ES-02/356

Frank Santomauro, Chief
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Dear Mr. Santomauro:

This transmits the U.S. Fish and Wildlife Service's (Service) final Biological Opinion (Opinion), in accordance with Section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq*.) (ESA), on the effects of the U.S. Army Corps of Engineers, New York District's (Corps) proposed continuing construction of Sections I and II of the Atlantic Coast of New Jersey Sandy Hook to Barnegat Inlet Beach Erosion Control Project (BECP), Monmouth County, New Jersey on the federally listed (threatened) piping plover (*Charadrius melodus*) and seabeach amaranth (*Amaranthus pumilus*). The proposed project consists of a 50-year program of beach nourishment from Sea Bright Borough to Manasquan Borough for the primary purpose of providing storm protection to upland development. The first regularly scheduled renourishment is currently under construction, and includes parts of Sea Bright and Monmouth Beach Boroughs in Section I, and part of Spring Lake Borough in Section II.

ONGOING CONSTRUCTION

Federal regulations at 50 CFR Part 402.14 state that a federal agency shall make no irreversible or irretrievable commitment of resources that would prevent formulating or implementing any reasonable and prudent alternatives for the action, until the requirements of Section 7(a)(2) are satisfied. Pursuant to this regulation, an irreversible federal action that is likely to adversely affect a federally listed species may not commence prior to issuance of the Service's final Opinion. Although work on the 2002 renourishment cycle began in advance of this final Opinion, your May 17, 2002 letter states that the Corps "will adhere to the terms of the draft [Biological Opinion] including the 1,000-meter [piping plover nesting area] buffer, for this current renourishment cycle." Additionally, the Corps May 17 letter

withdraws a previous Corps request for major modifications to the conservation measures contained in the draft Opinion. Therefore, this final Opinion is not substantially different from the Service's December 6, 2001 draft Opinion. An overview of changes from the draft, and responses to specific Corps comments, are provided at the end of this letter.

PROPOSED STUDIES

Your May 17, 2002 letter indicates that the Corps intends to commission a study of the movement of piping plover chicks in the project area during upcoming nesting seasons to determine an appropriate buffer size for Corps construction activities. The Service appreciates Corps efforts to collect sound data that can inform future Section 7 consultations regarding the project. An investigation of piping plover prey base recovery time following renourishment within nesting areas is required under the terms of this Opinion. Additional studies are recommended at the end of this Opinion. The Service requests thorough coordination with this office regarding any Corps-sponsored studies of federally listed species in New Jersey, and that the Corps work closely with this office to develop an integrated study plan for listed species within the project area.

BUFFERS AND DEFINITION OF A NESTING AREA

The Corps purpose in undertaking the aforementioned chick movement study is to reduce the size of a piping plover "nesting area," as defined in this Opinion, as well as the size of buffers afforded unfledged chicks when sand placement cannot be avoided within a nesting area during the nesting season. Two such occasions are included in the current project description, each occurring either between March 15 and April 15, or between July 31 and the fledging of the last chick in the nesting area. The Service concurs that a scientifically credible study of chick movements within the project area, as proposed by the Corps, will assist in future decisions regarding buffers necessary to protect unfledged chicks from sand placement and other project activities.

Please note that the Service-recommended inclusion of 1,000-meter buffer zones in the definition of a "nesting area" was based not only on the movements of unfledged chicks, but also on the need to protect habitat early in the nesting season to allow the natural shifting and expansion of nesting areas. The significant expansion in 2002 of the Sea Bright North nesting area supports the Service's finding that work within suitable habitat between 200 and 1,000 meters from the previous year's nest sites between March 15 and late June is likely to prevent piping plovers from establishing territories and nests, thereby causing incidental take. Please also note that the 1,000-meter buffer afforded unfledged chicks protects these birds not only from direct injury or death, but also from increased predation during sand placement (page 83) and reduced prey availability caused by drifting suspended sediments (page 92). These protections are especially important given the repeated movement by two unfledged chicks of over 850 meters in as little as 24 hours, documented in Monmouth Beach during the 2002 nesting season.

REINITIATION OF CONSULTATION

The Service understands that the Corps will consider reinitiating formal, programmatic consultation for the project based upon the results of the above-mentioned studies. A revised Biological Assessment must be submitted with any future request for reinitiation of consultation, and must include the Corps assessment of impacts to federally listed species from any proposed changes to the project or Corps conservation measures (*i.e.*, change in buffer distances or timing restrictions). For any future formal or informal consultations, the Service requests that the Corps submit a complete, detailed, and specific project description containing unambiguous, biologically appropriate conservation measures to avoid and minimize adverse effects to federally listed species. Submission of a clear and precise project description will expedite future issuance of Biological Opinions and avoid confusion.

As a reminder, under the terms of this programmatic Opinion, streamlined informal or formal consultation is required prior to the start of each future renourishment cycle. In addition, federal regulations at 50 CFR 402.16 require reinitiation of this programmatic consultation if significant new information comes to light or if the project is substantially modified. Specific reinitiation triggers are given at the end of this Opinion.

TERMS OF THIS OPINION

With respect to ESA compliance, all aspects of the Corps project description in this Opinion are binding, including the specific nature, timing, and extent of proposed beach nourishment activities, as well as all conservation measures included in the Corps project description. Reasonable and Prudent Measures (RPMs) and the accompanying terms and conditions provided within this Opinion are designed to minimize incidental take of piping plovers anticipated as a result of the proposed project; these measures, terms, and conditions are nondiscretionary. In order to be exempt from the prohibitions of Section 9 of the ESA, the Corps and its contractors must comply with all measures, terms and conditions in this Opinion.

Please note that the terms of this Opinion are binding for all current and future activities related to the project until such time as superceded by any future, revised, programmatic Opinion issued for Sections I or II of the BECP, or by *project-specific* terms of streamlined informal or formal consultations, under the auspices of this programmatic Opinion, on individual renourishment events included as part of the subject project. Implementation of <u>all</u> terms (*i.e.*, before, during, and after construction) of these streamlined consultations for individual renourishment events will be required for ESA compliance.

The Corps did not agree to the terms of the draft Opinion until May 17, and renourishment activities began on May 20; therefore, pre-construction terms and conditions (*i.e.*, a pre-construction meeting, distribution of required information to contractors, Service notification and monitoring procedures for work within an occupied reach) were not implemented in a full and timely manner. Failure to comply with pre-construction terms and conditions resulted in poor communication among the Service, the Corps, and construction and monitoring contractors. Poor communication ultimately led to motorized

construction activities, including sand placement, occurring within 200 meters of unfledged piping plover chicks, in clear contradiction to the terms of this Opinion. Construction in close proximity to plover chicks occurred because construction contractors erroneously continued measuring 1,000-meter buffers from a nest site, rather than from the actual chicks, which had moved 800-900 meters toward the construction site.

This Opinion also includes post-construction measures, terms, and conditions for the current renourishment cycle, such as developing municipal endangered species management plans, conducting prey studies, curtailing dune stabilization and mechanical raking within nesting areas, and restoring seabeach amaranth in 2003. The Service requests a meeting at your earliest convenience to discuss implementation of post-construction measures, terms, and conditions for the 2002 renourishment, as well as improved coordination for future renourishments. Improved coordination before and during future construction will eliminate confusion regarding monitoring protocols, buffer sizes, and other conservation measures, terms, and conditions, and will avoid additional occurrences of inadvertent non-compliance with the terms of this Opinion.

CHANGES FROM THE DRAFT OPINION

General Changes

As indicated in the Service's April 18, 2002 correspondence, an RPM and implementing terms and conditions have been added to the Incidental Take Statement at the end of this Opinion. The RPM addresses continued Corps, Service, and State access to private property within the project area for endangered species management. The introductory paragraph under RPMs (page 104) has also been changed as per our April 18 letter.

The species status section has been updated to reflect current information, particularly for piping plovers. The consultation history section has been updated to include key communications between the Corps and the Service since the December 6, 2001 issuance of the draft Opinion. In addition, minor changes have been made throughout the Opinion to reflect the changed construction schedule; most significantly, terms and conditions regarding the sequence of renourishment activities (page 105, #1a) have been revised to reflect the new schedule.

To ensure consistency with other Opinions recently issued by this office, the analysis of effects has been revised to include consideration of increased predation of piping plovers during sand placement and potential loss of seabeach amaranth genetic diversity. Both effects are considered minor given the species protections included in Corps conservation measures. A minor change was made to the Incidental Take Statement, and a conservation recommendation was added, to reflect the potential effects of increased predation. The analysis of effects was also changed to reflect the fact that the extent of areas actually receiving sand within a given construction reach may vary among renourishment cycles, and will not necessarily include the entire reach. Finally, two terms and conditions (page 105,

#1b and page 106, #3d) have been added to address Service concerns that became apparent during the 2002 nesting season.

Incorporation and Responses to Corps Comments

The numbers below correspond to the Corps March 29, 2002 comments on the draft Opinion, and are consistent with the Service's April 18, 2002 and the Corps May 17, 2002 correspondences; please refer to these documents for context.

Comment 1: The Service recognizes the distinction between the annual Endangered Species Management Program (ESMP) and construction monitoring during renourishment activities. The Service understands that the Corps has committed budget funds for construction monitoring during each renourishment cycle. (Based on this information, Comment 11 has not been incorporated in the final Opinion.) In contrast, while the Corps expects continuation of the ESMP, its future implementation will be subject to availability of funding. The Service has revised the consultation history section (page 3) as per our April 18, 2002 letter, to reflect the 1995 agreement reached between the Corps and the Service to initiate the ESMP through a cooperative partnership.

The Service concurs that the ESMP provides substantial benefits to piping plovers and seabeach amaranth, as well as the State-listed (endangered) least tern (*Sterna antillarum*). The Service also concurs with the intent of May 17 Corps statements under Comment 30 that the ESMP is a model of cooperation among federal and State agencies to protected listed species. The Service commends the Corps for its continuing commitment to the ESMP, including substantial funding, in furtherance of Corps responsibilities under Section 7(a)(1) of the ESA.

Comments 2, 13, 15, 18, 19, 23: These Corps comments have been incorporated in the final Opinion.

Comments 3 and 6: In our April 18 letter, the Service concurred with the Corps March 29 request to change three breeding seasons to two in the definitions of "occupied reaches" and "nesting areas." At the time, there were no known instances of plovers using a nesting area in the project area for two non-consecutive breeding seasons, with no breeding activity during the intervening year. With no evidence to the contrary, the Service concurred that a change from three to two breeding seasons would not substantially affect our analysis of effects to piping plovers.

Subsequently, new information has been documented within the project area. At the National Guard Training Center in Sea Girt Borough, a plover was observed scraping in 2000, no plovers were observed in 2001, and nests were established in 2002. Based on this new information, the Service must apply the best available scientific information and withdraw its concurrence with the Corps-requested change. Given the new information, the Service now finds that a change from three to two breeding seasons would substantially change the Service's standard definition of a "nesting area" and

"occupied reach"; therefore, this change has not been incorporated into the final Opinion.

The Service also cannot concur with the May 17 Corps request (Comment 3) to change "occupied reach" to "nesting area," and has not revised the final Opinion to reflect this change. This Opinion defines three types of areas, with varying levels of seasonal restrictions to protect plovers: (1) unoccupied construction reaches, with no seasonal work restrictions; (2) occupied construction reaches outside of nesting areas, with no seasonal work restrictions but careful monitoring if work occurs during the nesting season; and (3) nesting areas, with seasonal work restrictions from March 15 to the fledging of the last chick, usually around August 15.

Comments 4, 5, 8, 10, 11, 16, 20, 21, 22, 24, 28, and 31: As per your May 17 letter, no changes have been incorporated in the final Opinion in response to these Corps comments. Regarding comment 22, the citation in question was provided in the draft Opinion, and a printed copy of the paper was supplied with the Service's April 18 letter. Regarding comment 31, the conservation recommendation regarding seabeach amaranth genetic research has been left in the final Opinion; however, implementation of this and all conservation recommendations is at the Corps discretion.

Comments 7, 9, 12, and 14: Revisions to the Opinion regarding delineation of nesting areas (page 24) and plover use areas (page 26) reflect a more cooperative process. Although the Service reserves the final judgement, the parties will work together before and during renourishment to accurately delineate and map these areas in accordance with the definitions contained in this Opinion.

Comment 17: The Service recognizes that initial nourishment created suitable habitat in some areas where none previously existed, and has no objection to the term "create." Although "create" was used in the draft Opinion, the original focus was on the drawbacks of the created beach as piping plover and seabeach amaranth habitat (*i.e.*, stabilized shoreline, recreational use conflicts). The Opinion has been revised to better recognize the benefits, as well as the drawbacks, of initial nourishment for listed species.

Comments 25 and 26: The Service recognizes that delegating the stop work authority to the field monitor(s) would be operationally impractical for the Corps. However, establishing clear procedures to halt or modify work activities is necessary to ensure contractor compliance with the terms of this Opinion and to minimize incidental take of piping plovers. Such procedures must include adequate communications and clear authority. The Service has revised the terms and conditions (page 106, #3c) to permit consistency with normal Corps operating procedures, while providing the Service adequate assurances that work can be promptly halted or modified as needed to protect plovers.

Comment 27: The terms and conditions regarding mechanical beach raking (page 108, #10) have been revised as per our April 18, 2002 letter. The Service does not concur with the May 17 Corps comment that July 1 is an extreme late date to allow mechanical raking if no plover breeding activity has been observed in a nesting area. Piping plovers eggs may be present on the beach from mid-April to

late July. Re-nests often occur on the same site, but movements between nest sites have been recorded (U.S. Fish and Wildlife Service, 1996). In New Jersey, nests (usually re-nests) are routinely established during June. July 1 is not an extreme date, but is the standard cut-off date used by this office and the State to classify a nesting area as inactive during the current breeding season.

Comment 29: The Service maintains that scheduling sand placement, including sequencing nesting areas, to minimize effects to plovers meets the criteria of an RPM. The Service does recognize that cost is a factor in determining whether a measure is "reasonable," according to the Consultation Handbook (U.S. Fish and Wildlife Service and National Marine Fisheries Service, 1998). Therefore, the Service has revised this RPM (page 104, #1). During the streamlined informal or formal consultation process preceding each renourishment, the Corps and the Service will develop a schedule and sequence for renourishment of nesting areas to minimize effects to plovers, in accordance with the terms of this programmatic Opinion and consistent with the Consultation Handbook. Please note that the implementing terms and conditions for this RPM (page 105, #1a) for the 2002 renourishment cycle have been revised from the draft Opinion to reflect the new construction schedule.

Comment 30: The Service reiterates that the ongoing, cooperative, Corp-funded ESMP is a commendable effort to fulfill Corps Section 7(a)(1) responsibilities within the project area. The Service <u>does not</u> consider the ESMP, as it has been implemented to date, limited or insufficient. (See additional Service response under Comment 1.)

In contrast, local participation and cooperation in endangered species protection has been inconsistent. For example, in some portions of the project area, some municipal staff continue to disregard repeated requests to restrict vehicle use in nesting areas, resulting in several documented instances of harassment of piping plover chicks. Service and State staff are working to improve municipal cooperation through the ESMP. However, local cooperation has been generally insufficient to minimize incidental take caused indirectly by the local management of Corps-created beaches.

By creating and maintaining habitat that attracts listed species, the Corps bears responsibility for how that habitat is managed by local entities. The Service recognizes that "forcing" local cooperation is beyond the Corps jurisdiction; however, the Service continues to recommend that the Corps require local participation in endangered species management as a condition of future beach renourishment.

The Service supports a cooperative partnership among the Corps, Service, State, and municipalities to protect listed species through the ESMP, the terms of this programmatic Opinion, and the development and implementation of individual local management plans. The relevant RPM (page 104, #6) has been revised to reflect a more cooperative approach; however, the implementing terms and conditions requiring development of local management plans (page 107, #6) have not been changed. The intent of such plans is to encourage municipalities to recognize their own responsibilities for protecting listed species, as recipients of federally funded beach nourishment. The Service will work cooperatively to assist the Corps and the municipalities in developing plans consistent with this Opinion and the Service's

1994 "Guidelines for Managing Recreational Activities in Piping Plover Breeding Habitat on the U.S. Atlantic Coast to Avoid Take under Section 9 of the Endangered Species Act" (Guidelines).

If cooperative efforts are insufficient to prevent continued take of piping plovers by local management actions, and such take of piping plovers is not in accord with the terms of this Opinion or the Service's Guidelines, then the take is not protected by Section 7(o)(2) of the ESA. Responsible parties, including municipal staff and officials, can be held accountable for unauthorized take.

CONCLUSION

The Service acknowledges the benefits of the project in maintaining suitable habitat for piping plovers and seabeach amaranth within the project area, and appreciates the Corps cooperation in avoiding adverse effects to these species from project implementation. If you have any questions or concerns regarding this consultation, please contact John C. Staples or Wendy Walsh of my staff at (609) 646-9310, extensions 18 and 48, respectively.

Sincerely,

Clifford G. Day
Supervisor

Enclosure

REFERENCES

U.S. Fish and Wildlife Service. 1996. Piping plover (*Charadrius melodus*), Atlantic Coast population, revised recovery plan. U.S. Department of the Interior, Fish and Wildlife Service, Hadley, Massachusetts. 245 pp.

_____ and National Marine Fisheries Service. 1998. Endangered species consultation handbook, provisions for conducting consultation and conference activities under section 7 of the Endangered Species Act. U.S. Department of the Interior, Fish and Wildlife Service, and U.S. Department of Commerce, National Marine Fisheries Service, Washington, D.C. 154 + appendices.

cc: NJFO (4)
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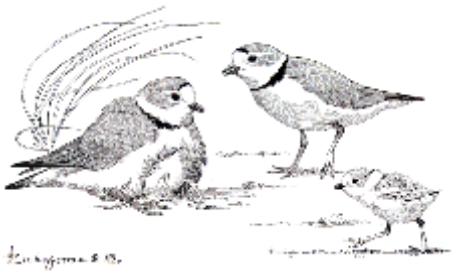
Final: jg 9/17/02

BIOLOGICAL OPINION ON THE EFFECTS OF COMPLETION OF SECTIONS I AND II OF THE ATLANTIC COAST OF NEW JERSEY BEACH EROSION CONTROL PROJECT SEA BRIGHT TO MANASQUAN, MONMOUTH COUNTY, NEW JERSEY ON THE PIPING PLOVER (*Charadrius melodus*) AND SEABEACH AMARANTH (*Amaranthus pumilus*)



Prepared for:

U.S. Army Corps of Engineers
New York District
New York, New York 10278-0090

September 2002

BIOLOGICAL OPINION ON THE EFFECTS OF COMPLETION OF SECTIONS I AND II OF THE ATLANTIC COAST OF NEW JERSEY BEACH EROSION CONTROL PROJECT SEA BRIGHT TO MANASQUAN, MONMOUTH COUNTY, NEW JERSEY ON THE PIPING PLOVER (*Charadrius melodus*) AND SEABEACH AMARANTH (*Amaranthus pumilus*)

Prepared for:

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September 2002

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I. INTRODUCTION

This document represents the U.S. Fish and Wildlife Service's (Service) Biological Opinion, in accordance with Section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq*.) (ESA), on the effects of the U.S. Army Corps of Engineers, New York District's (Corps) proposed continuing construction of Sections I and II of the Atlantic Coast of New Jersey Sandy Hook to Barnegat Inlet Beach Erosion Control Project (BECP), Monmouth County, New Jersey on the federally listed (threatened) piping plover (*Charadrius melodus*) and seabeach amaranth (*Amaranthus pumilus*). The proposed project consists of a 50-year program of beach nourishment from Sea Bright Borough to Manasquan Borough for the primary purpose of providing storm protection to upland development. Within Sections I and II, the BECP calls for construction and maintenance of a 30.5-meter-wide berm at an elevation of 3 meters above Mean Low Water (MLW) under a 0.6-meter-deep storm berm cap. The design also includes a sloping beach from the seaward edge of the berm to a depth of about 3 to 6 meters below MLW. Initial beach nourishment in Sections I and II was begun in 1995, and is complete in all but one constructable reach. Renourishment of each constructable reach is proposed at 6-year intervals through 2047.

