Robert J. Smith of my staff at 917-790-8729.

Sincerely,

Frank Santomauro, P.E.
Chief, Planning Division

Attachment
cc. USFWS-LIFO
Chris Soller, Superintendant, NPS-FIIS
Alan Fuchs, Director, Bureau of Flood Control and Dam Safety, NYSDEC
Glibert Andersen, P.E., Commissioner, Suffolk County DPW
Paul Phiefer, Assistant Regional Director, USFWS, Northeast Region

TABLE 1.

Plan Modifications	
Pattersquash Island Overwash – 13 HA	
Dune location	Seaward location, as shown on plans.
Dune Slopes	1:5 slopes.
Dune Planting	Vegetated 18" spacing.
Dune De-vegetation	No dune management.
Bayside De-vegetation	De-vegetate when >30 percent cover, 10 yrs.
Project Sand-Fencing	No project installed sand fencing.
Locally-installed fencing	No limitation on locally-installed sand fencing within dune and within 75 ft buffer (allow for vehicle management).
Road location	Burma Road located within 75 ft buffer north of landward toe of dune to maximize bayside habitat.
Smith Point Breach Overwash – 6.1 HA	
Dune Location	Seaward location, as shown on plans.
Dune Slopes	1:5 slopes.
Dune Planting	Vegetated 18" spacing.
Dune De-vegetation	No dune management.
Bayside De-vegetation	De-vegetate when >30 percent cover, 10 yrs.

Project Sand-Fencing	No project installed sand fencing.
Locally-installed fencing	No limitation on locally-installed sand fencing within dune and within 75 ft buffer (allow for vehicle management).
Road location	Burma Road located within 75 ft buffer north of landward toe of dune to maximize bayside habitat.
New Made Island Overwash – 10.5 HA	
Dune location	Seaward location, as shown on plans.
Dune Slopes	1:5 slopes.
Dune Planting	Vegetated 18" spacing.
Dune De-vegetation	No dune management.
Bayside De-vegetation	De-vegetate when >30 percent cover, 10 yrs.
Project Sand-Fencing	No project installed sand fencing.
Locally-installed fencing	No limitation on locally-installed sand fencing within dune and within 75 ft buffer (allow for vehicle management).
Road Location	Burma Road located within 75 ft buffer north of landward toe of dune to maximize bayside habitat.
Great Gun Area & expanded Great Gun East - 34 HA	
Recontouring	Maintain existing dune adjacent to the road. The berm would be configured as +9 that steps down to elevation +7 to promote ephemeral pools. Specific plans to be developed. Need to assess volume of sand, and will keep sand in the system.
Construction – De-vegetating berm	De-vegetate fronting berm, as part of recontouring.
Adaptive De-vegetation	De-vegetate when >30 percent cover, 10 yrs.
Adaptive pool management	Maintain berm height if too high. Focus on pre-season efforts to maintain height. Subject to adaptive management.
New Made Dredge disposal habitat location - 4HA + 2 HA expansion	
Recontouring	Lower dike to adjacent grades, regrade existing substrate, and cover with 2 ft of ocean sand. Achieve desired slopes and percentage of foraging / nesting habitat. Specific plans to be developed, possible connection to the east for an additional 2 HA.

Appendix 5: Stabilization Efforts Following Coastal Storms: 1938-present

Currently, the south shore of Long Island is a heavily managed system with navigation inlets and frequent beach renourishment and stabilization projects. There are few areas remaining, if any, where natural processes can occur unaffected or uninfluenced by human action. The current situation arrives from a long history of responding to storms in an effort to protect human life, property and use.

One of the major responses to breaching and overwashing on the barrier beaches followed the unnamed Hurricane of 1938. The human response was extensive and included debris removal, and the rebuilding dunes, public infrastructure, and public facilities, as well as the closure of breaches and the filling in of overwash habitats. Ten of eleven breaches were reportedly closed on Westhampton Island using trucks, bulldozers, and dredged material. A breach also formed in the area of now known as Shinnecock Inlet. Suffolk County decided to stabilize the inlet with a timber crib structure on the western shoreline to create a permanent inlet (U.S. Army Corps of Engineers 2009 DFR).

During a November 1953 Nor'easter a breach, measuring 100 ft wide by 6 ft deep, joined the ocean with Moriches Bay at Westhampton Beach. This breach was summarily closed. About 11 years later, during Hurricane Carol in 1954 the barrier beach was breached in 14 locations between Montauk Point and Fire Island, including 10 locations at Westhampton Beach. A breach 200 ft wide was cut through the beach west of the West Bay Bridge at Westhampton Beach. All of these breaches were artificially closed.

Another storm of record occurred in 1962, termed the Ash Wednesday Storm, resulted in breaches and overwashes of the barrier beaches along the south shore of Long Island. . A total of 50 washovers occurred, and a 300 ft wide inlet was formed west of the Jessup Lane Bridge at Westhampton Beach. Additional smaller inlets on Westhampton Island also formed. Local authorities worked quickly to close these breaches and fill any overwash habitat that formed within one week. Because this storm had far reaching impacts, the Corps responded to with "Operation Five High," which undertook efforts to rebuild beaches and dunes along the entire Atlantic Ocean shoreline from Virginia to New York. Within the area stretching from Fire Island Inlet to Montauk Point, there was significant Federal dune and beach rebuilding as part of this program, and a number of smaller efforts undertaken by local governments. Overall, approximately 2,220,000 cy of sand was placed along 14.7 mi of shoreline in this reach. Additional local efforts to stabilize beaches were undertaken on Fire Island, included dune rebuilding and beach construction at Cherry Grove, Point O' Woods, Village of Saltaire, and the Village of Ocean Beach (U.S. Army Corps of Engineers 2009 DFR). The Corps also contracted the placement of 9,529 ft of dune and 37,000 ft of berm along Fire Island (U.S. Army Corps of Engineers 1963). In total, over 2 million cy of material were used to rebuild over 23 miles of beaches and dunes from Fire Island to Montauk Point: http://www.nan.usace.army.mil/Missions/CivilWorks/ProjectsinNewYork/FireIslandtoMontaukPointReformulationStudy/FIMPProblemID.aspx.

As a result of a nor'easter in January 1980 a breach formed about 1,000 ft east of the eastern jetty at the Moriches Inlet Federal Navigation Jetty. By June of that year, the breach had a width of about 2,500 ft. The Corps initiated breach closure operations in October 1980, completing closure in March 1981. A combination of material was used to recreate the barrier island and fill in the breach and overwash habitats including steel sheet pile, dredged material, and a stone revetment along the bayside of the barrier island in order to protect the shoreline from erosion and prevent the likelihood of another breach.

In late 1992 and early 1993, two breaches (Pikes and Little Pikes Inlet) formed on the western end of Westhampton Island. The Corps commenced closure of Little Pikes Inlet in May 1993, which required the placement of 1.5 million cy of dredged material. About 1,800 ft of 30 ft long, double row steel sheetpile, was also used. The entire operation was completed by November 1993 (U.S. Army Corps of Engineers 2009 DFR).

Most recently, Hurricane Sandy formed a 1,500 ft wide breach and associated sand flats, and overwash fans just east of Moriches Inlet in Cupsogue County Park. This storm also created a 500 ft wide breach and extensive overwash habitat to the west of Moriches Inlet in Smith Point County Park. The Corps, under their Breach Contingency Plan (BCP), closed both breaches and filled in the naturally created overwash habitats. The Smith Point County Park breach was small and did not appear to flow at low tide, which would not be considered a breach under the BCP, however, it was still artificially closed by the Corps using 50,000 cy and Cupsogue County Park breach was filled using 200,000 cy of dredged material from Moriches Bay.