Beach nourishment programs may potentially impact beach strand-dependent species, both directly and indirectly. Preclusion of natural habitat formation, such as creation of inlets and overwash, is often the most significant, and unavoidable, effect of beach nourishment on piping plovers and seabeach amaranth. However, due to the highly stabilized and developed nature of the project area, baseline conditions largely preclude natural habitat formation during the foreseeable future. Beach nourishment does not significantly decrease the already marginal prospects for natural habitat formation within the project area, and in fact, the initial nourishment has allowed colonization of the project area by piping plovers and seabeach amaranth by creating sandy beach where none previously existed. The proposed project is expected to benefit these species through continued maintenance of beach habitat in the project area. However, the project as proposed also includes rehabilitation and maintenance of existing seawalls and other structures, and provides storm protection to these structures, contributing to the perpetuation of an artificially stabilized system, essentially devoid of opportunities for natural habitat formation.

Other potential adverse effects from periodic beach nourishment could detract from the overall benefits of created habitats. These include: direct disturbance of nesting piping plovers and destruction of seabeach amaranth plants; burial of the piping plover prey base and seabeach amaranth seed bank; creation of possible population sinks due to lowered reproductive success; construction of a beach profile that provides a sub-optimal physical configuration as piping plover and seabeach amaranth habitat; recreational impacts; adverse beach management practices; and predation. In its Biological Assessment and subsequent communications with the Service, the Corps has proposed numerous conservation measures that effectively avoid or minimize many of these potential adverse impacts. The Corps proposed conservation measures were central in the Service’s formulation of this Biological Opinion. A complete administrative record of this consultation is on file in the Service's Ecological Services, New Jersey Field Office.

II. CONSULTATION HISTORY

A. SUMMARY

Service involvement in the Atlantic Coast of New Jersey, Sandy Hook to Barnegat Inlet Beach Erosion Control Project (BECP) dates back to the 1970s. From the 1970s through the early 1990s, the Service provided comments on draft and final Environmental Impact Statements/General Design Memoranda (EIS/GDM) for Sections I and II of the BECP, and completed several related reports through Scopes of Work (SOW) with the Corps pursuant to the Fish and Wildlife Coordination Act (48 Stat. 401; 16 U.S.C. 661 *et seq*.). In the course of this work, the Service indicated that no federally listed species under Service jurisdiction were present in the project area at the time.

On the basis of results from similar projects in other parts of New Jersey, however, the Service began advising the Corps in 1995 that the federally listed (threatened) piping plover (*Charadrius melodus*) might nest in the project area if beach nourishment created suitable habitat. The Service informed the Corps that, if such circumstances arose, additional cooperation would be required to manage the species in compliance with the Service's 1994 "Guidelines for Managing Recreational Activities in Piping Plover Breeding Habitat on the U.S. Atlantic Coast to Avoid Take under Section 9 of the Endangered Species Act" (Guidelines), and that further consultation pursuant to Section 7 of the ESA would be required prior to future renourishment activities.

In response, the Corps, the Service, and the New Jersey Endangered and Nongame Species Program (ENSP) have partnered since 1996 to conduct annual endangered species monitoring and management in the project area (the Endangered Species Management Program), funded by the Corps via Interagency Agreement and a SOW. Piping plovers began nesting in the project area in 1997. The Corps initiated formal consultation with the Service in 2001, prior to starting the first renourishment cycle in Sea Bright and Monmouth Beach Boroughs, where plovers were nesting. The federally threatened plant seabeach amaranth (*Amaranthus pumilus*) was discovered in these same municipalities in 2000 and was also included in the consultation.

B. CHRONOLOGY OF KEY CORRESPONDENCE, MEETINGS, AND COMMUNICATIONS

June 13, 1995 — In a letter transmitting comments on the final EIS for Section II, the Service informed the Corps that recent beach renourishment projects, such as in Ocean City, New Jersey, had resulted in the creation of piping plover nesting habitat that did not previously exist. The piping plover's use of these renourished beaches constituted new information that was not available during the Service's previous review of the project. In light of the new information, the Service advised the Corps that further coordination would be necessary should piping plovers nest on Section II beaches. The Service

recommended that if nesting were documented, the Corps, in coordination with municipalities and the ENSP, establish protective zones in accordance with Service Guidelines. The Service also advised the Corps that subsequent plans for renourishing beaches occupied by piping plovers would require further consultation pursuant to Section 7 of the ESA.

July 20, 1995 Via letters, the Corps informed municipalities in Section II that, although piping plovers had not been documented in the project area, construction of a beach as proposed by the Corps may provide suitable nesting habitat. The Corps advised municipalities that if piping plovers nested on a newly constructed beach, implementation of Service Guidelines would be necessary to ensure protection of the birds.

August 2, 1995 Via letter, the Service informed the Corps that the potential consequences of piping plovers nesting in Section II, as discussed in a July 6, 1995 telephone conversation, would also apply if piping plovers were to nest within Section I. The Service recommended that the Corps: (1) conduct further consultation prior to additional nourishment or renourishment activities in Section I if plovers were present, (2) notify municipalities in Section I that if piping plovers nest in the area they would be afforded protection in accordance with Service Guidelines, and (3) incorporate the Guidelines as mitigation in the agreement or contract between the Corps and municipalities in the project area.

August 14, 1995 In a follow-up letter regarding Service comments on the final EIS for Section II, the Service informed the Corps that its cooperation was needed to apprize municipalities in the project area that protection in accordance with Service Guidelines would be afforded to any piping plovers that may nest in the project area over the life of the project. The Service recommended that the Corps incorporate these concerns into its Record of Decision, and notify all municipalities in the project area of the Guidelines and the potential for recreational restrictions. The Service also recommended that the Guidelines be incorporated as a mitigation contingency in the agreement or contract between the Corps and all municipalities cooperating or participating in the proposed project. A copy of the Guidelines was enclosed.

November 1, 1995 Via conference call, the Service and the Corps discussed the Service's August 2, 1995 recommendations. The Corps disagreed with the Service's recommendation to include the Guidelines as a mitigation contingency in the agreement or contract between the Corps and participating municipalities because these agreements were with the State, not the municipalities directly, and were primarily financial in nature, including very specific requirements, but not including environmental recommendations or conditions. Instead, the Corps offered to address this Service recommendation by implementing a monitoring program, as well as an education and outreach program for municipalities with nesting plovers to ensure municipal

compliance with Service Guidelines (together, the Endangered Species Management Program). The Corps would carry out the Endangered Species Management Program every year for the life of the project (50 years), pending availability of funds and necessity of management activities. Citing lack of Congressional authority, the Corps also disagreed with the Service's recommendation that the Corps identify in the Record of Decision a willingness to participate in ecosystem planning strategies to identify and implement long-term solutions to coastal beach erosion. The parties agreed upon a compromise statement for the Record of Decision.

February 2, 1996 — Via letter, the Service transmitted to the Corps a summary of the November 1, 1995 conference call, and specific recommendations for the Corps-funded monitoring program (Endangered Species Management Program), with contingencies if renourishment activities were to take place in occupied piping plover habitat during the nesting season.

January 12, 1999 — Via letter, the Corps informed the Service that renourishment of portions of Section I were planned to begin in fiscal year 2000 or 2001, and requested reinitiation of consultation with the Service pursuant to Section 7 of the ESA.

February 12, 1999 — Via letter, the Service advised the Corps that piping plovers were now present within the project area, that they would likely continue to be attracted to habitat created by the project, and that they may expand their nesting range within the project area. The Service also stated that the project may create suitable habitat for seabeach amaranth, although no extant occurrences of the species were then known within the project area. The Service informed the Corps of potential adverse effects to these species that may result from project implementation, and advised the Corps that a Biological Assessment (BA) must be prepared in accordance with Section 7(c) of the ESA. The Service also provided specific recommendations for avoiding adverse impacts to federally listed species including: (1) restrict renourishment activities to avoid work in areas occupied by piping plovers during the breeding season; (2) survey for seabeach amaranth and, if present, establish a protective zone around the plants during construction; and (3) require each municipality in the project area to prepare a management plan for federally listed species in accordance with Service Guidelines.

October 22, 1999 — Via letter, the Corps responded to the Service's February 12, 1999 recommendations, agreeing to: (1) schedule activities of the first renourishment cycle in accordance with the seasonal restriction; (2) conduct surveys for seabeach amaranth and, if present, develop and implement a plan to protect the species; (3) continue to partner with the Service in the Endangered Species Management Program; and (4) assist the Service in developing and coordinating endangered species management plans with municipalities. The Corps indicated that it did not

	plan to prepare a BA, and that it did not have the authority to require public or private landowners to adhere to natural resource management plans.
January 19, 2000	Via letter, the Service informed the Corps that it was unable to concur that the project was "not likely to adversely affect" federally listed species. The Service reiterated its February 12, 1999 recommendations to the Corps.
March 2, 2001	Via letter, the Corps transmitted a BA for piping plovers and seabeach amaranth in Sections I and II of the BECP, and requested initiation of formal consultation pursuant to Section 7 of the ESA.
April 5, 2001	Via letter, the Service informed the Corps that its initiation package was incomplete, and that specific additional information would be required before formal consultation could begin.
April 16, 2001	Via conference call, the Service and the Corps discussed the additional information required to initiate formal consultation. The parties also clarified several points, chiefly that the Corps wished this consultation to include all nourishment and renourishment activities in all of Sections I and II for the remaining life of the BECP. Both parties agreed that conducting such a "programmatic" consultation at this time will likely allow more streamlined consultations for future renourishment cycles.
April 23, 2001 to May 18, 2001	Via regular and electronic mail, the Corps provided the Service with the requested additional information to initiate formal consultation, including a copy of the March 1990 EIS/GDM for Section I; the draft final Biological Monitoring Program report for Section II; and a schedule, fill volumes, maps, beach profiles, and construction plans for the proposed 2002 renourishment of Sea Bright, Monmouth Beach, and a portion of Spring Lake.
June 13, 2001	Via letter, the Service acknowledged receipt of a complete initiation package as of May 10, 2001. The Service reiterated the scope of this consultation as agreed upon during the April 16, 2001 conference call, referred the Corps to the NMFS for further consultation if required by that agency, and provided background materials on the formal consultation process.
June 18, 2001	Via telephone, the Corps provided additional project background information to the Service.
July 23, 2001	Via letter, the Service requested that the Corps review a draft project description compiled by the Service from the various components of the Corps' initiation package. The Service also recommended several modifications to clarify and reduce uncertainty in parts of the project description, including Corps conservation

	measures.
August 12, 2001	Via letter, the Corps replied to the Service's July 23, 2001 draft project description and recommended modifications.
August 14, 2001	Via letter, the Service transmitted a revised Corps conservation measure regarding seasonal work restrictions to protect piping plovers, based upon telephone conversations between the Service and the Corps.
August 22, 2001	Via telephone, the Corps indicated general agreement with the seasonal restrictions described in the Service's August 14, 2001 letter.
December 6, 2001	The Service issued a draft non-jeopardy Biological Opinion for the subject project.
March 29, 2002	The Corps provided comments on the draft Biological Opinion, including changes to the conservation measures in the Corps project description.
April 18, 2002	The Service responded to the Corps comments and advised the Corps that substantial modifications of the Corps conservation measures would require the Service to re-assess the effects of the project and reconsider its Biological Opinion.
April 22, 2002	The Corps and the Service met to discuss the Corps request for modification of its conservation measures, and the schedule for 2002 renourishment activities.
May 15, 2002	By conference call, the Corps informed the Service that 2002 renourishment activities were set to begin on May 20. The Corps verbally agreed to 1,000- meter buffers around piping plover nesting areas until the end of the nesting season, but requested that workers be allowed to retrieve pipe material located within the buffer. The Service agreed.
May 16, 2002	At the Corps request, the Service conducted a site visit to oversee retrieval of the pipe material.
May 17, 2002	By conference call, the Corps and the Service discussed 2002 renourishment activities and the terms of the draft Biological Opinion. The Service requested that contract, State, and Service staff be provided with consistent information regarding the terms of the draft Biological Opinion.
May 17, 2002	The Corps provided revised comments on the draft Biological Opinion and agreed to adhere to the terms of the draft Biological Opinion, including 1,000- meter piping plover nesting area buffers, for the 2002 renourishment cycle.
May 20, 2002	Renourishment activities commenced in Sea Bright Borough.

III. BIOLOGICAL OPINION

A. DESCRIPTION OF THE PROPOSED ACTION

1. Definition of Project and Action Areas

The proposed federal action (Project) constitutes the completion of Section I (Sea Bright to Deal) and Section II (Asbury Park to Manasquan Inlet) of the Atlantic Coast of New Jersey Sandy Hook to Barnegat Inlet Beach Erosion Control Project (BECP). The BECP provides for federal participation in the initial cost of beach restoration and subsequent renourishment costs for 82 kilometers (km) (51 miles) of New Jersey shoreline extending from the southern limit of the Sandy Hook Unit of Gateway National Recreation Area (Sandy Hook) to Barnegat Inlet (see Figure 1) (U.S. Army Corps of Engineers, 1990). Section III of the BECP (Point Pleasant Beach to Seaside Park) is not included in the proposed Project, and is not reflected in this Biological Opinion. The U.S. Army Corps of Engineers, Philadelphia District, is currently conducting a separate consultation that includes Section III of the BECP.

The term "Project area" in this document is consistent with its definition in the Biological Assessment (BA) prepared by the Corps. The Project area is located entirely in Monmouth County, New Jersey, along 33.8 km (21 miles) of the Atlantic shoreline. It encompasses the current sandy beach and intertidal zone from the northern boundary of Sea Bright Borough to the Manasquan Inlet. The BA defines the western boundary of the Project area as structures such as seawalls, bulkheads, dunes, roads, and parking lots (i.e., the western terminus of sandy beach areas), and sets the eastern boundary as the ecotone between the intertidal and subtidal zones (U.S. Army Corps of Engineers, 2001a).

The Project area is divided into two Sections (see Figure 1). Section I is 19.3 km (12 miles) long and extends from the northern border of Sea Bright Borough to the southern boundary of Loch Arbour Village in Ocean Township. From north to south, the municipalities included in Section I are: Sea Bright Borough, Monmouth Beach Borough, Long Branch City (including Seven Presidents County Park), Deal Borough, Allenhurst Borough, and Loch Arbour Village. Section II is 14.5 (9 miles) long and extends from the northern boundary of Asbury Park City to the northern jetty of the Manasquan Inlet. From north to south, the municipalities included in Section II are: Asbury Park City, Neptune Township (Ocean Grove), Bradley Beach Borough, Avon-By-The-Sea Borough, Belmar Borough, Spring Lake Borough, Sea Girt Borough (including the National Guard Training Center), and Manasquan Borough (U.S. Army Corps of Engineers, 2001a).

According to the GDM/EIS prepared for Section I, the affected environment of the BECP includes the shorelines and immediate upland area, as well as offshore bottom areas proposed for sand borrow (see Figure 2). According to the GDM/EISs for Sections I and II, the project area includes subtidal areas along the shoreline down to 7.6 meters (m) below MLW, including the shallowest portion of the nearshore zone to depths of 18.3 to 27.4 m (U.S. Army Corps of Engineers, 1990; 1995).

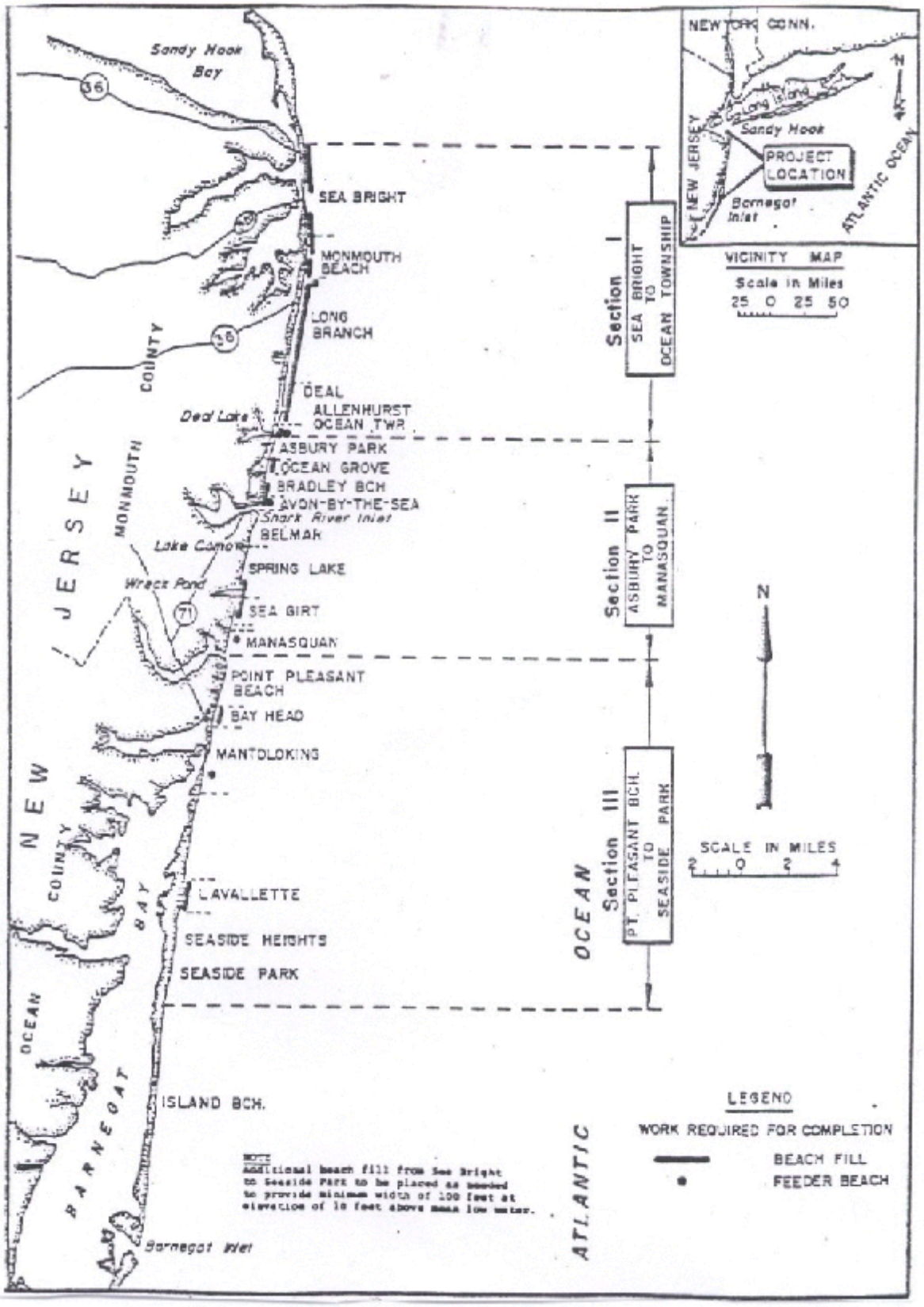

Figure 1. Project Location (U.S. Army Corps of Engineers, 1990)

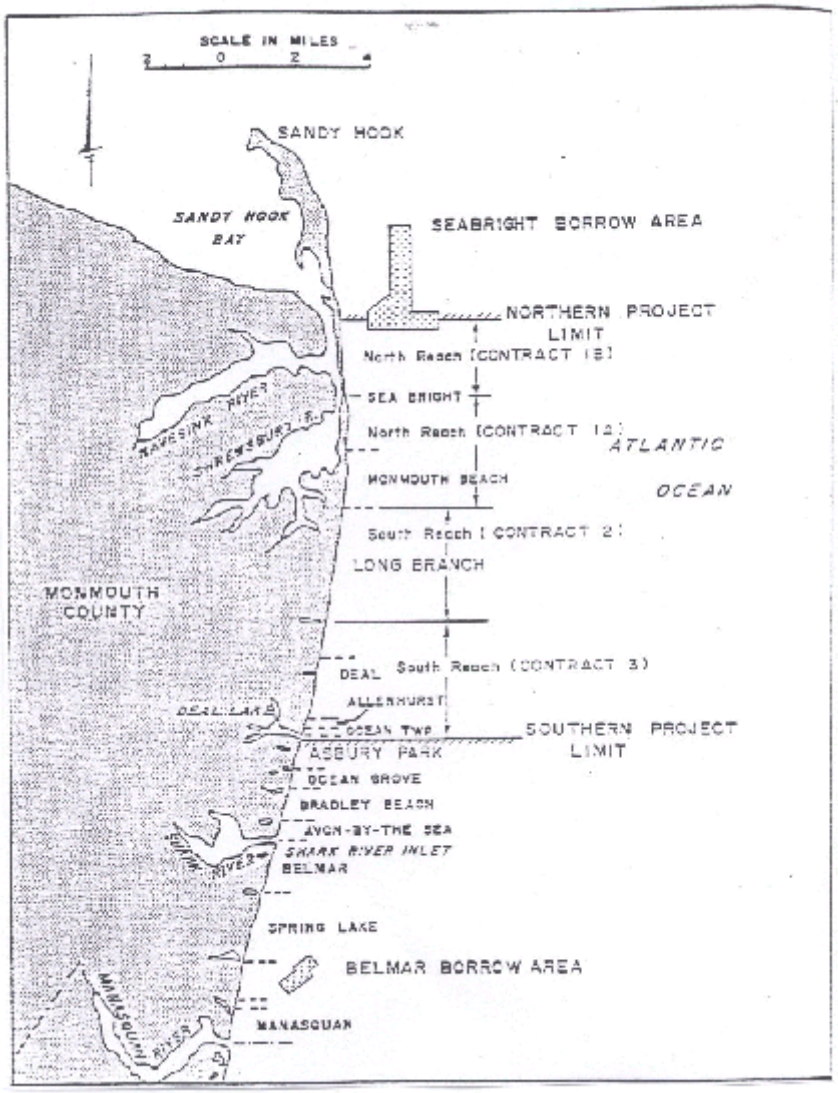

Figure 2a. Borrow Areas, Section I (U.S. Army Corps of Engineers, 1990)

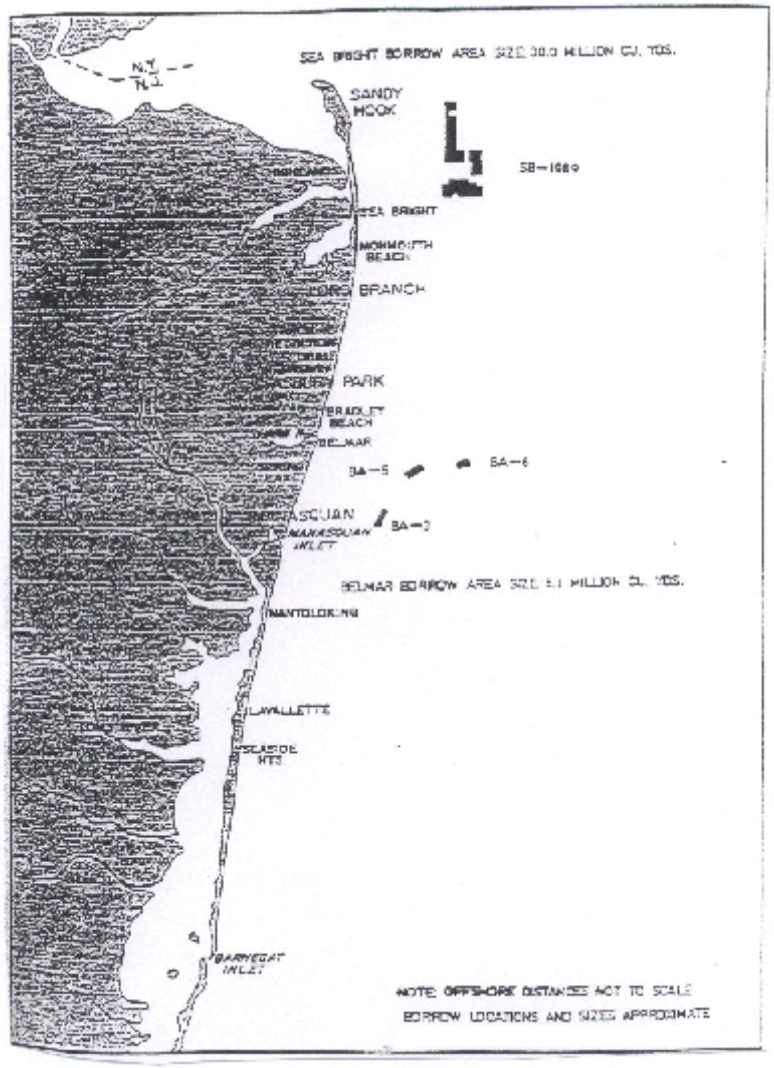

Figure 2b. Borrow Areas, Section II (U.S. Army Corps of Engineers, 1995)

For the purposes of consultation pursuant to Section 7 of the ESA, federal regulations define the "action area" as all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action (50 CFR 402.02). Areas to be directly affected by the Project include the entire Project area as defined in the BA, as well as offshore borrow areas and subtidal areas as indicated in the GDM/EISs. Areas to be indirectly affected include upland areas and beaches down-drift of the Project area. The Project indirectly affects upland areas by reducing storm-related inundation and recession (temporary scouring and erosion) landward of the beach. The Project indirectly affects down-drift areas by increasing the amount of sediment reaching these beaches via littoral drift. As drift in the Project area runs from south to north, down-drift beaches are located on the Atlantic coast of Sandy Hook (U.S. Army Corps of Engineers, 1990). Indirect effects to up-drift beaches (northern Ocean County) are minimal because the existing jetties protecting the Manasquan Inlet interrupt littoral drift into the Project area. Based upon known species ranges and distributions, no federally listed species in areas other than those just described are likely to be affected by the proposed Project. The "action area," therefore, is comprised of the Project area as defined in the BA, all upland areas receiving storm protection from the Project, Atlantic coast beaches on Sandy Hook, and all affected offshore areas including borrow areas and the subtidal area adjacent to the Project area.

2. Description of the Action Area

a. Project Area (Beaches from Sea Bright to Manasquan)

The Project area is comprised of a 33.8-km (21-mile) stretch of sandy beach. The northern portion of the Project area, Sea Bright and northern Monmouth Beach, lies on a barrier peninsula separating the Shrewsbury River from the Atlantic Ocean. The peninsular spit complex continues north from Sea Bright to form Sandy Hook. In Sea Bright and Monmouth Beach, the peninsula is a narrow strip of unconsolidated sand between 75 and 460 m wide, but generally less than 305 m wide, lying at an elevation of 1.5 to 3 m above the National Geodetic Vertical Datum (NGVD). South of the peninsula, the Project area constitutes the headland portion of the mainland coastal plain. The southern portion of Section I is characterized by bluffs immediately adjoining the ocean, ranging in elevation from 3 to 7.6 m above NGVD (U.S. Army Corps of Engineers, 1990).

The Atlantic shores of New Jersey are high energy beach environments, characterized by shifting sands, pounding surf, strong wave action, and a semi-diurnal tidal cycle. Within the Project area, mean tidal range is 1.3 m, and the spring tidal range is 1.6 m. Waves are predominantly from the south/southeast, with an average height of 0.5 m, and longshore currents run from south to north. The area is subject to the effects of occasional tropical storms, and more frequent extra-tropical storms ("northeasters"). Relative sea level is estimated to rise an average of 0.43 cm per year, with a corresponding average annual shoreline recession of 12.4 cm per year (U.S. Army Corps of Engineers, 1990; 1995).

Project area beaches vary from 15 to 105 m in width, except along the reach from Lake Takanasee to

Deal Lake, which is much narrower (U.S. Fish and Wildlife Service, 2001b). As explained below, this reach has not yet been nourished. September/October 2000 beach profiles of Sea Bright, Monmouth Beach, and a portion of Spring Lake show the existing berm between 15 and 61 m wide at an elevation of 3 to 3.4 m above NGVD. Except at the National Guard Training Center, dunes in the Project area are generally absent or small. Back beach vegetation, dominated by beach grass (*Ammophila breviligulata*), sea rocket (*Cakile edentula*), and seabeach spurge (*Chamaesyce polygonifolia*), varies in density throughout the Project area, from dense stands to bare sand (U.S. Fish and Wildlife Service, 2001b).

The Project area is characterized by numerous and extensive shoreline stabilization structures built to protect navigation channels, reduce erosion, and prevent storm damage. Approximately 10.9 km (6.8 miles) of stone and concrete seawalls, 3.2 km (2 miles) of timber/steel bulkheads, and 1.0 km (0.6 miles) of rock revetments separate Section I beaches from upland development. The longest continuous structure is a 4,572-meter-long stone seawall in the peninsular area. Ranging in height from 4.3 to 6.7 m above MLW, the seawall was originally constructed to protect the Long Branch and Seashore Railroad, which was long ago abandoned and the tracks removed. Further south in Section I, variations of rip-rap construction and bulkheads protect the bluffs. Section I also includes 103 groins (U.S. Army Corps of Engineers, 1990) (see Figure 3). Section II is fronted by 4,298 m of protective structures, including concrete seawalls, steel and wood bulkheads, and rock revetments. The longest of these are a wooden bulkhead along the boardwalk in Bradley Beach, and a 335-meter-long concrete seawall at the National Guard Training Center. In addition, Section II features about 85 stone and timber groins and jetties (U.S. Army Corps of Engineers, 1995).

In Section I, direct controlled outlets to the Atlantic Ocean include two coastal ponds, Lake Takanasee and Deal Lake, as well as the Poplar Brook drainage. There are also 47 drainage outfalls, from 3 to 72 inches in diameter, most of them constructed of steel or concrete (U.S. Army Corps of Engineers, 1990). In Section II, the Shark and Manasquan River Inlets, federal navigation channels, are protected by jetties. Section II also has 34 drainage outfalls to the ocean, including aluminum culverts and PVC, steel, and concrete pipes between 4 and 84 inches in diameter (U.S. Army Corps of Engineers, 1995).

b. Upland Areas

Residential and commercial development dominates the upland portion of the action area, with the exceptions of Seven Presidents County Park in Long Branch and the National Guard Training Center in Sea Girt. These two areas contain the only significant undeveloped upland habitats in the action area (U.S. Army Corps of Engineers, 1990; 1995). Numerous residential and commercial developments are adjacent to Project area beaches, including multi-story apartment complexes and condominiums, single family houses, and beach clubs (U.S. Fish and Wildlife Service, 2001b). State Route 36, an important transportation and evacuation route, runs adjacent to the beach behind the seawall along the length of the peninsular area (U.S. Army Corps of Engineers, 1990). In Long Branch and several municipalities in Section II, boardwalks separate the beach from upland development (U.S. Fish and Wildlife Service, 2001b).

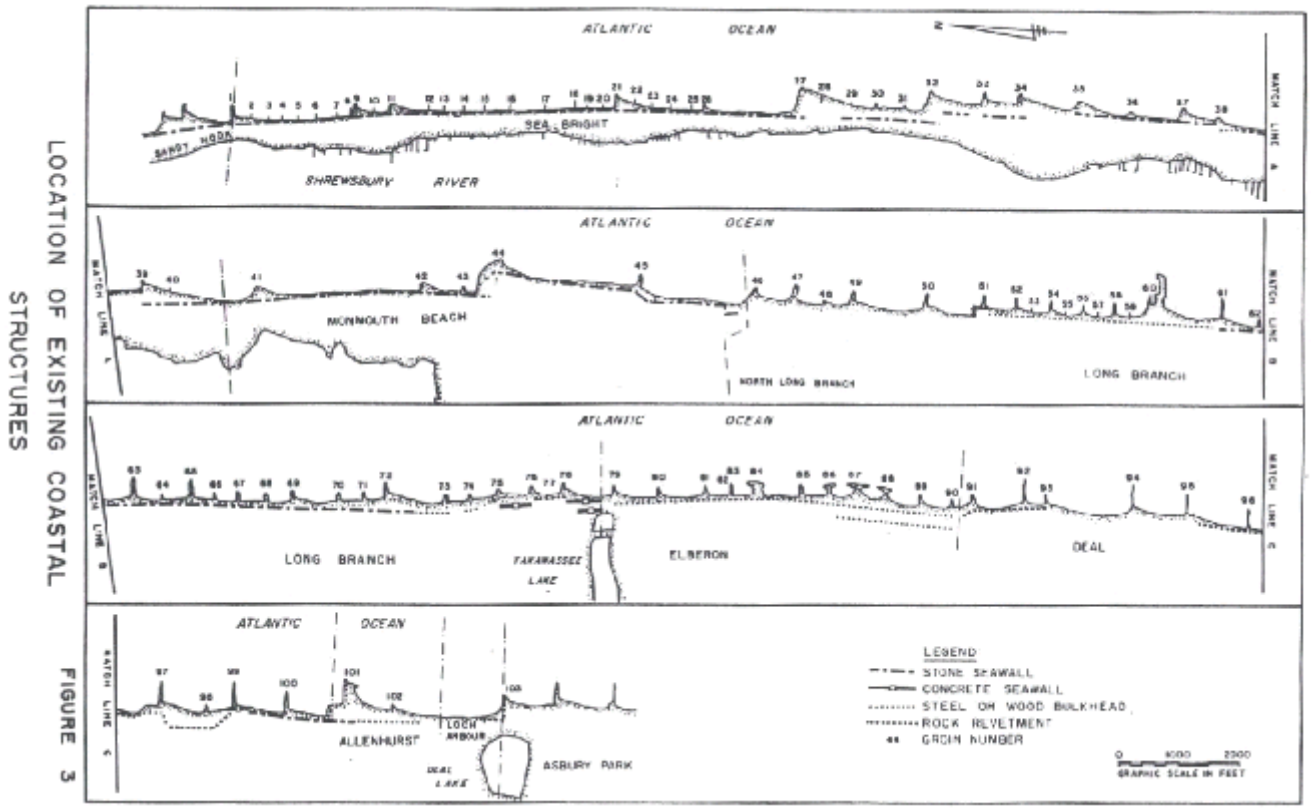

Figure 3. Locations of Existing Coastal Structures, Section I (U.S. Army Corps of Engineers, 1990)

c. <u>Sandy Hook Atlantic Coast Beaches</u>

Sandy Hook is the terminal 9.7 km (6 miles) of the barrier spit that stretches northward from the coastal headland portion of Monmouth Beach. As part of Gateway National Recreation Area, the Sandy Hook Unit is managed by the National Park Service (NPS) for natural resources and recreation. Its ocean beaches are backed by vegetated dunes, providing habitats for nesting shorebirds and other terrestrial wildlife. Designated bathing beaches receive intensive summer recreational use (U.S. Army Corps of Engineers, 1990).

Prior to initial nourishment of the Project area, Sandy Hook's stabilized southern bathing beaches were eroding. Many dune areas had been washed away and one area, termed the "critical zone," is still subject to breaching and inlet formation. Natural episodes of breaching and overwash have occurred in the past. The peninsular spit was breached and became an island at least six times during the 18th and 19th Centuries, and periodic overwash of the critical zone from both bay and ocean sides has occurred since the 1974 designation of Sandy Hook as a unit of the NPS (Hoffman, pers. comm., 2001). In recent decades, the man-made system of coastal protection structures to the south has accelerated erosion rates on southern Sandy Hook beaches. Periodic deposits of sand from various sources, such as harbor channel dredging, have forestalled a breach in the critical zone (U.S. Army Corps of Engineers, 1990). A seawall and a groin field have also been constructed along the southern beaches in attempts to stabilize the area (U.S. Fish and Wildlife Service, 1997).

d. Offshore Areas

The locations of borrow areas are shown in Figure 2. Subtidal areas directly affected by the Project are located immediately adjacent to the Project area, extending from MLW to 7.6 m below MLW. The biological resources of borrow and subtidal areas are discussed in the GDM/EISs for Sections I and II. Federally listed species occurring within offshore areas are under the jurisdiction of the National Marine Fisheries Service, and are not included in this Biological Opinion. Separate consultation with the NMFS will be required if adverse impacts to marine species are anticipated as a result of project implementation.

3. Project Description

a. Project Overview and Schedule

The proposed Project involves the transport of sand (fill) from designated borrow areas to the Project area, and the subsequent manipulation of fill to achieve targeted beach profiles. The BECP calls for the initial construction of the selected "design profile" (nourishment) throughout the Project area, to be followed by subsequent reconstruction of the design profile (renourishment) every 6 years for 50 years (Figure 4). Initial nourishment is accompanied by the extension of drainage outfalls, and groin notching to partially restore littoral drift (see Figure 5). Physical and biological monitoring is to be conducted annually (U.S. Army Corps of Engineers, 1990; 1995). In addition, the proposed Project in Section I includes repairs of seawalls and bulkheads as needed (Table 22 of the EIS/GDM). The Project also includes rehabilitation of the seawall in Sea Bright and Monmouth Beach, involving placement of 5 to 8 tons of rock at the toe of the seawall in critical sections by the State of New Jersey (U.S. Army Corps of Engineers, 1990).

The Project area is divided into "constructable reaches," each built under a separate contract (Figure 6) (U.S. Army Corps of Engineers, 1990). Initial nourishment of all but one reach (Section I, Contract 3) has been completed (Table 1 and Figure 7) (U.S. Army Corps of Engineers, 2001b). The proposed Project, therefore, consists of all remaining activities to be carried out as part of Section I or II of the BECP, including the one remaining initial nourishment, all renourishments, and all associated activities.

Table 1. Approximate BECP Construction Schedule

	Section I	**Section II**
Initial Nourishment	1995	1997
Renourishment 1	2001	2003
Renourishment 2	2007	2009
Renourishment 3	2013	2015
Renourishment 4	2019	2021
Renourishment 5	2025	2027
Renourishment 6	2031	2033
Renourishment 7	2037	2039
Renourishment 8	2043	2045
Project End Date	2045	2047

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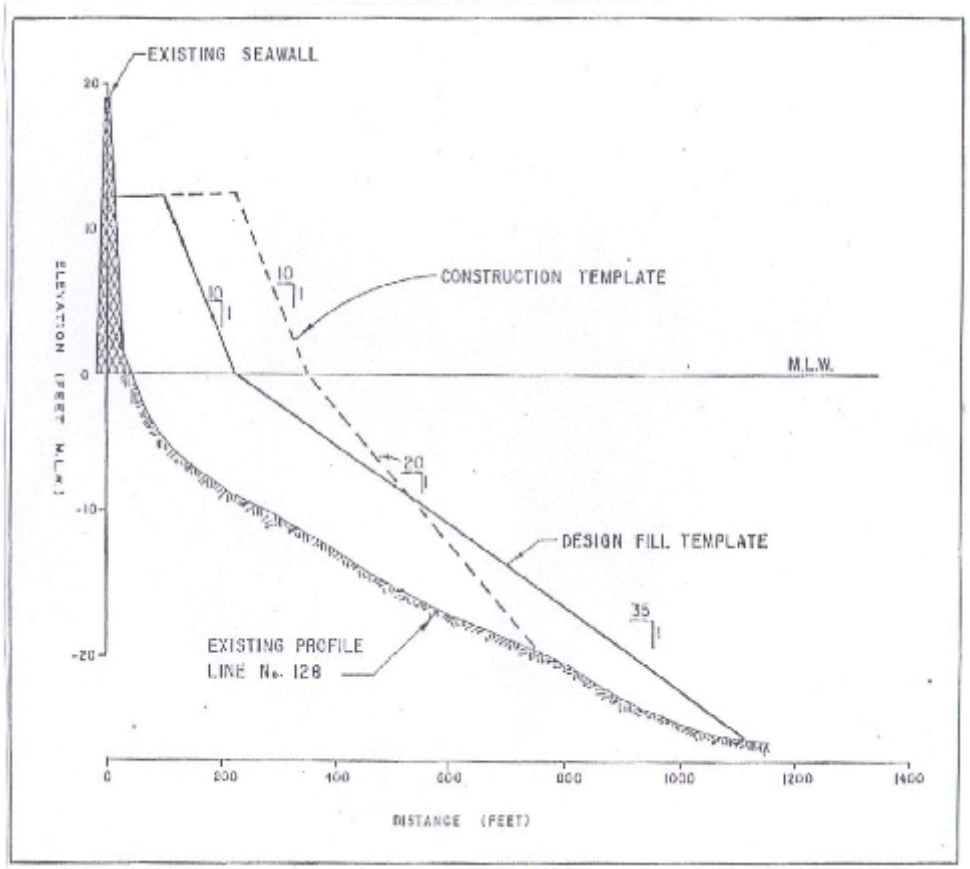

Figure 4a. Design Profile and Construction Template, Section I (U.S. Army Corps of Engineers, 1990)