Shoreline and Jetty Stabilization Projects from Montauk Point to Coney Island

Federal, State, and local governments undertook a variety of inlet and shoreline stabilization projects over the last 75 years across the south shore of Long Island. The following discussion provides a short description of these activities. The Service did not include a discussion of similar activities which were undertaken in the Peconic Bay or north shore of Long Island due to time constraints for preparing this Opinion. However, the Corps has constructed projects at Shelter Island (shoreline revetment in plover habitat), Mattituck Inlet, Lake Montauk Harbor, Goldsmith Inlet, Orient, and Asharoken Beach. The Corps also has permitted a number of dredging permits for small inlets within these areas, which are undertaken by the Suffolk County Department of Public Works, for the purposes of removing sand shoals and depositing dredged material on local beaches.

Montauk Point – Local and Federal Stabilization Activities

The area surrounding Montauk Point headland has undergone years of shoreline stabilization, mostly in an effort to protect the Montauk Point Lighthouse. From 1946 to the 1990s various shoreline stabilization projects were constructed including a 700 ft stone revetment with vegetative plantings (New York District, 1944), rubble placement (1960s), a terracing project (1970s and 1980s), gabion installation (1972), and two revetment projects (1990, 1992).

In 2005, the Corps completed a Feasibility Study for Montauk Point, which recommended construction of a stone revetment 840 ft in length with a crest height of 25 ft, constructed of 12.6 tone armor units from the crest to the toe, and three layers of 4 to 5 ton armor units atop a splash apron.

Corps' 83-mile Fire Island Inlet to Montauk Point Combined Beach Erosion Control and Hurricane Protection Project

The Corps' Fire Island Inlet to Montauk Point, New York, Combined Beach Erosion Control and Hurricane Protection Project was first authorized by the River and Harbor Act of 14 July 1960 in accordance with House Document (HD) 425, 86th Congress, 2d Session, dated June 21,1960, which established the authorized project.

The authorized project provides for beach erosion control and hurricane protection along five reaches of the Atlantic Coast of New York from Fire Island Inlet to Montauk Point by widening the beaches along the developed areas to a minimum width of 100 ft, with an elevation of 14 feet above mean sea level, and by raising dunes to an elevation of 20 ft above mean sea level, from Fire Island Inlet to Hither Hills State Park, at Montauk and opposite Lake Montauk Harbor. Construction would be supplemented by grass planting on the dunes, by interior drainage structures at Mecox Bay, Sagaponack Pond, and Georgica Pond and the construction of up to 50 groins, and by providing for subsequent beach nourishment for up to 10 years. Since the 1980s, the Corps has been reformulating this project to address concerns raised by the President's Council on Environmental Quality.

The Corps has undertaken a number of actions, including what they have termed as interim project, under this authorization. These are described below:

Corps' Easthampton Groin Field Construction

A special report was prepared in 1964 in support of the Corps' project authorized, the "Combined Fire Island Inlet to Montauk Point Beach Erosion Control and Hurricane Protection Project (FIMP)," the Corps identified the need for, and the design of, the two groins at Georgica Pond, Easthampton. Construction of these groins was completed in September 1965 (U.S. Army Corps of Engineers 2009 DFR).

Corps' West of Shinnecock Inlet Interim Storm Damage Protection Project

In the late 1990s, the West of Shinnecock Inlet Interim Storm Damage Protection Project was developed as an interim plan by the Corps to mitigate for the erosion of downdrift beaches due to the Shinnecock Federal Navigation Project until the FIMP Study was completed. The project includes beach nourishment along the 4000 ft long shoreline immediately west of Shinnecock Inlet. The project initially included periodic renourishment every two years for a period of six years (U.S. Army Corps of Engineers 2009 PDT). The Corps constructed the West of Shinnecock Inlet Interim Storm Damage Protection Project in 2005, using approximately 610,000 cy of sand to construct engineered dunes and beaches along 4,000 ft of shoreline. The project's design profile consisted of dunes with a crest of 15 ft NGVD and a 90-ft-wide beach berm and 115 ft wide foreshore.

The Corps recently reconstructed this project due to sediment losses resulting from Hurricane Sandy. Even though the project had expired, the Corps indicated that it was authorized through the Disaster Relief Appropriations Act of 2013 to restore projects impacted by Hurricane Sandy to their original design profile and they determined this project was eligible for reconstruction. Subsequently, the Corps placed approximately 301,000 cy of sand at just after Hurricane Sandy using emergency funds from Hurricane Irene. Of this, about 173,000 cy were placed to replace sand lost during Hurricane Sandy. The Corps recently awarded a contract in the Fall of 2013 for the placement of an additional 450,000 cy of sand in the project area to reconstruct dunes and beaches to the design profile. The project was completed in Winter 2014: http://www.nan.usace.army.mil/Portals/37/docs/civilworks/SandyFiles/Army percent 20Corps percent 20West percent 20of percent 20Shinnecock percent 20Inlet_FCCE_FactSheet.pdf.

Corps' Westhampton Groin Field Construction

The Corps constructed of 11 groins 1966 in Reach 2 of the FIMP Study area which corresponds to Westhampton Island. The Corps' Fire Island Inlet to Montauk Point General Design Memorandum dated 1959 recommended the construction of four additional groins, dune and beach construction using 1.95 million cy of sand dredged material) along 6,000 ft of beach west of the groin number 11. The design profile included dune construction at an elevation of 16 ft above mean sea level. This project was as completed in July 1970, bringing the total number of groins in Reach 2 to fifteen. Dune and beach fill was placed between October 1969 and October 1970 (U.S. Army Corps of Engineers 2009 DFR).

Corps' Westhampton Interim Storm Damage Protection Project

The Westhampton Interim Storm Damage Protection Project was developed as an interim plan by the Corps to provide protection of the western section of Westhampton Island until the Reformulation Study was completed. In 1991, the Corps issued a Public Notice for a conceptual plan which included tapering of the existing groin field (shortening of groins 14 and 15 and construction of an intermediate groin identified as groin 14a), fill within the groin compartments to ensure continued westward transport, and construction of a dune at +15 ft NGVD, fronted by a beach with a berm at +9.5 ft NGVD and a width of 90 ft, and a foreshore of 115 ft for the area west of the groin field, and tapering into Cupsogue County Park. The project also includes periodic nourishment for up to 30 years from the date of initial construction of 2027. The planning culminated in a Technical Support Document for Westhampton that was finalized in July 1995.

Initial construction of the project was completed in December 1997 (U.S. Army Corps of Engineers PDT 2009). The interim project has been subsequently renourished in 2001, 2004 and 2008. The Corps has indicated that it will be renourished for a fourth time in September 2014.

National Park Service - Fire Island National Seashore Community Projects 1992, 2003, and 2008; and Smith Point and Cupsogue County Park Projects

Two major beachfill projects occurred along Fire Island between 2000 and 2009. In 2003-2004 a number of FIIS Communities renourished the beach with about 1.28 million cy of sand in Western Fire Island (Saltaire to Lonelyville) and Central Fire Island (Fire Island Pines). In 2009, the beaches were renourished again with about 1.82 million cy of sand was placed, however several more communities participated in the project including Ocean Beach, Ocean Bay Park, and Davis Park (Coastal Planning and Engineering, Inc. 2013). In 2009, Suffolk County Department of Public Works also placed about 310,000 cy and 150,000 cy at Smith Point County Park on Fire Island and Cupsogue County Park on Westhampton Island, respectively, as part of a large scale dune and beach construction project. In addition to these major beach construction projects, 21,000 cy of sand was placed at the FIIS Community of Davis Park in 2007 (Coastal Planning, and Engineering, Inc. 2013).