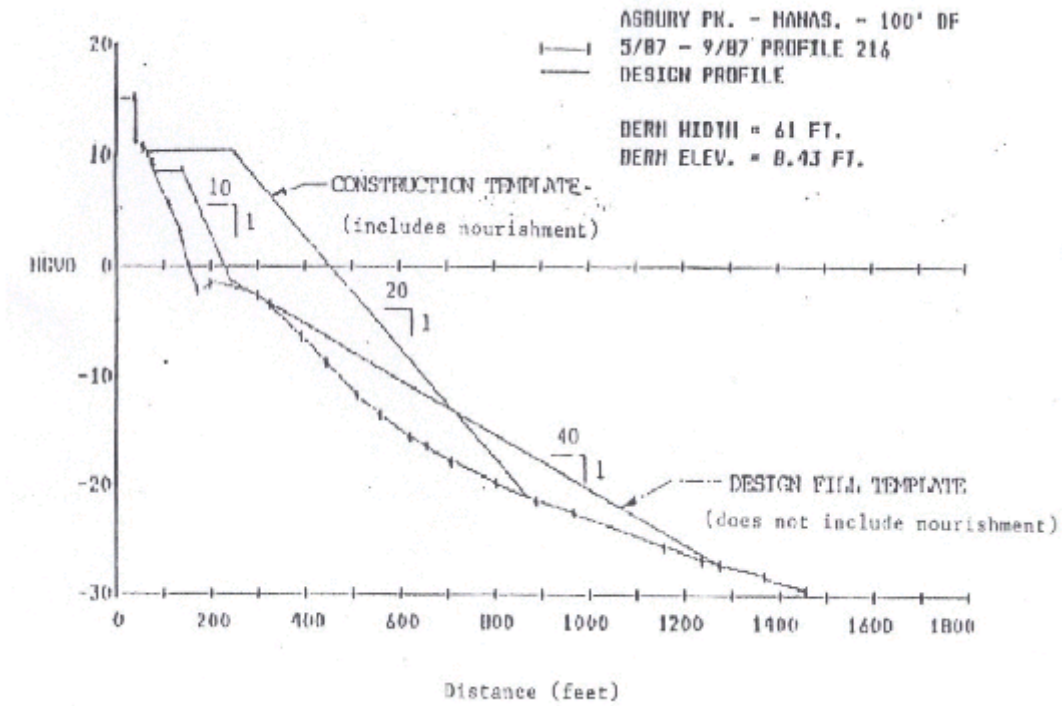

Figure 4b. Design Profile and Construction Template, Section II (U.S. Army Corps of Engineers, 1995)

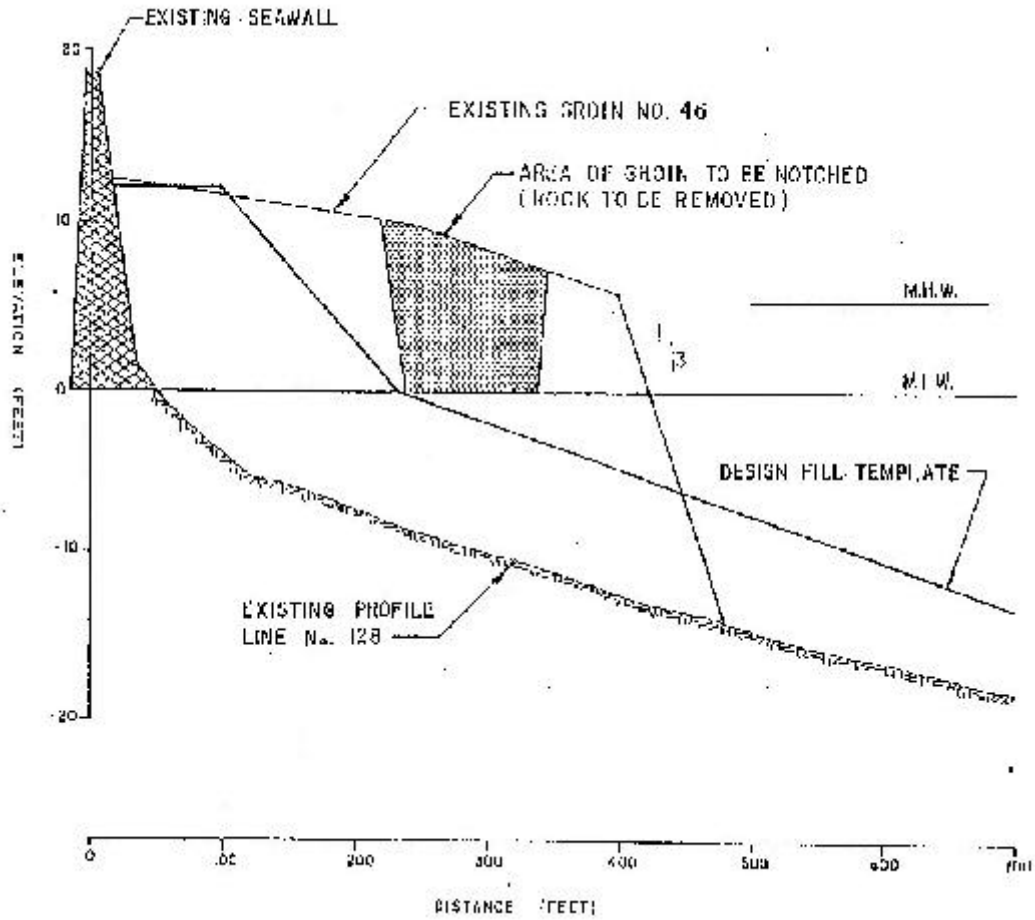

Figure 5a. Typical Notched Groin Cross-Section, Section I (U.S. Army Corps of Engineers, 1990)

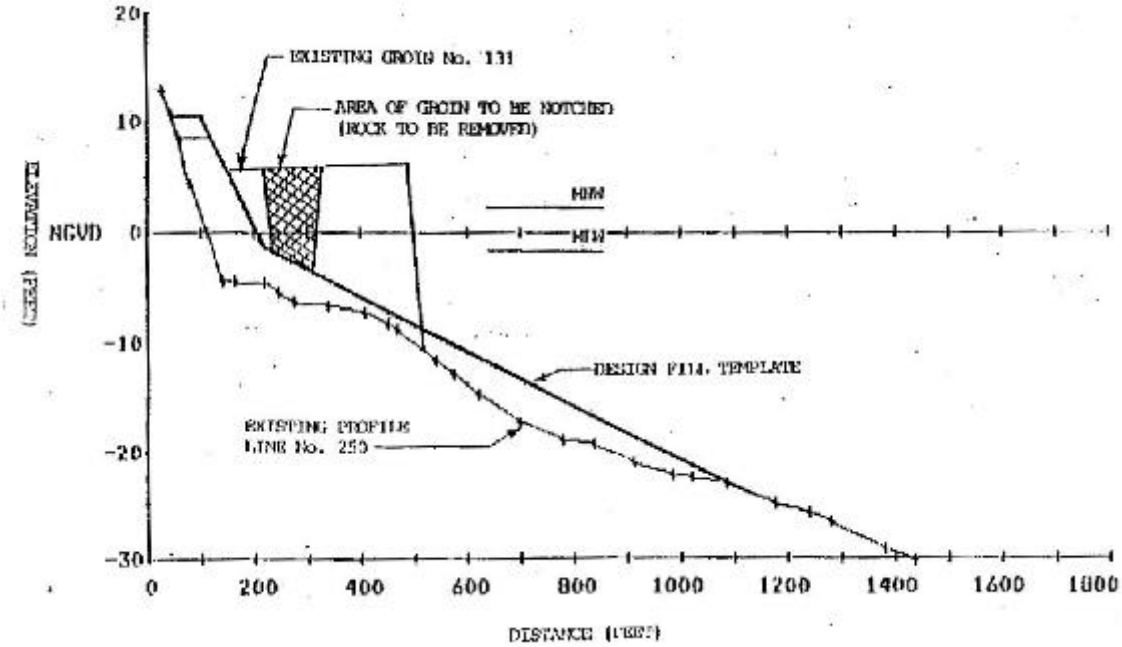

Figure 5b. Typical Notched Groin Cross-Section, Section II (U.S. Army Corps of Engineers, 1995)

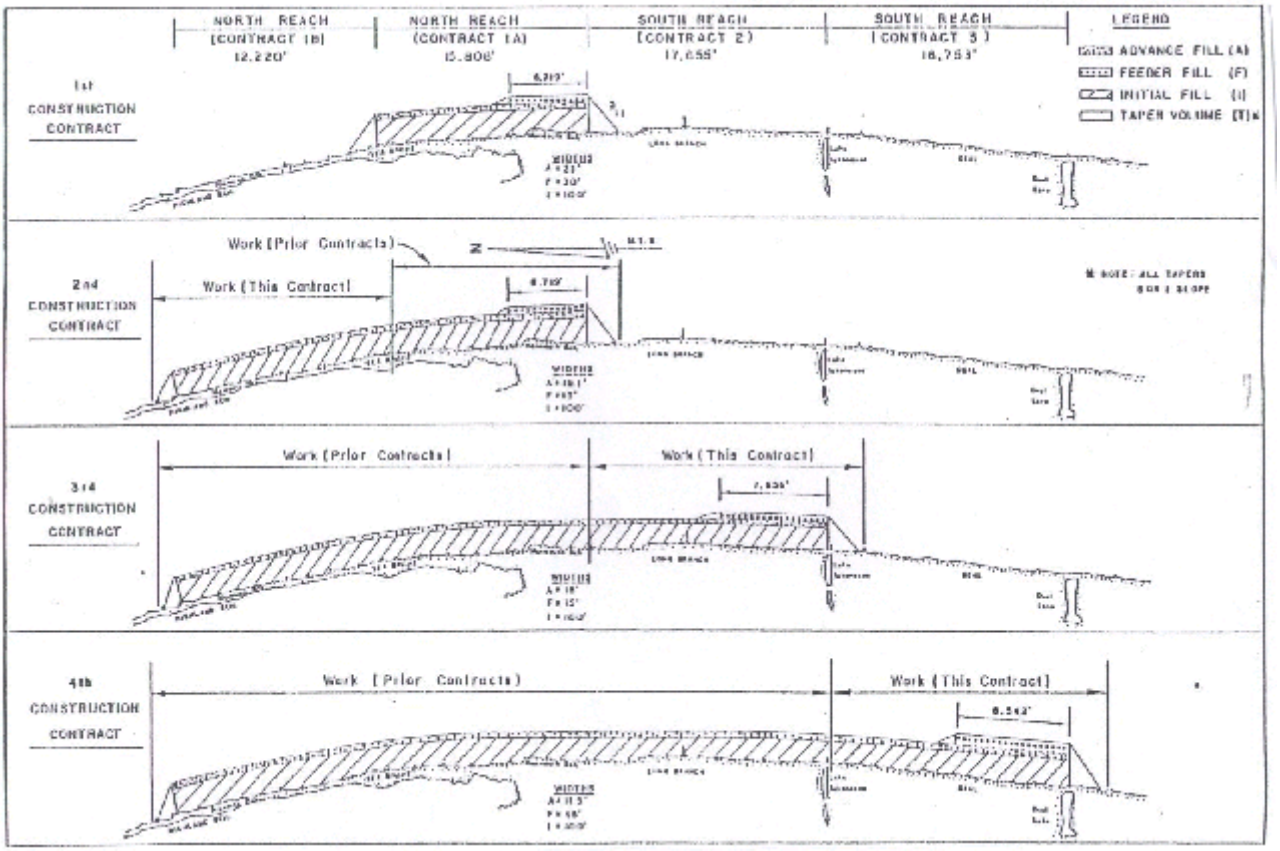

Figure 6a. Constructable Reaches and Fill Placement, Section I (U.S. Army Corps of Engineers, 1990)

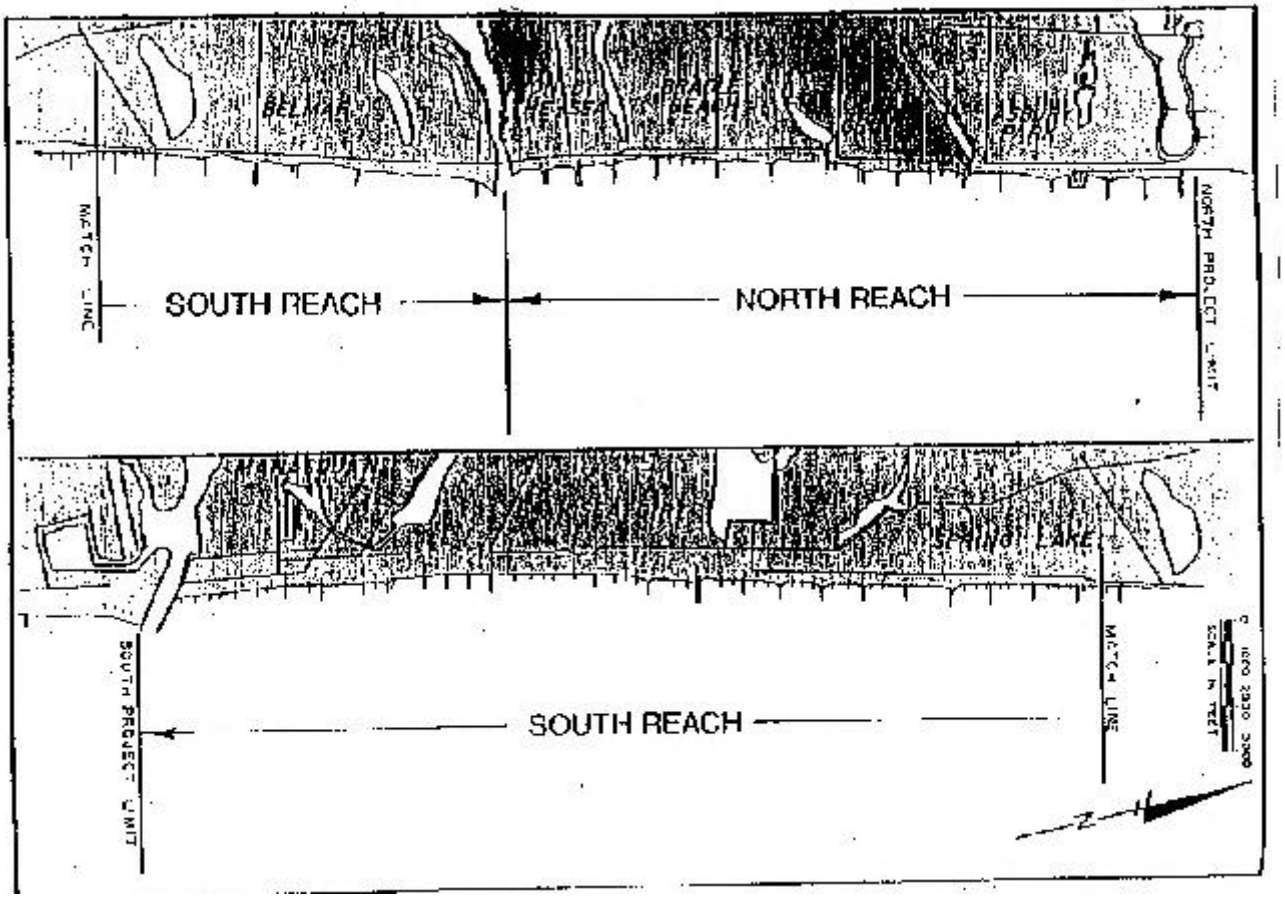

Figure 6b. Constructable Reaches, Section II (U.S. Army Corps of Engineers, 1995)

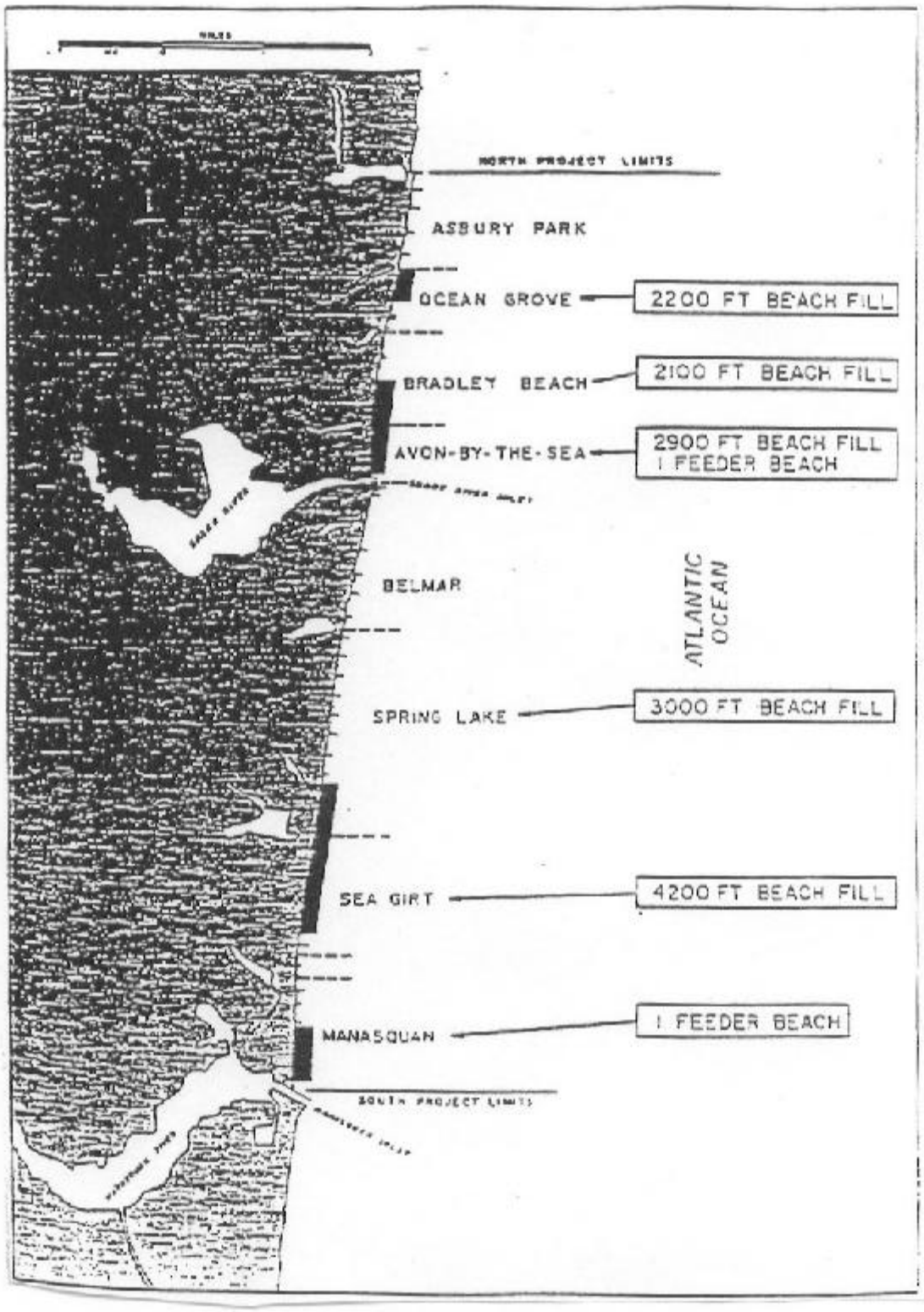

Figure 6c. Fill Placement, Section II (U.S. Army Corps of Engineers, 1995)

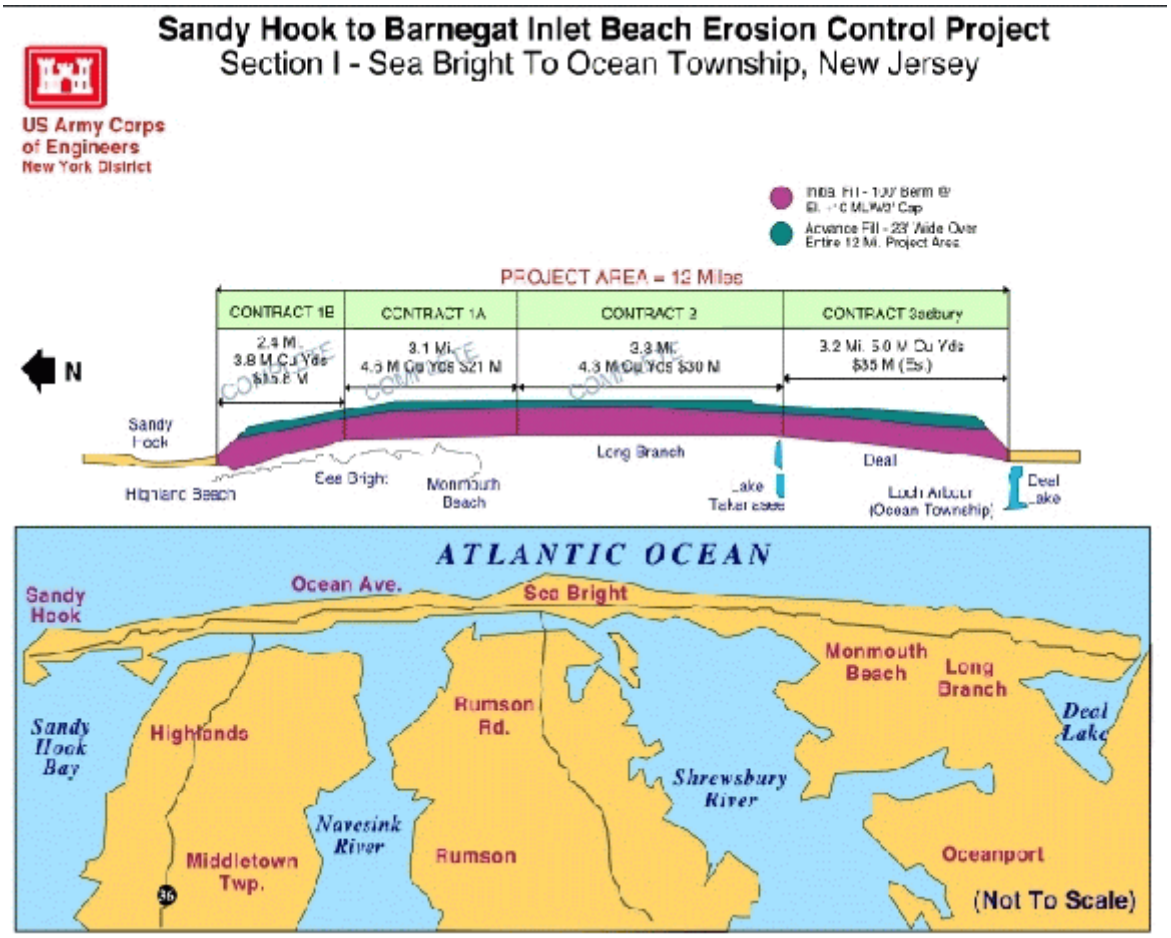

Figure 7a. Reach Status, Section I (U.S. Army Corps of Engineers, 2001b)

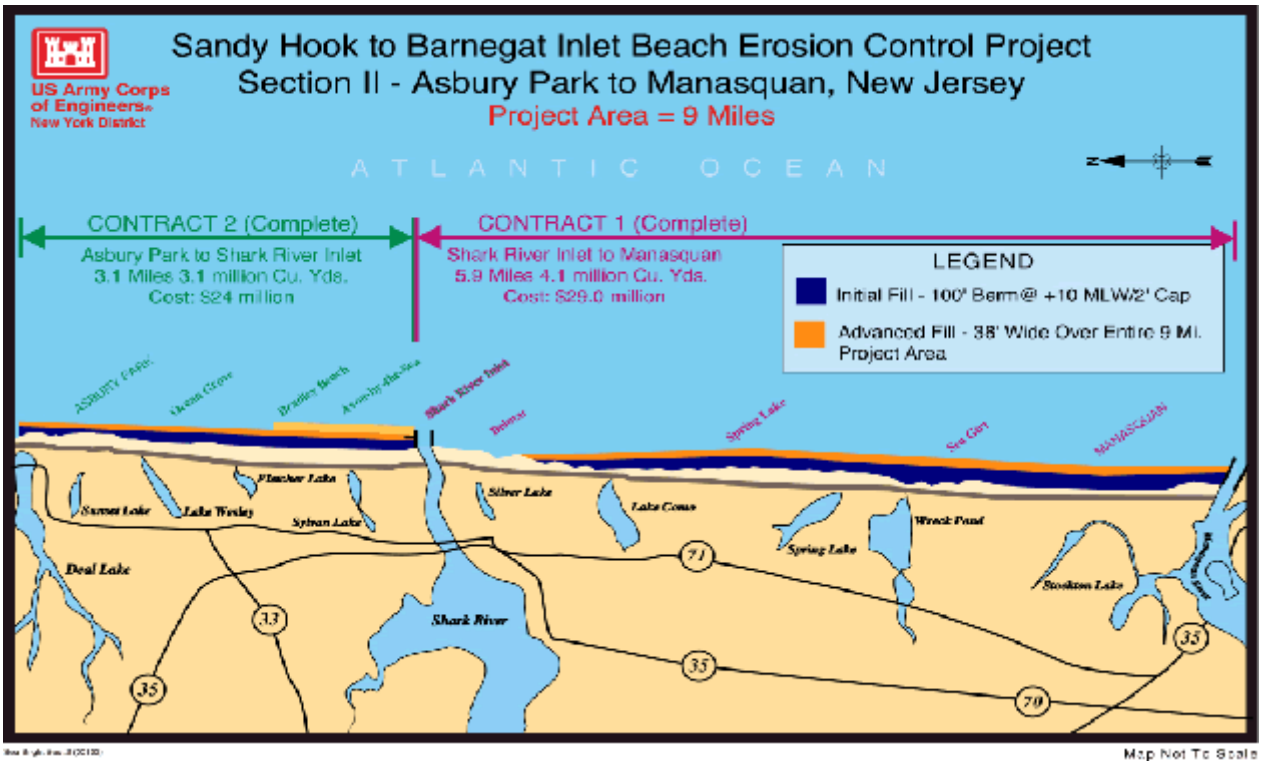

Figure 7b. Reach Status, Section II (U.S. Army Corps of Engineers, 2001b)

The renourishment dates given in Table 1 are for the first-built reach in each Section (Contracts 1A and 1B in Section I; Contract 1 in Section II). Other reaches are scheduled for renourishment roughly 6 years from the start of construction in that reach. The Project end date, however, is an absolute end date for the entire Section. Some later-constructed reaches, therefore, may not receive all 8 renourishments. The BECP does not call for additional renourishment activities outside the 6-year cycle; however, such renourishments may take place, pending availability of funds, to compensate for higher than expected erosion rates or storm damage (Burlas, pers. comm., 2001). Although additional renourishments may be necessary outside the 6-year cycle, they are not included in the proposed Project as evaluated in this Biological Opinion. If additional renourishments become necessary, the Corps will initiate informal [1] consultation with the Service to reevaluate any potentially changed conditions.

Initial construction in Section I began in 1994 (U.S. Army Corps of Engineers, 2001a). Contracts 1A and 1B, the North Reach, were completed in November 1995 and December 1996 respectively, extending from Sea Bright to Monmouth Beach. The South Reach is divided into Contracts 2 and 3. Contract 2 was completed in September 1999, extending from the southern portion of Monmouth Beach into the city of Long Branch, to Lake Takanasee in south Long Branch. Initial construction has not begun in Contract 3, Lake Takanasee to Deal Lake, and is subject to receipt of real estate (easements) from the non-federal sponsor, the New Jersey Department of Environmental Protection (NJDEP) (U.S. Army Corps of Engineers, 2001b). The first regularly scheduled renourishment of Sea Bright and Monmouth Beach (Contracts 1A and 1B) commenced May 20, 2002 and is expected to be completed by December 5, 2002 (Burlas, 2002, pers. comm.).

Initial construction in Section II began in 1997 (U.S. Army Corps of Engineers, 2001a). Contract 1, the South Reach, was completed in August 1999, extending from Shark River Inlet south to the Manasquan Inlet. Contract 2, the North Reach, was completed in January 2001, extending from Asbury Park to the Shark River (U.S. Army Corps of Engineers, 2001b). Groin notching and renourishment of a portion of Spring Lake are planned between May and December 2002 to correct for greater than expected erosion rates in that area (U.S. Army Corps of Engineers, 2001a; Burlas, 2002, pers. comm.).

The design profile consists of a flat, 30.5-meter-wide berm at an elevation of 3 m above MLW under a 0.6-meter-deep storm berm cap (Figure 4). The design profile also includes a sloping beach from the seaward edge of the berm to a horizontal distance of about 305 to 366 m from the reference line (often a seawall), corresponding to a depth of about 3 to 6 m below MLW. The design profile beach slope is 1:10 onshore, and 1:35 or 1:40 offshore (U.S. Army Corps of Engineers, 1990; 1995). No constructed dunes, vegetation planting or fertilizing, or sand fencing are included in the Project.

Due to technical limitations, it is not possible to achieve the offshore grade of the design profile at the time of construction. Instead, an estimated offshore slope of 1:20 is constructed, with a berm wider

[1] For additional renourishments and any other actions not evaluated in this Biological Opinion, formal consultation will be required if adverse impacts to federally listed species cannot be avoided.

than dictated by the design profile. This is known as the construction template (Figure 4). Natural processes subsequently redistribute sediments to achieve the design profile (U.S. Army Corps of Engineers, 1990; 1995).

Additional volumes of fill, called tapers, are placed on both exposed ends of a constructed reach. On top of the construction template are overfill (an additional fill volume to compensate for fines that wash out after construction), an excess fill volume to compensate for sea level rise, and a 0.3-meter construction tolerance equal to 15 percent of the design and taper volumes. Finally, two kinds of maintenance fill are placed on the seaward face of the nourished beach to compensate for littoral transport of sediments between renourishment cycles. These include wide feeder beaches, placed in select locations as sediment sources for down-drift areas, and advance fill, a narrower strip of fill placed along the entire length of beach (U.S. Army Corps of Engineers, 1990; 1995) (Figure 8). Feeder beach widths vary; advance fill is 7 m wide in Section I, and 11.6 m wide in Section II (U.S. Army Corps of Engineers, 2001b).

For the proposed 2002 renourishment activities, fill material will be dredged from the Sea Bright borrow area using hopper and/or cutterhead dredges. If a hopper dredge is used, the fill will be transported to a pump-out buoy located in the nearshore. The hopper dredge will anchor and connect to the pump-out buoy where the fill will be pumped from the hopper of the hopper dredge to the discharge area via pipeline. If a cutterhead dredge is used, the fill will be dredged and pumped directly from the dredge through a pipeline to the discharge area, without the need for a pump-out buoy. Once discharged, the fill will be spread to the appropriate construction template using earth-moving equipment. The discharge area will move once an area has met design criteria and/or when the transport of fill does not achieve optimal dredge placement efficiency. Each renourishment is expected to take 3 to 4 months to complete (U.S. Army Corps of Engineers, 2001a). The total 2002 fill volumes in cubic yards are estimated as follows (U.S. Army Corps of Engineers, 2001a):

Sea Bright	1,337,000
Monmouth Beach	662,000
Spring Lake	250,000

September/October 2000 beach profiles and construction plans for the 2002 renourishment of Sea Bright, Monmouth Beach, and Spring Lake show that a portion of northern Sea Bright approximately 670 m (2,200 feet) long, adjacent to the Route 36 jug handle, is scheduled for renourishment. Immediately to the south, an area in Sea Bright approximately 1.9 km (1.2 miles) long is not scheduled to receive sand in 2002. The remaining length of Sea Bright and Monmouth Beach, approximately 5.6 km (3.5 miles) is slated to be renourished, as are approximately 1.3 km (0.8 mile) in central Spring Lake. According to construction plans, some areas will receive only small amounts of fill, generally in the intertidal area. Other areas, however, will receive fill along the entire beach profile, in some places more than 3 m deep. Three designated upland staging areas are planned in central Sea Bright, southern Monmouth Beach, and southern Spring Lake. Equipment, machinery, and construction crews will most likely be present throughout the entire beach area during construction.

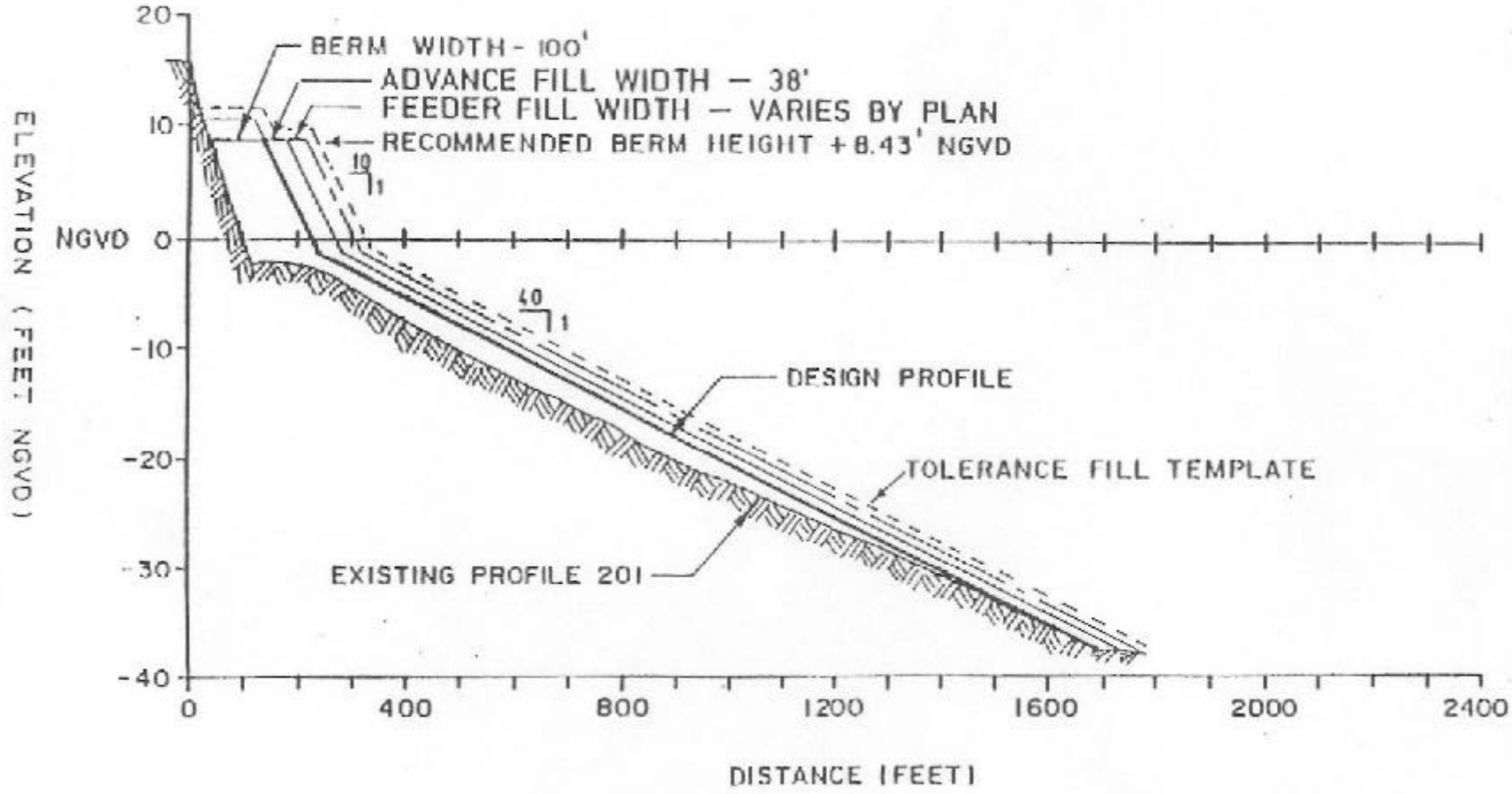

Figure 8. Design, Advance, and Feeder Fill Cross-Section (U.S. Army Corps of Engineers, 1990)

b. Conservation Measures

As part of the proposed Project, the Corps will carry out the following measures to avoid and minimize adverse effects to piping plovers and seabeach amaranth (U.S. Army Corps of Engineers, 2001a).

(1) Continuing Consultation with the Service

The Corps will initiate informal consultation with the Service at least 6 months prior to the start of initial nourishment and each renourishment cycle to reevaluate any potentially changed conditions. If a changed condition occurs that was not covered by the existing Biological Opinion, if incidental take of piping plovers is likely, or if relevant new information regarding federally listed species has become available, the Corps will reinitiate formal consultation at that time.

(2) Fill Material and Placement

All renourishment material will consist of clean sand fill material (*i.e.*, 90 percent or greater sand), will conform with the existing beach substrate, and will consist of material that is capable of maintaining suitable piping plover and seabeach amaranth habitat. Grain size will be compatible with existing beach material. Placement areas will be finished to approved and previously constructed grade.

(3) Endangered Species Management Program

In partnership with the Service and the NJDEP, the Corps will continue to institute the existing Endangered Species Management Program to advance public education and protection of the piping plover and seabeach amaranth. The Endangered Species Management Program includes the employment of a full time seasonal local monitor,[1] under the supervision of the NJDEP with oversight by the Corps and Service, to provide on-site education and outreach; to conduct endangered species surveys, monitoring, and management (including the use of symbolic fencing and predator exclosures as appropriate); and to serve as a municipal liaison. The survey, education, outreach, and protection protocols of future monitoring efforts will generally follow those of previous years, but may be changed as appropriate, pending consultation with the Service. If, at any time during the life of the Project, sufficient Corps funding is no longer available to continue the Endangered Species Management Program, the Corps will reinitiate informal [2] consultation with the Service to reevaluate project impacts with the loss of beneficial effects provided by monitoring and management.

(4) Educational Signs

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[1] From 1996 to 2001, the Program has adapted to meet changing needs of species management in the Project area. Efforts greater or less than one full time seasonal monitor may be necessary to maintain adequate species protection in future years.

[2] As the Program was key to the Service's analysis of indirect effects to listed species from recreational impacts, beach management, and predation, and is critical to accurate delineation of piping plover nesting areas, reinitiation of formal consultation will be required if diminishment or elimination of the Program causes an effect on the species not considered in this Opinion.

In addition to the educational signs already developed and paid for by the Corps, the Corps will provide for the development and production of additional signs regarding threatened and endangered species for the Project area if necessary.

(5) Seasonal Restrictions to Protect Piping Plovers

(i) Unoccupied Reaches

Constructable reaches[1] that have not been occupied by breeding plovers for the past three breeding seasons will be classified "unoccupied reaches," and work may proceed in these areas with no seasonal restrictions to protect piping plovers. However, work in unoccupied reaches during the nesting season, defined in unoccupied reaches as March 15 to August 15, will be avoided, if possible. As with occupied reaches, the Corps will reinitiate consultation at least 6 months prior to the start of a regularly scheduled renourishment cycle in an unoccupied reach, as per Conservation Measure (1). In these areas, as in occupied reaches, additional renourishments outside the regular 6-year cycle are not included in the proposed Project. To detect any new piping plover activity in unoccupied reaches, the Endangered Species Management Program [described in Conservation Measure (3)] will continue to include annual surveys and habitat assessments of the entire Project area, and weekly spot checks of potentially suitable habitat in both occupied and unoccupied reaches, from early April to early July. If a piping plover is observed at any time in a previously unoccupied reach, the Corps will immediately notify the Service to determine if further consultation is necessary, and will extend the Endangered Species Management Program to include protection of birds in such areas.

(ii) Occupied Reaches

A constructable reach in which piping plovers have been observed carrying out breeding behaviors, including courtship, territorial, and/or nesting activities, during any of the three most recent nesting seasons (including the current one if territories have been established for the year) will be considered an "occupied reach." In occupied reaches, to protect piping plovers, the Corps prime intent is to conduct all work outside the nesting season. In occupied reaches, the nesting season is defined as March 15 to the fledging [2] of the last chick in the reach, usually occurring by August 15. Therefore, the Project as proposed does not include any work during the nesting season in any occupied reach, except as described in Conservation Measure (5)(iii) below. Except for the contingencies in Conservation Measure (5)(iii) below, work in occupied reaches will begin after the last chick has fledged and will be completed by March 15, including removal of all pipeline material, machinery, equipment, and construction crews, and grading of fill to the construction template.
With written concurrence from the Service, work may proceed in an occupied reach after July 1

[1] The term "constructable reaches" as used in this conservation measure is consistent with the delineation of these areas in the preceding project description, and in the GDM/EISs for Sections I and II of the BECP. The Corps will reinitiate consultation if the geographic extent of any constructable reach is redefined at any time.

[2] In this context, and throughout this conservation measure, a "fledged chick" means one that has been observed in level flight for more than 15 meters, not just a chick having reached 25 days of age.

without further restrictions if thorough surveys by a Service-approved field monitor have determined that no piping plovers are engaging in breeding activity in the reach at that time. If nesting attempts failed or otherwise ended within the reach earlier in the season, work may proceed only if no breeding activity has been observed after 8 days of surveying throughout the full tidal cycle over at least 2 weeks, and the Service concurs.