Groin at Ditch Plains

There is an existing groin in the vicinity of Ditch Plains, Easthampton New York. The groin has been constructed at a location that is a natural headland, and transitions between a rocky beach to the east and a sandy beach to the west (U.S. Army Corps of Enigneers 2009 DFR).

State Groins at Georgica Pond and Hook Pond

Between January 1959 and February 1960, the State of New York constructed two groins, deposited 450,000 cy of sand fill, and planted 10 acres of beach grass along 12,500 ft of shoreline between Georgica and Hook Ponds in Easthampton. The first groin was located 700 ft east of Georgica Pond; the second groin was located 550 ft east of Hook Pond (U.S. Army Corps of Engineers 2009 DFR).

Smith Point County Park Steel Sheetpile Bulkhead and Rock Revetment

Following the storms of the early and mid-1990's Suffolk County Department of Public Works constructed a steel sheetpile bulkhead fronting the existing pavilion at Smith Point County Park. The revetment was constructed in conjunction with a small beachfill project, to cover the revetment. Following construction of the revetment, a memorial for TWA Flight 800 (which crashed in the Atlantic Ocean off of Moriches Inlet in July 1996) was constructed. The memorial was located outside the alongshore extent of the revetment, and in a location vulnerable to erosion. In 2005, Suffolk County extended the revetment to provide protection of the memorial for TWA Flight 800 (U.S. Army Corps of Engineers 2009 DFR).

Ocean Beach Groins History

In 1970, the Village of Ocean Beach and the State of New York built two groins at the western end of this community to provide shoreline and infrastructure protection (U.S. Army Corps of Engineers 2014b).

Jones Island

Engineering activities began in 1927 around Fire Island Inlet starting with the placement of 40 million cy of embankment fill to create 15 miles of Ocean Parkway from Jones Inlet to Captree State Park. In 1959, to reduce the extensive erosion around Oak Beach, located on Jones Island on the north side of the inlet, a one-half mile perpendicular dike (known locally as "The Sore Thumb") was created using 1.1 million cy of material dredged from the inlet's ebb shoal. The total volume of material that has been dredged from Fire Island Inlet channel from 1946 to around 2004 is about 19 million cy (Bonisteel *et al.* 2004).

The Corps is in the process of dredging Fire Island Inlet and placing more than 1.2 million cy of sand along Gilgo Beach, including additional sand being placed nearby in partnership with the state of New York to reduce risks even more:

http://www.dvidshub.net/news/115893/us-army-corps-engineers-works-after-sandy-repair-and-restore-beaches-new-york-designed-coastal-storm#.UzGdAONdVVU#ixzz2wzJ1OCS4.

Rockaway Barrier Beach

The Corps is currently undertaking post-Sandy dune and beach construction activities area on Rockaway Beach in Queens, NY, using roughly 3.5 million cy of dredged material:

http://www.dvidshub.net/news/115893/us-army-corps-engineers-works-after-sandy-repair-and-restore-beaches-new-york-designed-coastal-storm#.UzGdAONdVVU#ixzz2wzIjwmQf.

Natural Inlets and Stabilized Inlets along the South Shore of Long Island

According to records dating to the 16th century, numerous breaches and inlets areas have existed along the study area. The recent stability of the existing inlets along the south shore of Long Island is largely due to maintenance and stabilization efforts that have included dredging of navigation channels and jetty construction. (e.g., U.S. Army Corps of Engineers 2009 DFR).

It is evident that inlets and breaches are ephemeral in the absence of inlet maintenance and/or stabilization efforts, and that long periods of multiple inlets to any single estuary are rare. On the other hand, long periods characterized by no inlets have been experienced, although only at Moriches and Shinnecock Bays. This history suggests that the estuaries in the study area are generally incapable of supporting multiple inlet openings in the long term (U.S. Army Corps of Engineers 2009 DFR).

Shinnecock Inlet

In 1939, Shinnecock Inlet was a natural inlet measuring about 700 ft wide, but local interests constructed a 1,470 ft long jetty type structure on the west side of the inlet to prevent its westward migration. The original structure was comprised of a timber piling bulkhead, 20 spur dikes normal to the bulkhead and a revetment fronting the bulkhead. The western jetty structure was repaired and a 130-foot long stone groin was added to its northerly end in 1947.

New stone jetties were constructed on both sides of the inlet by local interests during the period from 1952 to 1953 and the west jetty was extended in 1954. After completion of the jetties, the width of the inlet was fixed at 800 ft.

In 1988 the Corps completed a general design memorandum for Shinnecock Inlet Navigation Project, which recommended a plan for improvements to Shinnecock Inlet consisting of (1) an inner channel within Shinnecock Bay with a width of 100 ft and a low water depth of 6 ft, (2) an outer channel with a width of 200 ft and low water depth of 10 ft accompanied by an 800 ft wide by 20 ft deep deposition basin, (3) rehabilitation of the east and west jetties, and construction of a 1,000 ft revetment on the eastern side of the inlet on the bayside. Construction was initiated in late 1990 and completed in mid-1993.

Initial construction of the navigation channel was performed in October 1990 and included dredging of a total of 668,000 cy. About 138,000 cy was placed immediately west of the western jetty and 77,000 cy was used to fill an underwater scour hole which had formed near the southern end of the west jetty. About 193,000 cy of sand was stockpiled on the east side of Shinnecock Inlet for use as fill behind the bayside revetment, and 260,000 cy was placed at Ponquogue Beach on the west side of the inlet. Subsequent dredging of the seaward deposition basin was conducted in May 1993 with removal of 475,000 cy. This material was placed in the underwater scour hole (104,000 cy) and west of the west jetty (371,000 cy).

Following these activities, the channel was dredged in September 1998, when 440,000 cy of sand was dredged from the inlet, and in 2004 when 303,000 cy of sand was dredged and placed on the shorelines immediately to the west, and from 7,000 to 10,000 ft west, of the inlet (U.S. Army Corps of Engineers 2009 DFR). The last maintenance dredging cycle was completed January 2010. Dredged sand was placed at Tiana Beach, Southampton, NY, and two sand stockpiles (20,000 cy and a 50,000 cy) were created on the ocean beach near Road K. Nearly 500,000 cy of sand was removed from the inlet at that time.

Shinnecock Inlet was also used as a sand borrow area for stabilizing beaches along the south shore of LI following Hurricanes Irene and Sandy (Table 1). The Corps characterizes the Shinnecock Inlet Navigation Project as being in "caretaker status," which includes monitoring of the conditions of the inlet, maintaining depth reports, and coordination with partners and stakeholders on maintenance needs.

Table 1. Shinnecock Inlet Maintenance

Shinnecock Inlet Maintenance		
Date	**Activity**	**Description**
Sep-38	**Inlet opens**	**Storm opens Inlet at its present location**
1939	**Jetty (western bank)**	**Inlet stabilization**
1943	**Channel dredging**	**Inlet to ICW (west channel)**
1947	**Jetty repair**	**Storm damage**
1952 to 1953	**Stone jetties (east and west banks)**	**Inlet stabilization**
1954	**West jetty extension**	
1958	**Channel dredging**	**Inlet to ICW (west channel deepened)**
1963	**Channel dredging**	**Inlet to ICW (west channel widened)**
1966	**Maintenance dredging**	**Inlet to ICW**
1969	**Maintenance dredging**	**Inlet to ICW**
1973	**Maintenance dredging**	**Inlet to ICW**
1978	**Maintenance dredging**	**Inlet to ICW**
1984	**Inlet dredging**	**Maintenance dredging 162,000 cubic yards**
1990	**Inlet dredging**	**Dredging of 668,000 cubic yards**

1993	**Deposition basin**	**Dredging of 475,000 cubic yards**
1990 to 1993	**Jetty rehabilitation**	
1996	**Maintenance dredging**	**East Cut dredging 150,000 cubic yards**
1998	**Channel and deposition basin**	**Maintenance dredging 440,000 cubic yards**
2002	**Channel and deposition basin**	**Planned dredging:**
USACE (1988)		
USACE 1988b		
CENAN 1998-2002		

Westhampton Island

Nersesian *et al.* (1992) described the location of breaches and overwash that formed between 1938 and 1962 in the area of the Corps' Westhampton Beach groin field. In every instance of storm-created habitat formation, habitat was destroyed or degraded by artificial nourishment and closure. Three inlets and six overwashes formed in 1938. Two to three overwashes formed in 1944. One breach occurred in 1950. Two overwashes formed in 1954 and 1958, and one inlet formed in 1962.

Moriches Inlet

Historically, the 1938 Hurricane created two breaches immediately west of Moriches Inlet on Fire Island. These breaches were closed artificially in May 1939. Moriches Inlet remained open, but to stop the westerly migration of the inlet a rubble-mound revetment was constructed on the western inlet bank from 1947 to early-1948. This condition led to the eventual natural closure of Moriches Inlet during a storm in May 1951. Subsequently, local interests constructed jetties on both sides of the inlet from 1952 to 1953 and the inlet was reopened while it was still under construction by a storm in September 1953. Following stabilization of the inlet, its length (approximately 2,000 ft) and width (approximately 800 ft) were essentially fixed.

The Moriches Inlet Federal Navigation Project was authorized by the Rivers and Harbors Act of 1960 and the 1985 Supplemental Appropriations Act. The Navigation Project provided for a channel, 10 ft deep, 200 ft wide, extending from that depth in the Atlantic Ocean to Moriches Bay. The channel extends into Moriches Bay for approximately 0.8 mi, having a depth of 6 ft, and a width of 100 ft wide, to the Long Island Intracoastal Waterway, length approximately 1.1 mi. In addition, the Navigation Project included an in-water deposition area at the entrance of the channel.

The last maintenance dredging cycle of the Moriches Inlet Federal Navigation Project occurred during the winter of 2009. Approximately 460,000 cy of material was removed by Suffolk County Department of Public Works and placed at Cupsogue Beach and Smith Point County Parks. Prior to this last cycle, maintenance dredging of the inlet was last performed by the Corps in February 2004 using Federal/non-Federal cost-share funds, when they removed about 250,250 cy of material were from the channel and deposition basin and placed it along the shoreline west of the jetty: http://www.nan.usace.army.mil/Media/FactSheets/FactSheetArticleView/tabid/11241/Article/8248/fact-sheet-moriches-inlet-new-york-maintenance-and-stewardship.aspx.

A summary of the known dredging and construction activities at Moriches Inlet (Table 2) since opening in March 1931 indicates total dredging quantities are estimated to be near 3.2 million cy, although the excavation quantities are unknown for several operations. Dredged material has typically been placed on the beaches, on dredge spoil islands, or within nearshore areas east and west of Moriches (U.S. Army Corps of Engineers 2009).

Table 2. Moriches Inlet Maintenance Activities

Date	Activity	Description
Mar-31	Inlet opens	Storm opens Inlet 3,500 feet east of its location
1943	Channel dredging	Dredging of channel from Inlet to ICW
1947	West revetment construction	Inlet stabilization
1951	Storm closure	
1952 to 1953	Jetty construction	
1953	Storm opening	Storm opens Inlet at present location
1953	Channel dredging	Dredging of 747,000 cubic yards
1954	Jetties extended	
1957	Channel dredging	Maintenance dredging 37,000 cubic yards
1958	Channel dredging	Dredging of 366,000 cubic yards from Inlet to ICW
1959	Channel dredging	Maintenance dredging 100,000 cubic yards
1963	Channel dredging	Channel widened
1964	Channel dredging	Maintenance dredging 59,000 cubic yards
1966	Channel dredging	Dredging of 678,000 cubic yards
1969	Channel dredging	Maintenance dredging 151,000 cubic yards
1973	Dredging	Maintenance dredging 138,000 cubic yards
1977	Dredging	Maintenance dredging 59,000 cubic yards
1978	Dredging	Maintenance dredging 218,000 cubic yards
1985	Dredging	Dredging of 355,000 cubic yards
1986	Dredging	Maintenance dredging 41,000 cubic yards
1996	Dredging	Maintenance dredging 256,600 cubic yards
1998	Dredging	Maintenance dredging 186,200 cubic yards
2002	Dredging	Planned dredging
USACE (1998a),		
USACE 1983		
CENAN 1998-2002		

Old Inlet

After189 years, Old Inlet reopened as a result of Hurricane Sandy (Figure 1). The inlet is located on the eastern portion of Fire Island, in the area of Bellport Bay, and is in designated Federal Widlerness. Currently the inlet is located 1.5 miles west of the NPS Smith Point Visitor Center. The inlet was over 400 m wide, based on NPS field measurements taken on April 1 and 3, 2014 (NPS electronic correspondence dated April 7, 2014). There are no current measurements of the inlet's cross sectional area or bathymetry available as of the writing of this Opinion. Flood and ebb tidal deltas have formed in response to the inlet opening.

Figure 1. April 22, 2014 aerial oblique of Old Inlet in the Federal Wilderness Area. Imagery was collected between 8:30 and 9 am during ebb tide. Photo provided by Dr. Charles Flagg, SOMAS, SBU. Provided by NPS in electronic correspondence dated April 28, 2014.

Fire Island Inlet to Shores Westerly Project to Jones Inlet

The Fire Island Inlet Navigation Project was authorized by the Rivers and Harbors Act of 1937, and subsequently modified by the Rivers and Harbors Acts of 1958 and 1962. Fire Island Inlet is located on the western end of Fire Island. Originally, a prograding spit, the Corps undertook jetty construction at Democrat Point in 1941, as part of the Federal Fire Island Inlet Navigation Project. This effectively halted the westward migration of the inlet. The 1962 project modification provided for sand dredged from Fire Island Inlet to be placed at Gilgo Beach to offset the downdrift erosion and to protect Ocean Parkway (U.S. Army Corps of Engineers 2009 DFR).

In August 1988, the project was modified again to provide for the maintenance of a realigned channel in the vicinity of the naturally deep channel to a depth of 14 ft plus 2 ft allowable overdepth. The material from the dredged channel will be used as nourishment along the shoreline several miles west of the inlet at the designated beach, Gilgo Beach, for erosion control. This project is cost shared by New York State Department of Environmental Conservation.

The Corps describes the Fire Island Inlet and Shores Westerly to Jones Inlet project as a multi-purpose project that provides navigation and shore protection benefits through the periodic maintenance dredging of Fire Island Inlet. The dredged material is placed along the Jones Island shoreline several miles west of the inlet in the vicinity of Gilgo Beach. The sand placed at Gilgo is intended to nourish the westerly beaches, provide coastal storm risk reduction and to ultimately help reduce the risk of barrier island breaches: http://www.nan.usace.army.mil/Portals/37/docs/civilworks/SandyFiles/Army percent 20Corps percent 20GilgoBeach_FCCE_FactSheet.pdf.

A total of 953,263 cy of sand was dredged and placed as beach nourishment along the Gilgo Beach shoreline in 2003 and 2004. An additional, 135,983 cy of dredged sand was placed as

beach nourishment along Robert Moses State Park Beach during this time at full non-Federal cost (NY State). In Winter 2007-08, about 619,000 cy was dredged from the inlet and placed along Gilgo Beach. In August 2013, the Corps awarded a contract for maintenance dredging of 1.7 million cy of sand with placement on Gilgo Beach. The project is scheduled to be completed in Spring 2014:
http://www.nan.usace.army.mil/Media/FactSheets/FactSheetArticleView/tabid/11241/Article/10863/fact-sheet-fire-island-inlet-and-shores-westerly-to-jones-inlet-new-york.aspx.