(iii) Contingencies for Nesting-Season Work in Occupied Reaches

Outside of Nesting Areas: The Corps prime intent is to conduct all work in occupied reaches outside the nesting season. However, to avoid project delays and to provide the Corps adequate flexibility to handle unforeseen obstacles in project implementation (*i.e.*, adverse weather, equipment problems), the proposed Project includes in-season work within occupied reaches outside of piping plover nesting areas with the following protective measures.

1. Within each occupied reach, "nesting areas" will be delineated by the Service, with Corps and ENSP input, prior to the start of each renourishment cycle, and adjusted as appropriate during the breeding season. A nesting area is defined as 1,000 meters on either side of a site [as determined by a Service-approved field monitor (monitor) and confirmed by the Service] currently occupied by courting, territorial, incubating, or brood-rearing piping plovers, nests with eggs, or unfledged chicks, or any site so occupied during any of the most recent three nesting seasons (including the current one if territories have already been established for the year). The designation of a nesting area will also be contingent upon the continued existence of suitable habitat in the area, as determined by the Service.

2. Outside of nesting areas, work may proceed during the nesting season in other parts (non-nesting portions) of an occupied reach, with certain restrictions. For work in these areas, the Corps will notify the Service at least 1 week prior to any work between March 15 and August 15. In addition, between March 15 and July 1, work in non-nesting portions of occupied reaches may commence only if the monitor has detected no piping plovers in the area after 4 days of surveying, throughout the full tidal cycle, in the week immediately preceding the start of work.

3. If any piping plovers are detected in non-nesting portions of an occupied reach, work will not be conducted within 1,000 meters of the bird(s) until the monitor can determine whether the plovers are migrants, or may establish breeding territories. With written Service concurrence, work may proceed if no piping plovers have been observed for 2 weeks, or if no breeding behavior has been observed by July 1. If any breeding behavior is observed, the area will be classified as a "nesting area" as defined above.

Within Nesting Areas: To provide for additional flexibility in Project implementation, the Project as proposed includes a maximum of two (2) episodes of nourishment or renourishment work in nesting areas during the nesting season (*i.e.*, two episodes total over the entire Project area for the life of the Project; not two per occupied reach, not two per nesting area, and not two per renourishment cycle). If nesting-season work in a nesting area becomes necessary, the Corps will implement all of the following protective measures.

1. All work will be completed by April 15 or initiated after July 31. To avoid disturbance of piping plovers during the most critical season, no work will occur between April 16 and July 31.

2. The Corps will notify the Service at least 2 weeks prior to the start of work.

3. Beginning March 15 or July 25, for early or late-season work, respectively, daily piping plover surveys will be conducted of the entire construction area, as well as any areas where work will commence within the next 4 days. The daily surveys will be conducted by a Corps-funded, Service-approved field monitor (monitor), and will continue until work in the nesting area is complete, or until the last chick in the area has fledged. In addition, the monitor will conduct daily observation of all piping plovers in the construction area while work is in progress.

4. The monitor will maintain field notes (including documentation of negative survey data) as agreed upon by the Service, and provide copies to the Service. With Service concurrence, the Corps may modify survey and monitoring specifications based on site-specific considerations. The Corps will ensure coordination between the monitor and the project engineer responsible for the oversight of construction activities.

5. Fencing will be used to delineate areas used by piping plovers, and protective buffers will be set up around these areas. Work restrictions and buffer sizes will be as follows:
   - Adult (both migratory and breeding birds) foraging areas:
     no activities within 100 meters.
   - Courtship/territorial areas (the entire area being used or defended):
     no activities within 200 meters.
   - Nests with eggs:
     no non-motorized activities within 100 meters;
     no sand placement or motorized activities within 200 meters with a monitor present;
     no sand placement or motorized activities within 1,000 meters without a monitor present.
   - Brood rearing/unfledged chick foraging areas (the entire area used by unfledged chicks):
     no activities within 1,000 meters, extending from the low water line to the furthest extent of beach or dune habitat, with a monitor present.
   - Fledged chick foraging areas within their nesting area (not transient, fledged juveniles):
     no activities within 200 meters.

6. The extent of areas used by piping plovers will be determined by the monitor, with Corps input and ENSP and Service concurrence.

7. All protective buffers will be enlarged, reduced or otherwise modified as needed based upon any disturbance of piping plovers observed by the monitor, and the boundaries of fenced areas will be moved or adjusted as needed to reflect changes in use based on the monitor's observations of the birds' movements.

8. No nighttime work will take place while unfledged chicks are present within a nesting area, as the movements of unfledged chicks cannot be adequately monitored at night. [1]

9. If temporary intrusions into buffer areas become necessary, (*i.e.*, surveys of physical beach parameters, equipment retrieval), the Service will be notified prior to entry, and construction personnel will be accompanied by the monitor. The activity will be curtailed if any disturbance to piping plovers is observed.

10. A system of notification will be established. If any Project activities result in observed disturbances or harassment of piping plovers, the monitor will immediately initiate corrective actions to avoid further disturbance, then report to Corps or Service representatives to establish permanent procedures to address such disturbances. The on-site contractors will be notified immediately, and activities adjusted or halted by the monitor as needed to avoid or minimize any immediate threat to the birds. The monitor will also notify the Corps project engineer and biologist, and the NJDEP.

    In the event that a piping plover is injured or killed during construction activities, two sets of actions will be undertaken by the monitor: (1) notification of all appropriate personnel (*i.e.*, Corps, Service, contractor, managers); and (2) collection of evidence and information, and production of a written record. The information will include: the incident, the time and location, maps, photographs if possible, a written description, and names and telephone numbers of witnesses to the incident or the discovery.

11. Subject to site safety plans, the Service, the NJDEP, or their designated representatives will be given access to the construction area as needed for the purpose of surveying, monitoring, posting, and/or symbolically fencing piping plover use areas, and erecting predator exclosures for nests. Access will be given during daylight hours on any day(s) at the required frequency to accomplish the purposes stated above. All non-Corps personnel will notify the Corps construction manager 48 hours in advance prior to entering a construction area. All non-Corps personnel shall adhere to all requirements of the safety plan(s). [2]

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[1] Nocturnal foraging has been documented in piping plovers, and is believed to be a natural, if variable, behavior (Staine and Burger, 1994).

[2] The Service, ENSP, and all monitors should be provided with a complete copy of the safety plan prior to initiation of construction activities to ensure the safety of non-construction personnel.

12. All protective measures will follow and be consistent with the Service's 1994 "Guidelines for Managing Recreational Activities in Piping Plover Breeding Habitats on the U.S. Atlantic Coast to Avoid Take Under Section 9 of the Endangered Species Act." In any case where restrictions in these conservation measures (pages 22 to 28 of this Biological Opinion) are more protective of piping plovers than the Guidelines, the conservation measures will be controlling.

13. If for any reason, at any time over the life of the Project, additional nesting-season work in a nesting area becomes necessary (*i.e.*, more than two episodes of work between March 15 and April 15, or between July 31 and fledging of the last chick per nesting area; or any work at all between April 16 and July 31), the Corps will reinitiate consultation with the Service to reevaluate project impacts. If the Service determines that piping plovers are likely to be adversely affected, a new Biological Opinion will be required before further nesting-season work may proceed within a nesting area.

(6) Measures to Avoid, Minimize, and Compensate for Adverse Effects to Seabeach Amaranth

(i) Surveys

If any Project activities are scheduled to occur during the growing season of seabeach amaranth (May 15 to December 1), a Corps or contract biologist, botanist, or designated representative will survey the Project area for this species twice a month from July 1 to October 1, and also immediately prior to any construction or other work. Plant locations, numbers, and sizes will be recorded.

(ii) Fencing and Avoidance of Plants

If construction personnel or vehicles will be present in, or may pass through seabeach amaranth areas, symbolic fencing will be erected encompassing a 3-meter protective buffer around the plants if practical. All construction activities will avoid all delineated locations of seabeach amaranth where feasible. The Corps will undertake all practicable measures to avoid incidental take of plants.

(iii) Transplantation of Plants Likely to be Destroyed

In the event that seabeach amaranth is present in the placement area, and it is likely that the surrounding placed sand will encroach upon and smother the plant, the Corps proposes to transplant the individual plant to a similar habitat near or within the Project area to lessen the impact of placement. Transplantation will include removal of a sufficiently large and intact volume of sand to include the full extent of the roots. When necessary, this action will occur with Service cooperation[1] as soon as possible after the plant is identified, and every attempt will be made to include the entire (undamaged) root system. Transplanted individuals

[1] This Service is available to provide technical assistance pursuant to Conservation Measures (6)(iii), (6)(iv), and (6)(vi), including relevant scientific literature, contact information for species experts, and review of procedures and protocols developed by the Corps. Additional Service assistance and staff time for administration of these measures can be arranged through the Corps-funded Endangered Species Management Program.

will be monitored until their deaths, and the monitoring results will be provided to the Service.

(iv) Seed Collection and Other Measures to Offset Adverse Effects

In consultation and cooperation with the Service, the Corps 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 seed 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 seed will be stored under controlled conditions appropriate for the species (*e.g.*, temperature, humidity, light), and later redistributed within the Project area, including renourished sites. Qualified practitioners will attempt to germinate the remainder of the seed. If successful, germinated plants will be replanted in suitable habitats within the Project area, including renourished sites. If the number of wild plants bearing seed is insufficient to collect an adequate amount of seed, individual plants will be sent to a qualified greenhouse and propagated to produce additional seed 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 seeds. The stockpiled sand would be re-spread on the construction template upon completion of renourishment.

Based upon the best available scientific data, the Corps and the Service will cooperatively determine an acceptable course of action to compensate for seed bank burial, including the amount of seed to be collected; thresholds for collecting and propagating plants for production of additional seed; the proportions of collected seed 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 Corps 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, nor as research on the part of the Corps. Such activities will not continue past the second year of each renourishment cycle.

(v) Notification

The Corps will develop and utilize a System of Notification for seabeach amaranth similar to the one described above for the piping plover.

(vi) Evaluation of Seabeach Amaranth Conservation Measures

In consultation and cooperation with the Service, the Corps will evaluate the success of measures to protect seabeach amaranth and will revise these protective measures as appropriate for each subsequent renourishment cycle.

B. SPECIES STATUS

Relevant biological and ecological information considered by the Service in formulating this Biological Opinion is presented below. Appropriate information on the species life histories, habitats, distribution, and other factors affecting species survival is included to provide background for analyses in later sections. This section also documents the effects of past human and natural activities or events that have led to the current status of the piping plover and seabeach amaranth.

1. Piping Plover

a. Species Description

Piping plovers are small, sand-colored shorebirds, approximately 17 centimeters (cm) (7 inches) long with a wingspread of about 38 cm (15 inches) (Palmer, 1967). On January 10, 1986, the piping plover was listed as endangered and threatened pursuant to the ESA. Protection of the species under the ESA reflects the species precarious status range-wide. Three distinct populations were identified and listed separately: Atlantic Coast (threatened), Great Lakes (endangered), and Northern Great Plains (threatened). The Atlantic Coast population breeds on sandy, coastal beaches from Newfoundland to North Carolina, and winters along the Atlantic Coast from North Carolina south, along the Gulf Coast to Texas, and in the Caribbean (U.S. Fish and Wildlife Service, 1985). On July 10, 2001, the Service designated critical habitat for wintering piping plovers, including areas used by wintering plovers from the Atlantic Coast population. Critical habitat was also designated in the Great Lakes breeding area on May 7, 2001, and proposed for the Northern Great Plains breeding area on June 12, 2001 (U.S. Fish and Wildlife Service, 2001a). No critical habitat has been designated or proposed in the Atlantic Coast breeding area.

The recovery plan for the Atlantic Coast population of the piping plover (U.S. Fish and Wildlife Service, 1996a) delineates four recovery units or geographic subpopulations within the population: Atlantic Canada, New England, New York-New Jersey, and Southern (Delaware, Maryland, Virginia, and North Carolina). Recovery criteria established within the recovery plan defined population and productivity goals for each recovery unit, as well as for the population as a whole (see Table 2 for goals and current status). Attainment of these goals for each recovery unit is an integral part of a piping plover recovery strategy that seeks to reduce the probability of extinction for the entire population by: (1) contributing to the population total, (2) reducing vulnerability to environmental variation (including catastrophes, such as hurricanes, oil spills, or disease), (3) increasing likelihood of genetic interchange among subpopulations, and (4) promoting re-colonization of any sites that experience declines or local extirpations due to low productivity or temporary habitat succession. The plan further states: "A premise of this plan is that the overall security of the Atlantic Coast piping plover population is profoundly dependent upon attainment and maintenance of the minimum population levels for the four recovery units. Any appreciable reduction in the likelihood of survival of a recovery unit will also reduce the probability of persistence of the entire population." 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 Biological 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.

Table 2. Comparison of Piping Plover Population Estimates and Ten-Year Average Productivity with Recovery Criteria by Recovery Unit (U.S. Fish and Wildlife Service, 1996a; 2002)

Recovery Unit	2001 Population Estimate (Number of Breeding Pairs)	Minimum Subpopulation Needed for Recovery (Number of Breeding Pairs)	2001 Population Estimate as Percent of Recovery Goal (%)	Average Productivity 1992-2001 (Number of Chicks Fledged per Pair)	Percent of Breeding Population 1992-2001 on which Productivity Estimate is Based (%)	Average Productivity Needed for Recovery (Number of Chicks Fledged per Pair)
New England	641	625	102.6	1.54	97.4	1.5
New York-New Jersey	431	575	75.0	1.14	87.8	1.5
Southern	208	400	52.0	1.07	85.1	1.5
U.S. Total	1,280	1,600	80.0	1.34	92.0	1.5
Atlantic Canada	245	400	61.3	1.63	59.1	1.5
Atlantic Coast	1,525	2,000	76.3	--	--	1.5

b. Life History

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 (Cairns, 1982). Piping plovers are monogamous, 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 begin breeding as early as 1 year of age (MacIvor, 1990; Haig, 1992); however, the percentage of birds that breed in their first adult year is unknown.

Piping plover nests can be found above the high tide line on coastal beaches, on sand flats at the ends of sand spits and barrier islands, on gently sloping foredunes, in blowout areas behind primary dunes, and in washover areas cut into or between dunes. The birds may also nest on areas where suitable dredge material has been deposited. Nest sites are shallow, scraped depressions in substrates ranging from fine grained sand to mixtures of sand and pebbles, shells or cobble (Bent, 1929; Burger, 1987; Cairns, 1982; Patterson, 1988; Flemming *et al.*, 1990; MacIvor, 1990; Strauss, 1990). 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.*, 1990; MacIvor, 1990). Plover nests may be very difficult to detect, especially during the 6- to 7-day egg-laying phase when the birds generally do not incubate (Goldin, 1994).
Eggs may be present on the beach from early April through late July. Clutch size for an initial nest

attempt is usually four eggs, one laid every other day. Eggs are pyriform in shape, and variable buff to greenish brown in color, marked with black or brown spots. The incubation period usually lasts 27-28 days. Full-time incubation usually begins with the completion of the clutch and is shared equally by both sexes (Wilcox, 1959; Cairns, 1977; MacIvor, 1990). Eggs in a clutch usually hatch within 4 to 8 hours of each other.

Piping plovers generally fledge only a single brood per season, but may renest several times if previous nests are lost. Chicks are precocial (Wilcox, 1959; Cairns, 1982). They may move hundreds of meters from the nest site during their first week of life (U.S. Fish and Wildlife Service, 1994), and chicks may increase their foraging range up to 1,000 m before they fledge (are able to fly) (Loegering, 1992). Chicks remain together with one or both parents until they fledge at 25 to 35 days of age. Depending on 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 typical beach surroundings. Chicks sometimes respond to vehicles and/or pedestrians by crouching and remaining motionless (Cairns, 1977; Tull, 1984; Goldin, 1993; Hoopes, 1993). Adult piping plovers also respond to intruders (avian and mammalian) in their territories 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).

Plovers feed on invertebrates such as marine worms, fly larvae, beetles, crustaceans, and mollusks (Bent, 1929; Cairns, 1977; Nicholls, 1989). Important feeding areas include intertidal portions of ocean beaches, washover areas, mudflats, sand flats, wrack lines, 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). Studies have shown that the relative importance of various feeding habitat types 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). Feeding activities of chicks are particularly important to their survival. Most time budget studies reveal that chicks spend a high proportion of their time feeding. Cairns (1977) found that piping plover chicks typically tripled their weight during the first two weeks post-hatching; chicks that failed to achieve at least 60 percent of this weight gain by the twelfth day were unlikely to survive. During courtship, nesting, and brood rearing, feeding territories are generally contiguous to nesting territories (Cairns, 1977), although instances where brood-rearing areas are widely separated from nesting territories are not uncommon. Feeding activities of both adults and chicks may occur during all hours of the day and night (Burger, 1993), and at all stages in the tidal cycle (Goldin, 1993; Hoopes, 1993).

Migration patterns are poorly understood. Most piping plover surveys have focused on breeding or wintering sites. Northward migration occurs during late February, March and early April, and southward migration extends from late July to August and September. Both spring and fall migration routes are believed to occur primarily within a narrow zone along the Atlantic Coast (U.S. Fish and Wildlife Service, 1996a).

c. Status on the Atlantic Coast and in the New York-New Jersey Recovery Unit

(1) Historical Population Trends

Historical population trends for the Atlantic Coast piping plover have been reconstructed from scattered, largely qualitative records. Nineteenth-century naturalists, such as Audubon and Wilson, described the piping plover as a common summer resident on Atlantic Coast beaches (Haig and Oring, 1987). However, by the beginning of the 20th Century, egg collecting and uncontrolled hunting, primarily for the millinery trade, had greatly reduced the population, and, in some areas along the Atlantic Coast, the piping plover was close to extirpation. Following passage of the Migratory Bird Treaty Act (40 Stat. 775; 16 U.S.C. 703-712) in 1918, and changes in the fashion industry, piping plover numbers recovered to some extent (Haig and Oring, 1985).

Available data suggest that the most recent population decline began in the late 1940s or early 1950s (Haig and Oring, 1985). Starting in 1972, the National Audubon Society's “Blue List” of birds with deteriorating status included the piping plover (Tate, 1981). Johnsgard (1981) described the piping plover as “... declining throughout its range and in rather serious trouble.” The Canadian Committee on the Status of Endangered Wildlife in Canada designated the piping plover as "Threatened" in 1978 and elevated the species status to "Endangered" in 1985 (Canadian Wildlife Service, 1989).

Reports of local or statewide declines between 1950 and 1985 are numerous and many are summarized by Cairns and McLaren (1980) and Haig and Oring (1985). While Wilcox (1939) estimated more than 500 pairs of piping plovers on Long Island, New York, the 2001 population estimate was 309 pairs (U.S. Fish and Wildlife Service, 2002). There was little focus on gathering quantitative data on piping plovers in Massachusetts through the late 1960s because the species was commonly observed and presumed to be secure. However, numbers of piping plover breeding pairs declined 50 to 100 percent at seven Massachusetts sites between the early 1970s and 1984 (Griffin and Melvin, 1984). Further, recent experience of biologists surveying piping plovers has shown that counts of these cryptic birds sometimes go up with increased census effort. This suggests that some historic counts of piping plover numbers by one or a few observers, who often recorded occurrences of many avian species simultaneously, may have underestimated the piping plover population. Thus, the magnitude of the species decline may have been even more severe than available numbers imply.

(2) Population Trends Since Listing Under the Endangered Species Act

Table 3 summarizes nesting pair counts for the Atlantic Coast piping plover population since listing in 1986 through 2001. The apparent increase in numbers of pairs between 1986 and 1989 (Table 3) is thought, at least partially, to reflect the effects of increased survey efforts following the proposed listing in 1985. Intensified survey effort may have played an especially important role in population estimates for New York and New Jersey. For example, Wich (1993) surmised that, although protection of beach-nesting birds in New York increased after 1983, survey effort also intensified, especially at sites such as Breezy Point, Queens County, and Westhampton Beach, Suffolk County. While the relative contributions of each cannot be determined, he believes that "the stability of more recent [early 1990s] estimates probably accurately reflects the status of New York's plover population." Ducey-Ortiz *et al*. (1989) documented an increasing plover monitoring effort in New York between 1984 and 1988 and found that, when results from 54 uniformly monitored sites were analyzed, the population trend did not increase or decrease significantly. The New Jersey plover coordinator conjectured that one quarter to one third of the apparent population increase observed in that State between 1987 and 1989 was due to increased survey effort (Jenkins, 1993).