Jones Inlet Federal Navigation Channel

The Federal navigation project for Jones Inlet, NY was authorized by the Rivers and Harbors Act of 1945, 77th Congress, 1st Session, Document No. 409. In 2008, the Corps completed the maintenance dredging of nearly 680,000 cy of sand from Jones Inlet, placing it on downdrift Town of Hempstead beaches. The inlet incurred additional shoaling due to Hurricane Sandy which necessitated additional dredging, with 642,000 cy of sand being placed on 3,500 ft of shoreline, about 2/3 mi immediately west of the inlet at Point Lookout and to provide emergency stockpiles for resiliency against future storm impacts, as needed.

http://www.nan.usace.army.mil/Media/NewsStories/StoryArticleView/tabid/5250/Article/22435/us-army-corps-of-engineers-completes-jones-inlet-project.aspx

East Rockaway Inlet Federal Navigational Channel

East Rockaway Inlet, NY, is located at the eastern limit of Rockaway Beach, a 10.8-mile-long barrier island stabilized since the 1880s with beach fill, groins, bulkheads, and a rock jetty at the western limit. The East Rockaway Inlet Project was authorized by the Rivers and Harbors Act of 1930. The Federal navigation channel was used as a sand source to complete a shore protection project on Rockaway Beach in fiscal year 2013. Maintenance dredging has already provided about 300,000 cy to Rockaway beach in 2013, 137,000 cy in 2010, and 240,000 cy 2011-2012.

Historical dredging records indicate the channel dredging rate increased from an average 30,000 cy/yr in the 1938-to-1978 time period to an average 115,000 cy/yr recently. The inlet channel is nominally maintained by a 2-year dredging cycle although more frequently in the last few years due to combined effect of storm activities and a saturated updrift sediment fillet.

Long Beach Island

The total volume placed on Long Beach Island since 1956 is estimated to be 3,431,900 cy, or about 66,000 cy per year on average. This nourishment must be factored into the volumetric analysis to obtain a better estimate of the overall sediment budget and transport rates. There was an additional 731,000 cy placed in offshore areas, which is assumed to be outside the active profile of the beach. (CPE 2009 report Coastal Protection Study).

Appendix 6: Further New Jersey Information

Section 7 Consultations

Two programmatic biological opinions (PBOs) address both the beneficial and adverse impacts to listed species from all authorized Corps beach nourishment projects in New Jersey (USFWS 2005a; 2002). The 2002 PBO addresses beach nourishment projects from Sea Bright to Manasquan Inlet in Monmouth County under the jurisdiction of the Corps' New York District, and the 2005 PBO covers projects in the Corps' Philadelphia District, from Manasquan Inlet to Cape May in Ocean, Atlantic, and Cape May Counties. Since the issuance of the 2002 and 2005 PBOs, 45 Tier 2 (*i.e.*, project-specific) consultations covering deposition of 38 – 39 million cubic yards of fill along more than 80 cumulative miles of shoreline have been completed. Since 1996, but prior to the 2002 and 2005 PBOs, the Service had engaged in at least six formal consultations for beach nourishment projects covering 11.14 linear miles and more than seven million cubic yards of fill. In addition to Corps-funded projects, the Regulatory Branch of the Corps' Philadelphia District has active permits for non-Corps-funded beach nourishment activities in Avalon (expires 2017), Ocean City (two permits, expire 2017 and 2018), North Wildwood (two permits, expire 2018 and 2022), Upper Township (expires 2019), Stone Harbor (expires 2019), and Sea Isle City (two permits, expire 2019 and 2020) (Boyer pers. comm. 2014). Nearly all consultations for New Jersey nourishment projects include provisions to avoid or minimize construction during the piping plover breeding season.

Following issuance of the 2002 and 2005 PBOs for the Corps, the Federal Emergency Management Agency (FEMA) has become more active in funding beach nourishment and other coastal projects in New Jersey, through reimbursements to municipalities for costs associated with coastal disaster declarations. From Fiscal Year 2007 through Fiscal Year 2012, the Service reviewed approximately 20 FEMA projects in municipalities along New Jersey's Atlantic coast, some involving beach nourishment.

Inlets and Dredging

In New Jersey, many inlets that existed around 1885 and all inlets that formed since that time were artificially closed or kept from reopening after natural closure (Nordstrom 2000). Along New Jersey's Atlantic coastline, five of 11 currently existing inlets (not including New York Harbor or Delaware Bay) are armored with jetties or other hard structures on both sides, and the shoreline is hardened on one side of three other inlets (Kisiel 2009); see Table 1 Repairs of the existing hard structures at New Jersey's inlets, as well as dredging for navigation and/or as a sand source (borrow area) for beach nourishment (Table 1), are generally conducted in accordance with conservation measures to avoid disturbance to piping plovers (*e.g.*, seasonal restrictions). However, these activities perpetuate existing habitat losses and preclusion of new habitat formation by interfering with natural coastal processes. For example, past channel dredging at some of New Jersey's less stabilized inlets (*e.g.*, Townsend's) changed the amount of sediment transferred across the inlets and the location of accretion and erosion on adjacent shorelines (Nordstrom pers. comm. 2014; Nordstrom 2000).

Table 1. Status of inlets in New Jersey (Brandreth pers. comm. 2014; Staffieri pers. comm. 2014; Kisiel 2009)

Inlet	Hard-Stabilized Shorelines	Dredging
Shark River	Both	Navigation
Manasquan	Both	Navigation
Barnegat	Both	Navigation
Little Egg	None	Being Investigated as a Borrow Area
Brigantine	None	Active Borrow Area*

Absecon	Both	Navigation and Active Borrow Area
Great Egg	North only	Active Borrow Area
Corson's	South only - minimal	Approved as a Future Corps Borrow Area Active State Borrow Area
Townsend's	South only	Active Borrow Area
Hereford	South only	Active Borrow Area
Cape May**	Both	Navigation

*"Active Borrow Area" indicates inlets approved for sand removal to use in beach nourishment, and that have been used as a sand source in the past. Most borrow areas do not extend into the actual inlet but are located outside the mouth of the inlet, or in the general vicinity of the inlet.

**The Atlantic side of the Cape May Canal is referred to by the Corps as Cold Spring Inlet.

In addition to the inlet dredging listed in Table 9, dredging is also routinely conducted adjacent to Sandy Hook in New York Harbor.

Backpassing

Backpassing is a technique that reverses the natural migration of sediment by mechanically (via trucks) or hydraulically (via pipes) transporting sand from accreting, downdrift areas of the beach to eroding, updrift areas of the beach (Kana 2011; Chasten and Rosati 2010), thus recycling sediment already in the littoral system by moving it from areas with ample or excess sand to areas with a sand deficit (Brandreth pers. comm. 2014). Many of the adverse effects of backpassing on piping plovers are similar to those stemming from traditional beach nourishment (USFWS 2011), including disturbance during and after construction, alteration of prey resources, creation of sub-optimal habitats, and an incremental contribution toward a stabilized shoreline that precludes the formation of optimal habitats. Relative to beach nourishment, however, truck-based backpassing can also involve considerably more driving of heavy trucks and other equipment on the beach including areas outside the sand placement footprint, potentially impacting plover habitat and prey resources over a larger area (USFWS 2011). In addition, backpassing could potentially remove sand from piping plover nesting areas (USFWS 2005b).

In 2005, the Service and the National Park Service (NPS) completed formal consultation on a permanent sand slurry pipeline to backpass sand from other portions of the Sandy Hook shoreline, including a nesting area, to the Critical Zone (USFWS 2005b). The project has been constructed, but has not operated successfully in two attempts to date; no additional attempts are planned at this time (Adamo pers. comm. 2014). Since 2011, the Service has consulted on backpassing projects in Cape May (Corps-funded), North Wildwood (FEMA-funded), and Avalon (2 rounds, both locally funded). The Corps is moving ahead with plans for a periodic Federal backpassing project in North Wildwood (Corps 2013a).

Hurricane Sandy - Habitat Creation and Response

A detailed formal assessment of changes to New Jersey's beach nesting bird habitat from Hurricane Sandy is in progress, but has not yet been completed. Maslo (pers. comm. 2014) conducted a preliminary assessment of aerial imagery taken immediately following Hurricane Sandy and found that the storm caused a 7.2 percent increase in beach area, a 14 percent decrease in vegetated dune communities, and an approximately 10 percent increase in total tidal pond area. Imagery shows a 7 percent loss of mudflat habitats immediately following Hurricane Sandy; however, continuing recession of flood waters may have exposed additional mudflat areas after the initial imagery was collected. These data reflect only storm-induced changes and are not indicative of habitat availability after anthropogenic storm response activities, which are still under assessment (Maslo pers. comm. 2014). Major efforts to stabilize many beaches affected by Hurricane Sandy have already been implemented, are under construction, or are scheduled for implementation in the near term. Pertinent Federal and State actions are described below, but post-storm coastal stabilization activities are also being implemented by local and private beach managers.

In addition to the areas listed in Table 8, roughly 50 miles of hardened New Jersey coastline covered by authorized Corps projects have not received beach nourishment to date (Brandreth pers. comm. 2014; Gebert 2012) for various reasons, including deferment while higher-priority projects were completed (Corps 2013a), and because some local landowners had rejected or delayed granting the required public easements (Dawsey 2013; Huba 2013; Spoto 2013). Following the infrastructure damage caused by Hurricane Sandy, proposed (Huba 2013) and enacted (Christie 2013) State policy changes, and the resolution of a legal challenge to constructed dunes blocking ocean views (Dawsey 2013; Spoto 2013), many of these previously unnourished areas are now under construction or scheduled for beach nourishment. New nourishment areas being constructed since Hurricane Sandy include southern Long Branch to Loch Arbor (about 3.5 miles) (Corps 2014); Manasquan Inlet to Barnegat Inlet (excluding Island Beach State Park) (about 14 miles) (Corps 2013b); portions of Long Beach Island; Margate and Longport; and southern Ocean City (Brandreth pers. comm. 2014). Since they were previously authorized, these new construction projects will be evaluated under the 2002 and 2005 PBOs, as will several renourishment projects that are also being undertaken in response to Hurricane Sandy.

Within these Monmouth County renourishment areas, engineered dunes are not part of the approved Corps beach nourishment profile in Monmouth County (USFWS 2002). However, in response to Hurricane Sandy, dunes have been constructed by local beach managers in two Monmouth County nesting areas. This dune-building was coordinated with the New Jersey Division of Fish and Wildlife (NJDFW) and the Service, as required by the approved Beach Management Plans (discussed below) for these areas. This coordination was important to minimize adverse effects to plover habitat, but adverse effects cannot be completely avoided because man-made dunes are generally incompatible with piping plover habitat. As of January 2014, a third local beach management entity was proposing dune-building in a piping plover nesting area. If constructed, stabilized dunes in this area are likely to negatively impact habitat suitability for piping plovers even if constructed in accordance with NJDFW and Service recommendations.

Following Hurricane Sandy, the Service completed programmatic informal consultation with FEMA to expedite storm damage recovery projects in New Jersey. Individual project reviews under this consultation are ongoing and include numerous repairs and replacements of coastal infrastructure including boardwalks, piers, beach access structures, and engineered dunes (including dune fencing and plantings), as well as redistribution of beach material from adjacent sources. The Service has also completed several individual consultations for FEMA-funded, post-Sandy beach nourishments (USFWS 2013a; 2013b). In addition, the Service completed programmatic informal consultation with the U.S. Department of Housing and Urban Development (HUD) for the repair or replacement of residential homes damaged by Hurricane Sandy, and the Service is now conducting programmatic informal consultation with HUD for the repair and replacement of other types of storm-damaged coastal infrastructure.

The Service is also formally consulting with HUD on its proposed partial funding of a 4-mile-long sheet pile wall that would serve as a “last line of defense” to protect a coastal evacuation route (Route 35) and nearby homes and businesses in Mantoloking Borough and Brick Township, Ocean County. The proposed sheet piling would be located in a section of barrier island that was breached during Hurricane Sandy (NJDEP 2014). The breach formed on October 31, 2012 and was closed by November 4, 2012 through emergency actions taken by FEMA, the Corps, and the State (Corps 2012).

Beach Management Planning

Due to provisions in the PBOs, the Corps and the State have partnered with the Service since 2006 to develop 17 local Beach Management Plans (BMPs). Currently, every local jurisdiction receiving Corps-funded beach nourishment has an approved BMP in place, even including many areas without a recent history of plover nesting in the event that birds should colonize the widened beaches following nourishment. The BMPs have improved communication and coordination between beach nesting bird managers and local beach managers. Approved BMPs provide for management of recreational activities that is at least as protective as the USFWS (1994) *Guidelines for Managing Recreational Activities in Piping Plover Breeding Habitat on the U.S. Atlantic Coast* (Guidelines). The BMPs also go beyond the Guidelines in several areas, such as addressing predation issues and promoting proactive habitat management in designated areas (often called "protected zones"), which are located where conflict with recreation can be minimized.

Approved BMPs require local jurisdictions to coordinate with NJDFW and the Service for any State of Emergency post-storm beach or dune restoration, including sand transfers (beach scraping), vegetation planting, and sand fencing in protected zones. As mentioned above, dune building in two Monmouth County protected zones was coordinated with NJDFW and the Service. However, in other areas, post-storm activities affecting habitat have not been coordinated. Following observations of municipal and county actions taking place without such coordination, municipal and county BMP signatories have recently been reminded of these commitments (USFWS and NJDFW 2014). The need for coordination is underscored by 2013 revisions to the New Jersey Coastal Zone Management Rules, which restrict sand transfers in documented piping plover nesting areas between March 15 and August 31 and also state that sand transfers outside the breeding season must "be conducted in a manner that does not destroy, jeopardize, or adversely modify endangered or threatened wildlife or plant species habitat; and shall not jeopardize the continued existence of any local population of an endangered or threatened wildlife or plant species" (Pover pers. comm. 2014).

Some areas supporting plovers that have not received beach nourishment through a Corps project have voluntarily developed BMPs. Forsythe NWR manages plovers in accordance with its Comprehensive Conservation Plan. In 2007, the NPS completed a comprehensive BMP for listed species at Sandy Hook ("Shoreside Threatened and Endangered Species Management Plan"). The Service recently completed an ESA Section 7(a)(1) review of a new General Management Plan for Gateway National Recreation Area, which lays out a vision of expanded and increased recreation at the park including Sandy Hook. As part of the 7(a)(1) review, the NPS has committed to update and continue implementing its BMP. Several agencies are also working toward the development of BMPs for State lands, but progress has been slow.

Appendix 7: Phifer Notes Memo, May 23, 2014.

Fire Island Biological Opinion Notes to the File

May 23, 2014

Paul Phifer

There are multiple decision points along the way in completing a biological opinion (BO), especially one where there is significant scientific uncertainty. In these instances, professional assessments are needed to determine what is a reasonable understanding of the current and future condition. Further, the Service is directed to give the benefit of the doubt to the species when there is uncertainty, but again, this is conditioned by reasonableness.

In completing the BO, I attempted to give the benefit of the doubt to the species in a reasonable manner and to respect the scientific assessments of the technical experts on my team.