The Atlantic Coast population increased from approximately 950 pairs in 1989 to over 1,500 pairs in 2001, but the increase has been unevenly distributed. Between 1989 and 2001, the New England subpopulation increased by 441 pairs, while the New York-New Jersey subpopulation gained only 154 pairs. The Southern and Atlantic Canada subpopulations lagged even further behind, with gains of only 37 and 7 pairs, respectively (U.S. Fish and Wildlife Service, 2002). While rapid overall population growth between 1991 and 1995 (driven largely by the New England subpopulation) was encouraging, recent growth has been more modest, with an essentially flat population trend from 1998 to 2000. The New York-New Jersey subpopulation experienced a net decrease of, 43 pairs (11 percent) between 1996 and 1998, followed by several years of steady gains for a 3-year increase of 93 pairs by 2001 (U.S. Fish and Wildlife Service, 2002).

Table 3. Summary of Atlantic Coast Piping Plover Population Estimates, 1986-2001

STATE/UNIT	PAIRS																Goal
	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	
Maine	15	12	20	16	17	18	24	32	35	40	60	47	60	56	50	55	
New Hampshire	-	-	-	-	-	-	-	-	-	-	-	5	5	6	6	7	
Massachusetts	139	126	134	137	140[a]	160	213	289	352	441	454	483[a]	495	501	496[b]	495[b]	
Rhode Island	10	17	19	19	28	26	20	31	32	40	50	51	46	39	49	52	
Connecticut	20	24	27	34	43	36	40	24	30	31	26	26	21	22	22	32	
NEW ENGLAND	184	179	200	206	228[a]	240	297	376	449	552	590	612[a]	627	624	623	641	625
New York[c]				191	197	191	187	193	209	249	256	256	245	243	289	309	
New Jersey	102[e]	93[e]	105[e]	128	126	126	134	127	124	132	127	115	93	107	112	122	
NY-NJ UNIT	208	228	277	319	323	317	321	320	333	381	383	371	338	350	401	431	575
Delaware	8	7	3	3	6	5	2	2	4	5	6	4	6	4	3	6	
Maryland	17	23	25	20	14	17	24	19	32	44	61[f]	60	56	58	60	60	
Virginia	100	100	103	121	125	131	97	106	96	118	87	88	95	89	96	119	
North Carolina		30[g]	40[g]	55	55	40	49	53	54	50	35	52	46	31	24	23	
South Carolina	3	-	-	-	1	1	-	1	-	-	0	-	-	-	-	0	
SOUTHERN UNIT	158	160	171	199	201	194	172	181	186	217	189[f]	204	203	182	183	208	400
U.S. TOTAL	550	567	648	724	752[a]	751	790	877	968	1,150	1,162[f]	1,187[a]	1,168	1,156	1,207	1,280	1,600
ATLANTIC CANADA [a]	240	223	238	233	229	234	234[h]	234[h]	181	208	186	197[i]	212	240	231	245	400
ATLANTIC COAST [a]	790	790	886	957	981	985	1,024	1,111	1,149	1,358	1,348[f]	1,384	1,380	1,396	1,438	1,525	2,000

Table 3, continued:

a Reflects corrections in number of pairs reported in the 1999 Status Update for Massachusetts in 1990 and 1997, and for Atlantic Canada in 1991-1995, 1998, and 1999.

b Beginning in 2000, Massachusetts estimates reflect a slight change in methodology from prior years.

c The only statewide count tallied in New York in 1994-2001 is the window census.

d The recovery team believes that this estimate reflects an incomplete survey effort.

e The New Jersey plover coordinator conjectures that one quarter to one third of the apparent population increase between 1986 and 1989 is due to increased survey effort.

f Reflects correction in 1996 Maryland population from 60 pairs reported in 1996 Status Update to 61 pairs.

g The recovery team believes that the apparent 1986-1989 increase in the North Carolina population is due to intensified survey effort. No actual surveys were made in 1987; estimate is that from 1986.

h 1991 estimate.

i Assumes that the number of pairs in Newfoundland in 1997 was 11 pairs, the same as 1996; Newfoundland reported 35 adults in 1997, up from 27 in 1996, but provided no 1997 estimate for breeding pairs.

(3) Productivity

Productivity needed to maintain a stationary population for Atlantic Coast piping plovers is estimated at 1.24 fledged chicks per pair (Melvin and Gibbs, 1994). However, because small populations may be highly vulnerable to extinction due to variability in productivity and survival rates, the average productivity for a stationary population may be insufficient to assure a high probability of species survival (see discussion of effects of productivity rates on vulnerability to extinction below). Therefore, the recovery plan establishes productivity goals needed to assure a secure 2000-pair population at 1.5 chicks per pair in each of the four recovery units, based on data from at least 90 percent of each recovery unit's population.

Table 4 provides a summary of piping plover productivity from 1992 to 2001. Ten-year (1992-2001) average productivity for piping plovers in the U.S. Atlantic Coast portion of their range is 1.34 chicks per pair. Peak productivity in the U.S. was observed in 1993, 1994, and 1999, when average productivity approached or exceeded the recovery plan productivity goal of 1.5 chicks per pair. However, productivity in 1997 and 2000 was considerably lower, 1.16 and 1.17 chicks per pair, respectively (U.S. Fish and Wildlife Service, 2002), and well below the 1.24 chicks per pair required to maintain a stationary population. While weather events were major contributors to egg and chick losses in these years (U.S. Fish and Wildlife Service, 1998; 2002), such periodic natural events are inevitable, and they underscore the need to reduce the species vulnerability by increasing the breeding population and protecting the species against human-caused factors that impinge on productivity.

Mirroring the regional population trends, productivity rates have been unevenly distributed, with other recovery units lagging substantially behind New England. Average productivity from 1992 to 2001 in the New York-New Jersey Recovery Unit was 1.14 chicks per pair. The 1.24 chicks per pair productivity needed to maintain a stationary population has been attained only three times, in 1994, 1999, and 2001 in the New York-New Jersey Recovery Unit. In addition, productivity estimates for this recovery unit reflect a substantial gap between the number of pairs for which productivity is monitored and the total breeding population, with the 10-year average based on productivity data from only 88 percent of the total. Nearly all pairs in the recovery unit for which productivity is unknown nested in New York (U.S. Fish and Wildlife Service, 2002).

Table 4. Summary of Piping Plover Productivity Estimates for the U.S. Atlantic Coast, 1992-2001

STATE/UNIT	CHICKS FLEDGED PER PAIR										
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001[a]	10 year AVG [b]
Maine	2.00	2.38	2.00	2.38	1.63	1.98	1.47	1.63	1.60	1.98 (55)	1.85 (459/459)
New Hampshire	-	-	-	-	-	0.60	2.40	2.67	2.33	2.14 (7)	2.07 (29/29)
Massachusetts	2.03	1.92	1.80	1.62	1.35	1.33	1.50	1.60	1.09	1.49 (494)	1.52 (4081/4219)
Rhode Island	1.55	1.80	2.00	1.68	1.56	1.34	1.13	1.79	1.20	1.50 (52)	1.52 (406/410)
Connecticut	1.45	0.38	1.47	1.35	1.31	1.69	1.05	1.45	1.86	1.22 (32)	1.33 (274/274)
NEW ENGLAND	1.91	1.85	1.81	1.67	1.40	1.39	1.46	1.62	1.18	1.53 (640)	1.54 (5249/5391)
New York	0.98	1.24	1.34	0.97	1.14	1.36	1.09	1.35[c]	1.11[c]	1.27 (294)	1.19 (2008/2436)
New Jersey	1.07	0.93	1.16	0.98	1.00	0.39	1.09	1.34	1.40	1.29 (122)	1.06 (1178/1193)
NY-NJ UNIT	1.03	1.08	1.25	0.97	1.07	1.02	1.09	1.35	1.19	1.28 (416)	1.14 (3186/3629)
Delaware	1.00	0.50	2.50	2.00	0.50	1.00	0.83	1.50	1.67	1.50 (6)	1.31 (42/42)
Maryland	1.00	1.79	2.41	1.73	1.49[d]	1.02[e]	1.30	1.09	0.80	0.92 (60)	1.27 (474/474)
Virginia	0.59	1.45	1.65	1.00	1.54	0.71	1.01	1.21	1.42	1.52 (110)	1.24 (716/991)
North Carolina	0.42	0.74	0.36	0.45	0.86	0.23	0.61	0.48	0.54	0.50 (22)	0.51 (406/417)
SOUTHERN UNIT	0.62	1.18	1.37	1.06	1.34[d]	0.68	0.99	1.04	1.09	1.22 (198)	1.07 (1,638/1,924)
U.S. AVERAGE	1.35	1.47	1.56	1.35	1.30[d]	1.16	1.27	1.45[c]	1.17[c]	1.40 (1,254)	1.34 (10,073/10,944)
ATLANTIC CANADA	1.55	0.69	1.25	1.69	1.72	2.10	1.84	1.74	1.47	1.77 (219)	1.63 (1,281/2,168)

Table 4, continued:

a Parentheses indicate the number of pairs on which productivity is based.

b Parentheses denote number of pairs on which productivity is based/estimated number of pairs in the state or unit between 1992 and 2001.

c Number of pairs on which New York 1999 and 2000 productivity is based exceeded the population estimate. Reasons for the relatively large discrepancy between the 1999 and 2000 window estimates and the number of pairs on which the 1999 and 2000 New York productivity estimate is based are unclear, but appear to reflect undercounts in the window estimates and double-counting of some re-nesting pairs at some sites in the productivity estimates. If this is the case, it would, in turn, result in an underestimate of State-wide productivity.

d Reflects a correction in 1996 Maryland productivity.

e Chicks surviving to 25 days projected from data collected through day 15 based on linear regression analysis.

(4) Habitat Utilization

A growing body of information shows that overwash habitats, including bayside flats, unstabilized and recently closed inlets, ephemeral pools (areas on the beach where sea and/or rain water pooled during storm overwashes and rains), and moist, sparsely vegetated barrier flats, are especially important to piping plover productivity and carrying capacity in the New England, New York-New Jersey, and Southern Recovery Units (Wilcox, 1959; Strauss, 1990; Massachusetts Division of Fisheries and Wildlife, 1996; Jones, 1997).

Research indicates that plovers utilizing New England beaches are attracted to, and highly productive on, a wider variety of habitats (Massachusetts Division of Fisheries and Wildlife, 1996; Jones, 1997) than in the other recovery units in the southern half of their range. However, studies in the New England Recovery Unit also recognize the optimal value of overwash habitats with open connections to bayside foraging habitats. Out of 80 piping plover nests observed by Strauss (1990), no nests were found seaward of steep foredunes in Sandy Neck, Massachusetts, where this habitat constituted 83 percent of the beach front. Many areas in Strauss's study site had been artificially plugged with discarded Christmas trees and/or snow fences. 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 pondshore spent significantly less time responding to human disturbance (1.6 percent) than those limited to the ocean beach (17.0 percent). Since ocean beaches are highly attractive to recreational beach-goers, limiting plovers to these habitats may also increase the potential for disturbance from people and pets.

In New York, Wilcox (1959) described the effects on piping plovers of storms that breached the Long Island barrier islands in 1931 and 1938, forming Moriches and Shinnecock Inlets and leveling dunes across the south shore. Only 3 to 4 pairs of piping plovers nested on 27.4 km (17 miles) of barrier beach along Moriches and Shinnecock Bays in 1929. However, following the natural opening of Moriches Inlet in 1931, plover numbers increased to 20 pairs in 3.2 km (2 miles) of beach habitat by 1938. In 1938, a hurricane opened Shinnecock Inlet and also flattened dunes along both Shinnecock and Moriches Bays. In 1941, plover numbers along the same 27.4-km (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.

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 50 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. Where present, bay tidal flats and wrack were the most preferred

habitats. On segments with neither ephemeral pools or 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. To assist piping plover recovery, the authors recommend avoidance of beach management practices (*e.g.*, jetty construction, breach filling, dune building, sand renourishment) that typically inhibit natural renewal of ephemeral pools, bay tidal flats, and open vegetation habitats.

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. Results showed that both habitat selection and foraging behavior correlated inversely with the number of people present. In the absence of people, plovers fed in ocean and bayside habitats. Burger concluded that protection of the entire beach ecosystem with high habitat diversity will help mitigate effects of human beach recreation.

During the 2000 nesting season, Service biologists observed that 7 of the 21 sites (33 percent) occupied by nesting plovers in New Jersey were areas with low recreational use and access to ephemeral pools and/or bayside tidal flats. These 7 sites supported 58 percent (65 pairs) of the 112 piping plover pairs nesting in New Jersey in 2000 and accounted for 62 percent of the Statewide productivity (97 of 157 chicks fledged).

On Assateague Island, Maryland, dramatic increases in productivity and breeding population occurred in response to overwash events between 1991 and 1992 on the northern 8 km of the island. Productivity, which had averaged 0.77 chicks per pair in a 5-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 (MacIvor, 1990). Loegering and Fraser (1995) found that chicks on Assateague Island, which were able to reach bay beaches and the island interior, had significantly higher fledging rates than those that foraged solely on the ocean beach. The observed higher foraging rates, percentage of time spent foraging, and abundance of terrestrial arthropods on the bay beach and interior island habitats supported their hypothesis that foraging resources in interior and bayside habitats are key to reproductive rates on that site. Loegering and Fraser (1995) stressed the importance of sparsely vegetated cross-island access routes maintained by overwash, and the need to restrict or mitigate activities that reduce natural disturbance resulting from storms.

In Virginia, Watts *et al*. (undated) found that piping plovers nesting on 13 barrier islands in 1986-88 were not evenly distributed along the islands. Beach segments used by plovers had wider and more heterogeneous beaches, fewer stable dunes, greater open access to bayside foraging areas, and closer proximity to mudflats. Watts *et al*. noted that the characteristics of beaches selected by plovers are maintained by storms.

Further south at Cape Lookout National Seashore, North Carolina, 32 to 39 pairs of plovers 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 extremely patchy, with all nests clustered on the highly dynamic ends of the barrier islands, recently closed and sparsely vegetated "old inlets," expansive barrier mudflats, or new ocean-to-bay overwashes (Cape Lookout National Seashore, 1998). During a 1990 study, 96 percent of brood observations were on bay tidal flats, even though broods had access to both bay and ocean beach habitats (McConnaughey *et al.*, 1990).

d. Continuing Threats

Continuing threats to Atlantic Coast piping plovers in the breeding portion of their range include habitat loss and degradation, disturbance by humans and pets, increased predation, and oil spills. These threats are described within the revised recovery plan (U.S. Fish and Wildlife Service, 1996a), and discussion here is largely limited to the specific situation in the New York-New Jersey Recovery Unit. Many recent protection efforts in New York and New Jersey have been funded by revenues collected to restore oil spill damages (see below), and long-term funding for future protection efforts is uncertain.

(1) Predation

As noted in the revised recovery plan (U.S. Fish and Wildlife Service, 1996a) substantial evidence exists that human activities are exacerbating natural predation on piping plovers, their eggs, and chicks. Where Wilcox (1959) had observed 92 percent hatching success of nests observed between 1939-58 on Long Island, New York, and loss of only 2 percent of nests to crows (*Corvus* sp.), Elias-Gerken (1994) documented loss of 21 percent of nests in her study area to crows in 1992-93. Elias-Gerken (1994) also observed crows perching and nesting in exotic Japanese black pines (*Pinus thunbergii*) along the Ocean Parkway on Jones Island, and hypothesized that this vegetation and other artificial perches exacerbated depredation by crows. Other important predators of plover eggs and chicks in the recovery unit include foxes (*Vulpes vulpes*), raccoons (*Procyon lotor*), Norway rats (*Rattus norvegicus*), herring gulls (*Larus argentatus*), and great black-backed gulls (*Larus marinus*) (Riepe, 1989; Jenkins and Nichols, 1994; Jenkins *et al.*, 1999a; Canale, 1997). Predators accounted for over half of all piping plover nest losses in New Jersey from 1995 to 1998 (Jenkins *et al.*, 1999a; Jenkins and Niles, 1999).

A variety of techniques that have been employed to reduce predation on plovers are discussed in the revised recovery plan (U.S. Fish and Wildlife Service, 1996a). Some of these techniques, most notably the use of predator exclosures (fences around nests), have been used with demonstrated success to reduce predation on piping plover eggs (Melvin *et al.*, 1992; Rimmer and Deblinger, 1990) and credited with an important role in population increases in some parts of their range (Jenkins and Nichols, 1994; Jenkins *et al.*, 1999a). However, these same devices have also been associated with serious problems including entanglements of birds in the exclosure netting and attraction of "smart" predators that have "learned" there is potential prey inside. The downside risks may include not only predation or nest abandonment, sometimes at rates exceeding those that might occur without

exclosures, but also induced mortality of adult birds. Exclosures provide no protection for mobile plover chicks, which generally leave the exclosure within one day of hatching and move extensively along the beach to feed.

While plovers have derived important benefits from use of exclosures in the New York-New Jersey Recovery Unit (Jenkins and Nichols, 1994; Jenkins *et al.*, 1999a; Canale, 1997), the incidence of problems associated with these devices has been especially prevalent. At the Arverne site in Queens, New York for example, vandalism of exclosures has been a substantial problem (Davis, 1997; 1998). In 1995, foxes keyed in on exclosures at Westhampton Dunes, New York, causing high rates of abandonment. Trapping and removal of foxes at this site in 1996 and 1997 helped facilitate higher productivity (Houghton, 1997). At Sandy Hook, New Jersey, where exclosures had made important contributions to productivity between 1990 to 1996, heavy predation on exclosed and unexclosed nests was the major cause of a precipitous drop in productivity from 1.49 chicks per pair (1990-1996 average) to 0.36 chicks per pair in 1997 (McArthur, 1997).

(2) Oil Spills

Oil and "tar balls"from the June 1990 discharge of 267,000 gallons of number 6 fuel oil from the B.T. Nautilus spill in the Kill Van Kull were found on southern Long Island beaches from Breezy Point to Fire Island, and along the New Jersey coastline from Sandy Hook south to Brigantine. Evidence submitted in government claims for natural resource damages included direct visual confirmation of 27 oiled piping plovers, 10 in New York and 17 in New Jersey. Implementation of piping plover restoration plans using funds collected from the responsible party was completed in New Jersey (1995-1999) and in New York (1997-2001).

The May 1996 ANITRA spill discharged 42,000 gallons of light crude oil into Delaware Bay and spread oil along more than 70 miles of the southern New Jersey coastline. Oiling was detected on 51 adult plovers, nine of which were captured and cleaned (New Jersey Department of Environmental Protection, U.S. Department of the Interior, and National Oceanic and Atmospheric Administration, 1999). Negotiations between State and federal agencies and the responsible party to determine natural resource damages are still in progress at this time.

(3) Disturbance from Humans, Pets, and Motorized Vehicles

Intensive management measures to protect piping plovers from disturbance by beach recreationists and their pets have been implemented at many New York-New Jersey plover nesting sites in recent years. In 2000, more than half of the occupied piping plover nesting sites in New Jersey were located on State or private land (12 out of 21 sites) (Jenkins, 2000). In New York, 95.8 percent of piping plover pairs nested on non-federal land in 1999 (Rosenblatt, 2000). Piping plover protection in this recovery unit, therefore, is highly dependent on the efforts of State and local government agencies, conservation organizations, and private landowners. Landowner efforts are often contingent on annual commitments.

While many landowners are supportive and cooperative, others are not.

Recreational activities can be a source of both direct mortality and harassment of piping plovers. Pedestrians may flush incubating plovers from nests (Flemming *et al.*, 1988; Cross, 1990; Cross and Terwilliger, 1993), exposing eggs to predators or excessive temperatures. Repeated exposure of shorebird eggs on hot days may cause overheating, killing the embryos (Bergstrom, 1991); excessive cooling may kill embryos or retard their development, delaying hatching dates (Welty, 1982). Pedestrians can also displace unfledged chicks (Strauss, 1990; Burger, 1991; Loegering, 1992; Hoopes, 1993; Goldin, 1993), forcing them out of preferred habitats, decreasing available foraging time, and causing expenditure of energy.