While I do not have as much expertise on piping plovers as the Service team, through my doctoral research in conservation biology, and the subsequent 16 years employed on natural resource scientific and policy issues, I have obtained some competency in policy interpretation and biology, including avian ecology. Further, I have worked on piping plover issues frequently over the past 5 years. More specifically, I have been involved in discussions related to the Fire Island to Moriches Inlet (FIMI) project since its inception. I have participated in many discussions with Service scientific experts, and policy and biological experts from the Corps, Suffolk County, State DEC, National Park Service (NPS) and the US Geological Survey (USGS). I have participated in numerous face-to-face and telephonic meetings regarding FIMI and its potential effects on piping plovers. Finally, I have read quite a few of the primary scientific documents cited in the BO so as to better understand the underlying information.

Given this experience and knowledge, I took a draft BO that was 90 percent completed by Service staff and finalized it, concluding the project would not jeopardize the species, i.e., would not reduce appreciably the likelihood of survival and recovery.

It must be noted the Service staff did an exceptional job compiling the relevant scientific information and conducting important analysis in a highly-compressed timeline. The Endangered Species Act provides the Service 135 days to complete a BO. This large and complex BO is slated to be completed in 80 days or 57 work days.

Up until the final weeks before completing the BO, the Service was communicating to the Corps, County, DEC and NPS that, as designed, the project would jeopardize the species. Specifically, the Service was concerned the project, as described prior to agreements reached with the Corps, County, DEC and NPS on May 16, 2014, would impair newly-created habitat (to which we hoped the plover would respond positively).

In response to the Service's concerns, further habitat was offered by the County as lands to be managed for plovers. Prior to the May 16 meeting, the County had offered 39 ac (15.7 ha) to be restored (it is currently vegetated) for plovers. At the May 16 meeting, in response to the Service's concerns, the County offered an additional 59 ac (24 ha) to be managed for plovers, bringing the total acreage managed for plovers to 98 ac (39.7 ha). This additional acreage, and the stipulated beach management actions (e.g., vegetation and predator management, and stewardship and monitoring), were sufficient, I believe, to manage the effects such that the project will not jeopardize the species.

The details are explained in the BO, yet here I attempt to outline and explain the key decisions encountered while completing this BO.

- Estimates of “without project” nesting density

As makes common sense, the Service started the BO analysis by looking at how many plovers the project area (i.e., most of Fire Island) can support given the newly-created habitat by Hurricane Sandy in October of 2012. This original starting point was the topic of much conversation within the Service team and the relevant partners. One Service estimate was that the current habitat can support 60 pairs of plovers, while the Corps, County, DEC and NPS believed this was an overestimate due to existing and future modifications of this habitat, e.g., increased vehicle traffic.

Essentially, in the 60 pair estimate says in the three major overwash areas (Pattersquash, New Made Island, and Smith Point Breach) there is full connectivity between bay to ocean habitats, which provides ideal nesting and foraging habitat for the plovers. Hence, per Cohen et al. 2009[9], these acres are said to allow for 1 pair of plovers to nest per each hectare of this ideal habitat. Where the habitat abuts only a single side (i.e., ocean or bay), it can support only 0.5 pair/ha, because of reduced nesting or foraging opportunities. Again, this is per Cohen et al. 2009.

The Corps, County, DEC and NPS stated they believed there are already (existing today) impediments to full connectivity between bay and ocean. Further, it is fully expected that more impediments to connectivity will arise, such as more vehicle traffic or vegetation.

The Service must look to what is existing now to describe the environmental baseline, so the future possible future conditions could not be included here in determining the without project nesting density.

To best determine what is the existing condition, I spoke with biologists who work in that area and I reviewed maps on Google Earth. Clearly, there is some impediment now to full connectivity in the form of vehicle use and sand fencing (as is shown on the 9/13/13 Google Earth image, which local biologists corroborated represented an accurate picture of the current day), possibly in the form of elevational change as well. However, there are examples of plovers navigating through roads and sand fencing, so full disconnection between the bay and ocean side habitat doesn’t appear to have occurred yet.

In discussions among the Service team, it was questioned whether the Cohen et al. analysis just considered a bird’s eye view. Meaning, would a plover searching for nesting habitat notice the sand fence. They may choose to nest in the newly-created habitat and not discern that full bay to ocean connectivity was impaired.

Cohen et al. 2009 defines nesting density as “nesting pairs/ha of potential nesting habitat” (pg. 7). Therefore, it is important to understand how the article defines “potential nesting habitat”. In defining their field methods (pages 4-6), it is clear there was some assessment of the availability of nesting and foraging opportunities and the connection thereof. For example, Cohen et al. states that in Westhampton Dunes “we considered the artificial dune to be the boundary between the ocean and bay backshores” (pg. 4). Meaning, the potential nesting habitats were split into a bay side and an ocean side where an artificial dune was present, and each side was considered 0.5 pr/ha habitat. Connectivity, then, is an important element for “potential nesting habitat” and for the pr/ha density assigned to that habitat.

In the end, I believe there is partial, not total, connectivity from bay to ocean in the three overwash areas leading me not to consider this habitat as 1 pr/ha habitat. Some impediments, like sand fences, exist, but it is believed to be some connectivity.

9 This scientific article is an excellent source of relevant information as it is from an 11-year study in Westhampton Dunes, a town nearby to Fire Island.

Ultimately, I assigned a nesting pair density of 0.75 to Smith Point Breach and Pattersquash overwashes due to this impaired connectivity. I do not consider the habitat fully connected (therefore, 1 pr/ha) or fully disconnected (therefore, 0.5 pr/ha).

- Estimates of "with project" nesting density

The overall area available for nesting was reduced from the "without project" to "with project" analysis simply by the project footprint, e.g., the dunes are not considered habitat. The remaining potential nesting acres in the three overwash areas were then discounted from the 1 pr/ha density given concerns about these habitats providing both sufficient nesting and foraging opportunities.

It was discussed how much to discount the nesting density of these overwash areas. Should they be fully discounted to 0.5 pr/ha habitat as they do not have connectivity from bay to ocean?

It is clear bay side habitats are important for plovers. For example, "Because other variables indicative of food availability in our study (i.e., ocean-wrack widths and arthropod abundance) did not differ among years or between sites in any systematic way, we believe it was the extensive bayside intertidal flats at WHD that led to the more rapid population increase and higher peak density at WHD than at REF" (Cohen et al. 2009, pg 17).

In Cohen et al. 2009, single side only habitats (bay or ocean) were given 0.5 pr/ha nesting density. However, in that study, these habitats had limited foraging ability and degraded over time due to the growth of vegetation -- "The WHD bay side may have become less attractive to piping plovers by the end of our study due to increased fragmentation of the habitat due to vegetation succession and construction, in conjunction with several years of low reproductive success" (pg 17).

Yet, it is also clear that habitat on a single side (ocean or bay) can perform well -- "Bayside survival was higher than survival of broods that used both sides from 1997 to 2000, but the reverse was true from 2001 to 2004, and crossers experienced similar survival to ocean-side only broods in all periods with crossing (table 9)" (Cohen et al. 2009, pg 16).

Ultimately, I support assigning these areas a 0.75 pr/ha nesting density ratio for several reasons:

- The Corps agreed to modify the alignment of the road near these areas so as to increase nesting, possibly foraging, habitat opportunities while maintaining foraging opportunities on the bay side;
- These habitats will be managed to maintain vegetation at no more than 30% density – a management action that was not included in the Cohen et al. 2009 study site, which considered vegetation growth a degradation of the habitat.

Still, with this assignment of a 0.75 pr/ha ratio to the overwash areas, there was a deficit of possible nesting habitat from without to with project. So, in conversation with the Corps, County, State and NPS, more habitat was offered to mitigate the effects of the project.

In total, the new area managed for plovers went from 39 ac (15.7 ha) to 98 ac (39.7 ha) offered by the County (mostly at Great Gunn, the far eastern end of Fire Island, and including the dredge site restoration). The question we faced, though, was what nesting density value (e.g., 1 or 0.5 pr/ha) to assign to this habitat.

The Service is interested in determining whether we can create and manage single-sided habitat (ocean and bay) that can support plovers at the 1 pr/ha nesting density. Engineered sandbars have been created by the Corps on the Missouri River to some success. In fact, Catlin et al. 2012 found higher daily use and survival on the engineered sandbars than on the natural sandbars. However, the long-term effectiveness of these sandbars is still uncertain. We need to assess whether these restoration and creation options can work on the Atlantic coast now, as the options for recovering the piping plover in the NY-NJ Recovery Unit are declining. The threats plovers face in the area are most likely increasing while the habitat options are decreasing. So, we need to know what tools are available to create and restore plover habitat.

More immediately, these possible restored and created acres are proposed so as to minimize the effects of the project, and we need to estimate how well they will perform for nesting habitat.

Ultimately, we received commitments from the Corps, through reasonable and prudent measures and terms and conditions to manage the 39.7 ha in Great Gunn and the dredge site as plover habitat. In the Great Gunn (33.7 ha) and dredge site this entails devegetating when the area approaches >30% vegetative cover. Importantly, it also includes the creation of ephemeral pools in Great Gunn, so that this ocean side only habitat complements the forage availability found now only in the wrack line. In the dredge site restoration area (6 ha), the Corps committed to removing the existing berm and grading the area back from the bay at a 1:30 slope to develop moist forage areas. This 6 ha site will also be graded toward the south and east to connect to the existing plover habitat.

In deference to the species, I believe it is appropriate to assign a ratio of 0.75 pr/ha to the 33.7 ha in the Great Gunn area, assuming appropriate foraging habitat is created through ephemeral pools and vegetation is managed. Both of these management actions are included in the BO as Terms and Conditions.

However, it is more uncertain that the 6 ha proposed for the dredge site restoration will be successful in creating nesting and foraging habitat. This restoration will convert a bermed, dry landscape into a gently sloped (1:30) bay area that connects to dry upland area south. I believe there is much to learn from this site that will inform future actions, however, for this BO, we should be cautious about assuming too much. Hence, I believe these 6 ha should only be assigned a nesting density ratio of 0.33 pr/ha.

- Population model

The draft BO I was provided included population modeling with runs of with and without the project. I reviewed these models and decided to remove them from the final BO.

My modeling professor in graduate school was the wildlife modeling guru, Dr. Tony Starfield. Tony would say that, "While all models are wrong, some are useful." The question I asked was whether this plover models were useful. I do not believe they are as the specific input variables were not explained. The dynamic relationship between plover biology and coastal ecosystem ecology is more complex than we know, so I am cautious about reducing this complexity to simple models. Given the extreme time crunch, there was simply not time to create, review and revise a model that could fairly represent this complexity. How does the model account for environmental stochasticity? How does it include changing environmental conditions due to climate change? It seems to assume continued growth indefinitely into the future. How is this reasonable given past history clearly demonstrating something else? What is the assumed productivity and is it reasonable given the severe decline we've seen over the past 14 years in all of Long Island? How does one reconcile the different metrics on the y axis between the models? Further, is it reasonable to assess the effects of this project on such a timescale (i.e., multiple decades), when the system is highly dynamic and shifts quickly with the onset of new storms?

I think we definitely need a sound model to understand how future projects will affect the plover population. Such a model could be designed to inform any project and biological opinion completed along the Atlantic Coast. The reality is, the Service does not complete many BOs in the Atlantic Coast population. The last BO done in the Long Island area, for example, was 2008. We are busy working with communities to implement beach management guidelines and we are understaffed. So, developing something proactively like a peer-reviewed population modeling is difficult.

Ultimately, I believe there was too much uncertainty about the model to include it in this BO.

- Management actions benefitting productivity

There are two ways this project affects/benefits plovers. One is through nesting habitat (e.g., pr/ha density) and the other is through productivity (i.e., chicks fledged per pair). It has been difficult to separate these two elements in the analysis and drafting of the BO. Frankly, in reality there is obviously significant overlap between these aspects and we are concerned about both. Nesting habitat is essential and productivity is at historically low levels and of significant concern.

I think also this gets to one of the central issues and disagreements among participants in this discussion. Is the issue that if we simply leave good habitat alone, the birds will come and prosper? Or, is there some unknown ratio of having enough habitat while also managing that habitat to support plovers in the long-term?

The more involved I become in this issue, especially on Long Island, the more I am certain we need a good understanding of how to protect and restore habitat while simultaneously doing everything we can through management actions to maximize the plover productivity on this habitat.

With the increased acreage offered by the county to be managed for plovers, I believe there is an 11 pair difference of nesting habitat between the without project and with project scenarios. While I do not believe an 11 pair deficit over the 10-year span of this project jeopardizes the species', I frankly believe this assessment does not fully capture the benefits this project will bring that may increase the productivity of the pairs on the landscape. While some nesting habitat might be lost, productivity may be increased through better management actions.

The Corps has committed to $10.5 million over the 10-year project to assist with predator and vegetation management, stewardship (outreach and education), and implementation and effectiveness monitoring. Further, the BO outlines a commitment to form an interagency team to discuss how to fully design and implement these management actions.

To date, there has never been comprehensive predator, monitoring, or stewardship strategies, and I believe we now have an unprecedented opportunity, backed by sufficient funding, to design coordinated management strategies to help address key threats facing plover productivity (e.g., predators) as described in multiple scientific articles. For example, the Bouchard Barge 120 Oil Spill Final Restoration Plan - http://www.fws.gov/newengland/pdfs/FinalBouchardRPEApipingplover_%20122012.pdf - expects a 20 percent increase in productivity with an "enhanced management plan" involved predator management, law enforcement and stewardship. I believe we have that opportunity here.

Conclusion

I know there is disagreement among the Service team on some of these points. I also know there is disagreement on some of these points with the Corps, County, DEC and NPS.

Ultimately, it was my responsibility in finalizing this document to adhere to the requirements of the ESA. In doing so, I believe the BO provides a benefit of the doubt to the species in concluding that the project will not jeopardize the survival and recovery of the species.

Yet there is always risk associated with any action, and future unknowns. For example, we do not know when the next major storm will arrive that may damage the created dunes. Nor do we fully know exactly how the plovers will respond to the habitat created by Hurricane Sandy or the proposed restored habitat. We have to proceed with our best estimates based on the best available information and learn as we go.

Given that, I am encouraged we are committing in this BO to form an interagency team to discuss implementation and effectiveness monitoring. Further, the Corps has committed significant funding for these efforts. This type of effectiveness monitoring will provide essential information for the next project, following the next storm, or for the longer term and larger scope Fire Island to Montauk Point (FIMP) discussion we know is next.

In particular, there have been many calls in the scientific literature for us to test whether engineered landscapes can support plovers – "It also may be possible to artificially create and maintain habitat with at least some of the characteristics produced by natural scouring, but this needs to be carefully tested" (Elias et al. 2000, pg. 353). Or, "Management of breeding piping plover populations for increased growth should include allowing natural storm-processes that create habitat to act unimpeded; artificial creation or restoration of nesting and foraging habitat via sediment deposition and vegetation control; and trapping and removal of mammalian predators" (Cohen et al. 2009, pg. 20).

We have a learning opportunity in front of us that can provide needed information gathered in a way that comports with the requirements of the ESA. Shame on us if we find ourselves discussing these same issues for FIMP three years from now and we are no wiser, with no more tools for recovery. The plovers need us to do better.