Concentrations of pedestrians may deter piping plovers from using otherwise suitable habitat. In Jones Beach Island, New York, Elias-Gerkin (1994) found less pedestrian disturbance in areas selected by nesting piping plovers than areas unoccupied by plovers. Burger (1991; 1994) found that presence of people at several New Jersey sites caused plovers to shift their habitat use away from the ocean front to interior and bayside habitats, and that the time plovers devoted to foraging decreased and the time spent alert increased when more people were present. Burger (1991) also found that when plover chicks and adults were exposed to the same number of people, chicks spent less time foraging and more time crouching, running away from people, and being alert then did adult birds.

Fireworks are highly disturbing to piping plovers (Howard *et al.*, 1993). Plovers are also intolerant of kites, particularly as compared to pedestrians, dogs, and vehicles. Biologists believe this may be because plovers perceive kites as potential avian predators (Hoopes, 1993).

Motorized vehicle use on beaches is a threat to piping plovers. Vehicles can crush eggs, adults, and chicks (Wilcox, 1959; Tull, 1984; Burger, 1987; Patterson *et. al.*, 1991). In Massachusetts and New York, 18 piping plover chicks and 2 adults were killed by off-road vehicles (ORVs) in 14 documented incidents (Melvin *et al*., 1994). Goldin (1993) compiled records of 34 chick mortalities (30 on the Atlantic Coast and 4 on the Northern Great Plains) due to vehicles. Biologists that monitor and manage piping plovers believe that vehicles kill many more chicks than are found and reported (Melvin *et al.*, 1994).

Beaches used by recreational vehicles during nesting and brood-rearing periods generally have fewer breeding plovers than available nesting and feeding habitat can support. In contrast, plover abundance and productivity has increased on beaches where recreational vehicle restrictions during chick-rearing periods have been combined with protection of nests from predators (Goldin, 1993). Beginning in 1999 at the North Brigantine Natural Area, Atlantic County, New Jersey, a seasonal closure to all motorized vehicles was imposed during the period when unfledged chicks are present. The number of nesting pairs of piping plovers at this site rose from 8 pairs in 1998 to 11 pairs in 2000; productivity rose from 1.50 chicks per pair in 1998 to a State record of 3.17 chicks per pair in 1999, with 2.45 chicks fledged per pair in 2000 (Jenkins *et al.*, 1998; Jenkins *et al.*, 1999b; Jenkins, 2000).

Once hatched, piping plover broods are mobile and may not remain near the nesting area. Wire fencing placed around nests to deter predators (Rimmer and Deblinger, 1990; Melvin *et al.*, 1992) is ineffective in protecting chicks from vehicles because chicks typically leave the nest within a day after hatching and move extensively along the beach to feed. Typical behaviors of piping plover chicks increase their vulnerability to vehicles. Chicks frequently move between the upper berm or foredune and feeding habitat within the wrack line and intertidal zone. These movements place chicks in the paths of vehicles driving along the berm or through the intertidal zone. Chicks stand, walk, and run along tire ruts, and sometimes have difficulty crossing deep ruts or climbing out of them (Eddings *et al.*, 1990; Strauss, 1990; Howard *et al.*, 1993). Chicks sometimes stand motionless or crouch as vehicles pass by, or do not move quickly enough to get out of the way (Tull, 1984; Hoopes *et al.*, 1992; Goldin, 1993).

Vehicles also significantly degrade piping plover habitat or disrupt normal behavior patterns by crushing wrack into the sand and making it unavailable as cover or a foraging substrate (Hoopes, *et al.* 1992; Goldin, 1993). Additionally, vehicles create ruts that can trap or impede movements of chicks and may prevent plovers from using habitat that is otherwise suitable (MacIvor, 1990, Strauss, 1990; Hoopes *et al.*, 1992; Goldin, 1993; Hoopes, 1994). Vehicles that are driven too close to the toe of the dune may destroy vegetation that may also serve as piping plover habitat (Elias-Gerken, 1994).

While removal of human-created trash on the beach is desirable to reduce predation threats, the indiscriminate nature of mechanized beach-cleaning adversely affects piping plovers and their habitat. In addition to the danger of directly crushing piping plover nests and chicks and the prolonged disturbance from the machine's noise, this method of beach-cleaning removes the birds' natural wrack line feeding habitat (Eddings and Melvin, 1991; Howard *et al.*, 1993), and shell fragments, a preferred feature of nesting habitat.

(4) Habitat Loss and Degradation

While loss and degradation of habitat have been major contributors to the rangewide decline of the piping plover (U.S. Fish and Wildlife Service, 1996a), this threat is especially prominent 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," enjoy 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 that promote the formation of mature dunes, thus preventing overwash, inlet migration, and other natural coastal processes that create and maintain optimal plover habitat.

The beaches on the south shore of Long Island are affected by a variety of federal and non-federal management activities including inlet management, beach nourishment, dune construction, and dune

stabilization. There are six inlets stabilized by hard structures along the barrier chain system from Montauk Point west to East Rockaway Inlet. Within this stretch, multiple groin fields also exist. Gilgo Beach and Jones Beach on Jones Island, and Robert Moses State Park on Fire Island have been artificially nourished during the course of several Corps projects (see below). Dune construction and beach nourishment are implemented almost entirely to protect developments on the barrier island or mainland by reducing the potential for breaches and overwashes. Over the last 40 years, all major barrier island breaches have been artificially closed. Artificial plantings of American beachgrass and other species such as Japanese black pine, as well as the erection of snow fencing, are used to promote the formation of large, heavily vegetated dunes, thus reducing the potential for breaches and overwashes.

From 1986 to the present, the Corps has formally consulted with the Service's New York and Long Island Field Offices under the interagency ESA regulations for seven beach nourishment or navigation project activities between Jones Inlet and Montauk Point within the New York-New Jersey Recovery Unit. Biological Opinions (issuance date given in parentheses) were prepared for the following Corps projects:

(1) Shinnecock Inlet Reformulation Project (December 8, 1986);
(2) Fire Island Inlet and Shore Westerly to Jones Inlet Combined Navigation and Beach Erosion Control Project (May 1987);
(3) 30-year Westhampton Interim Storm Damage Protection Project (December 1994);
(4) 3-year Breach Contingency Plan (BCP) (July 1995);
(5) Fire Island Inlet and Shore Westerly to Jones Inlet Combined Navigation and Beach Erosion Control Project, Seabeach Amaranth Transplantation Program (May 1995);
(6) 15-year Shelter Island, New York, Erosion Control Project (June 1995; revised October 1997); and
(7) 6-year West of Shinnecock Interim Storm Damage Protection Project (Draft Biological Opinion August 1999; final Biological Opinion pending).

The Service has also conducted informal Section 7 consultations with the Corps for many projects in the New York portion of the New York-New Jersey Recovery Unit. Some recent examples are provided below. In the case of the navigation projects, these consultations are conducted consistent with the Corps channel maintenance schedule, or about every 2-3 years.

(1) Long Beach Island Beach Erosion Control (May 1994)
(2) Moriches Inlet Navigation Project (March 1996 and July 1998)
(3) Jones Inlet Jetty Rehabilitation Project (June 1995 and July 1998)
(4) Shinnecock Inlet Navigation Inlet Maintenance Dredging (July 1998)
(5) Fire Island Inlet and Shore Westerly to Jones Inlet Combined Navigation and Beach Erosion Control Project (June 1999)
(6) Coney Island

(7) East Rockaway Shore Protection Project
(8) Long Island Intracoastal Channel Project (May 2002)
(9) Atlantic Coast Monitoring Program (February 2002)

Of approximately 200 km (125 miles) of Atlantic coastline in New Jersey, stretching from Sandy Hook to Cape May, all but approximately 21 km (13 miles) are encompassed within a Corps beach nourishment project area. Shore protection projects within the New Jersey portion of the New York-New Jersey Recovery Unit for which the Service completed informal Section 7 consultation with the Corps for the initial phase of beach nourishment include the following:

(1) Sea Bright to North Asbury;
(2) Asbury Park to Manasquan Inlet;
(3) Manasquan Inlet to Barnegat Inlet;
(4) Barnegat Inlet to Little Egg Inlet;
(5) Brigantine Inlet to Great Egg Harbor Inlet;
(6) Great Egg Harbor and Peck Beach (Ocean City Beachfill);
(7) Great Egg Harbor Inlet to Townsends Inlet;
(8) Townsends Inlet to Cape May Inlet;
(9) Cape May Inlet to Lower Township (Cape May Beachfill);
(10) Lower Cape May Meadows to Cape May Point; and
(11) Delaware Bay Coastline.

In addition to the subject Project, the Service's New Jersey Field Office is currently conducting formal consultation with the Corps Philadelphia District regarding beach nourishment from Townsends Inlet to Hereford Inlet, and in Cape May City. In addition, the Service is aware of the following future Corps beach nourishment / renourishment projects in New Jersey that will require formal consultation (listed below with anticipated project start dates in parentheses):

(1) Lower Cape May Meadows and Cape May Point (2003);
(2) Brigantine (2003);
(3) Southern Ocean City and Sea Isle City (2004);
(4) Long Beach Island (2004);
(5) Manasquan Inlet to Barnegat Inlet (2005); and
(6) Great Egg Harbor Inlet to Townsends Inlet (2005).

Within the 21 km of New Jersey shoreline excluded from Corps nourishment programs, an approximately 900-meter-long section of Sandy Hook known as the Critical Zone is regularly renourished by the National Park Service (NPS). In May 2002, the NPS and the Service completed formal consultation for a planned September 2002 renourishment of the Critical Zone. Previous fills were conducted in 1977, 1982-83, 1989-90, 1996-97, and 1997-98 (National Park Service, 2001a); the NPS has consulted with the Service regarding past fill projects in accordance with the ESA. The NPS is currently preparing Biological and Environmental Assessments for a proposed long-term beach nourishment project. Known as the Sand Slurry Pipeline, this project would involve transport of sand from northern Sandy Hook to the Critical Zone on a regular schedule. The NPS and the Service are conducting informal consultation for the Sand Slurry Pipeline, and will proceed with formal consultation

as needed.

Authorized Corps navigation projects located within the New Jersey portion of the New York -New Jersey Recovery Unit include:

(1) Shark River Inlet;
(2) Manasquan Inlet;
(3) Barnegat Inlet; and
(4) Cape May and Ocean City.

The above consultations are a part of the many Section 7 consultations that the Service performs for federal agency actions and do not reflect those undertaken by the Corps pursuant to Section 10 of the Rivers and Harbors Act (30 Stat. 1151; 33 U.S.C. 403 *et seq.*) and Section 404 of the Clean Water Act (33 U.S.C. 1344 *et seq.*) for State, local, or private beach nourishment or dredging activities. Ultimately, 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 sparsely vegetated, low lying barrier beach habitats that are important to the piping plover. 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. The piping plover evolved in this highly dynamic ecosystem and has adapted to relocating nesting areas as natural coastal processes occur. As dune or back beach areas become established in accreting areas and vegetated through natural succession, these areas decline in suitability as piping plover habitat.

Throughout much of the New York-New Jersey Recovery Unit, periodic beach nourishment has interfered with natural coastal processes by precluding formation of newly forming inlets, overwash zones, and accreting beach habitats that would create, replace or revitalize piping plover nesting and foraging habitat.

e. Vulnerability to Extinction

The Atlantic Coast piping plover recovery plan (U.S. Fish and Wildlife Service, 1996a) provides a discussion of the demographic and genetic factors that were used to assess the species vulnerability to extinction. A population viability analysis was conducted to estimate probabilities of extinction, as well as probabilities that populations of various sizes and rates of fecundity would fall below thresholds of 50, 100, and 500 pairs during the next 100 years. The modeled scenario that most closely approximate the current status of the Atlantic Coast population (*i.e.*, 1,500 pairs with average productivity of 1.25 chicks per pair) showed an extinction probability of 31 percent over 100 years. In addition, the model showed a 92 percent probability of the population dropping below 500 pairs during the same period.

While the scenario described above is based on survival rates observed in a 1985-1989 Massachusetts

study, modeling also showed that even small drops in survival rates could very substantially increase the risk of extinction. Such long-term declines in survival rates could occur due to continuing declines in availability or quality of wintering or migration habitat, increased human disturbance on wintering grounds, increased mortality due to disease, parasites, or environmental contaminants, increased predation, or reduced longevity or fitness due to unforeseen genetic factors. When declines in adult and chick survival rates of just 5 percent and 10 percent, respectively, were modeled for a 1,500 pair population with average fecundity of 1.5 chicks per pair (far above the 1992-2001 average of 1.34 chicks per pair), the extinction probability increased from 9 percent to 40 percent, and the probability that population size would drop below 500 pairs increased from 44 percent to 97 percent.

The assessments of continuing vulnerability to extinction based on modeling, described above, are validated by empirical data from 1986-2001 coast-wide population and productivity monitoring. For example, the nearly flat population trend between 1995 to 1996, following 1995 productivity of 1.35 chicks per pair (well above the estimated rate needed to maintain a stationary population) and productivity of 1.47 and 1.56 chicks per pair in 1993 and 1994, respectively, suggest that survival rates may have been lower in 1995 and 1996 than in preceding years. While fluctuations in survival rates are to be expected, their occurrence provides vivid illustration of the inherent vulnerability of such small populations.

Another graphic demonstration of the Atlantic Coast piping plover's continued precarious status is provided by the population trend in New Jersey. A 44 percent population increase in the State population, from 93 pairs in 1987 to 137 pairs in 1992, was followed by a flat trend between 1993 and 1995. The New Jersey population then dropped precipitously over the next 2 years, returning to 1987 levels by 1998, when only 93 pairs were counted in the State. Despite the intensive protection efforts, productivity in the New York-New Jersey Recovery Unit since listing (1986 to 2001) has been below that needed to maintain a stationary population in all but 3 years.

The overall probability of extinction for the Atlantic Coast piping plover population is exacerbated by the fact that increases in productivity and abundance during the 1990s were largely attributable to the New England Recovery Unit (see Tables 2 and 3). In contrast, populations of the other three recovery units have leveled off or increased more slowly. Ten-year average productivity in New York-New Jersey and the Southern Recovery Units remains low (see Tables 2 and 3). The uneven distribution of population gains across recovery units increases overall vulnerability to catastrophes (such as oil spills or disease). It also leaves the population vulnerable if a hiatus in the occurrence of large storms should lead to a decline in habitat conditions in the New England portion of the range.

The New York-New Jersey Recovery Unit provides a vital link between the New England and Southern subpopulations. Available information demonstrates slow rates of dispersal between subpopulations (U.S. Fish and Wildlife Service, 1996a). Movements of birds (adults or chicks) between recovery units are few, and movement large enough to span the distance between non-adjacent recovery units has never been documented. Thus, loss or even near-extirpation of the New York-New Jersey Recovery Unit could acutely destabilize the population by isolating the Southern Recovery Unit, thereby forestalling exchange of breeding birds and genetic material across more than half the range of the Atlantic Coast population. Accessible overwash habitats are important to both the productivity and carrying capacity of plovers in the recovery unit.

Due to the scarcity of overwash habitats, systematically forestalling overwash formation in the New York-New Jersey Recovery Unit threatens the security of this subpopulation and the entire Atlantic Coast population.

2. Seabeach Amaranth

In 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).

a. Species Description

(1) Physical Description

Seabeach amaranth is an annual member of the Amaranth family (Amaranthaceae). Upon germination, the plant initially forms a small, unbranched sprig, but soon begins to branch profusely, forming 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 1.3 to 2.5 cm in diameter, and clustered towards the tip of the stem (Weakley and Bucher, 1992). The foliage of seabeach amaranth turns deep red in the fall (Snyder, 1996). Plants often grow to 30 cm in diameter, consisting of 5 to 20 branches, but occasionally reach 90 cm in diameter, with 100 or more branches. Flowers and fruits are inconspicuous, borne in clusters along the stems. Seeds are 2.5 millimeters (mm) in diameter, dark reddish-brown, and glossy, borne in low density, fleshy, indehiscent utricles (bladder-like seed capsules or fruits), 4 to 6 mm long (Weakley and Bucher, 1992). The seed does not fill the utricle, leaving an air-filled space (U.S. Fish and Wildlife Service, 1996b).

(2) Habitat

Seabeach amaranth is native to Atlantic coast barrier island beaches from Massachusetts to South Carolina. The species primary habitat consists of overwash flats at accreting ends of barrier islands, and lower foredunes and upper strands of non-eroding beaches. This species occasionally establishes small, temporary, and casual populations in secondary habitats including sound side beaches, blowouts in foredunes, and sand or shell dredge spoil or beach nourishment material (Weakley and Bucher, 1992).

Seabeach amaranth occupies a narrow beach zone that lies at elevations from 0.2 to 1.5 m above mean high tide, the lowest elevations at which vascular plants regularly occur. Seaward, the plant grows only above the high tide line, as it is intolerant of even occasional flooding during the growing season. Landward, seabeach amaranth does not occur more than a meter or so above the beach elevation on the foredune, or anywhere behind it, except in overwash areas. The species is, therefore, dependent on

a terrestrial, upper beach habitat that is not flooded during the growing season. This zone is absent on beaches that are experiencing high rates of erosion. Seabeach amaranth is never found on beaches where the foredune is scarped by undermining water at high or storm tides (Weakley and Bucher, 1992).

Seabeach amaranth usually occurs on a pure silica sand substrate, occasionally containing shell fragments. The U.S. Natural Resources Conservation Service classifies the habitat of seabeach amaranth as either Beach-Foredune Association or Beach (occasionally flooded). Seabeach amaranth habitat occurs within a wetland system classified by Cowardin *et. al.* (1979) as Marine System, Intertidal Subsystem, Unconsolidated Shore Class (Weakley and Bucher, 1992).

The habitat of seabeach amaranth is sparsely vegetated with annual herbs and, less commonly, perennial herbs (mostly grasses) and scattered shrubs. The number and type of seabeach amaranth's vegetative associates have been found to vary with specific habitat type (*i.e.*, overwash flat, accreting barrier island end, or lower foredune) (Chicone, undated). The most constant associates of seabeach amaranth, with which the species almost always co-occurs, are sea rocket (*Cakile edentula*) and seabeach spurge (*Chamaesyce polygonifolia*) (Weakley and Bucher, 1992). Known vegetative associates of seabeach amaranth by State are given in Table 5.

Seabeach amaranth does not occur on well-vegetated sites, 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 (*Ammophila* sp.) (U.S. Fish and Wildlife Service, 1996b). However, a positive correlation has been observed between seabeach amaranth and sea rocket, an annual (Hancock, 1995).

(3) Biogeography and Range

Seabeach amaranth is limited by its habitat requirements to a very narrow strip of barrier islands and mainland ocean front beach strands along the Atlantic coast. The original range of this species extended from Cape Cod in Massachusetts to central South Carolina, a stretch of coast approximately 1,600 km (994 miles) long. 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 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). Some authors have observed that seabeach amaranth tends to occur on south or southeast facing coasts (Weakley and Bucher, 1992; Snyder, 1996), but a range-wide analysis of beach orientation has not been conducted.

Seabeach amaranth is considered globally rare (G2) by the New Jersey Natural Heritage Program. Historic records of seabeach amaranth are known from nine States. Largely due to human activities, the species was eliminated from seven of these States by the 1980s, remaining only in North and South

Carolina. Seabeach amaranth is still considered extirpated from two States: Massachusetts and Rhode Island. Since 1990, the species has re-occupied five States from which it had previously been extirpated. Table 6 gives the dates of rediscovery and the last previously known occurrence of the plant in each State.

Table 5. Known Vegetative Associates of Seabeach Amaranth [1]

Carolinas (Weakley and Bucher, 1992)	sea rocket (*Cakile edentula*) seabeach spurge [seabeach sandmat, seaside sandmat] (*Chamaesyce* [*Euphorbia*] *polygonifolia*) beach elder (*Iva imbricata*) southern seabeach spurge [southern seabeach sandmat] (*Chamaesyce bombensis*) saltwort [common Russian thistle] (*Salsola tragus* [*australis*]) cordgrass (*Spartina patens*) sea oats (*Uniola paniculata*) bitter panic (*Panicum amarum*) shoreline seapurslane [sea-purslane] (*Sesuvium portulacastrum*) slender seapurslane [sea-purslane] (*Sesuvium maritimum*) seabeach orach [crested saltbush] (*Atriplex cristata* [*arenaria*]) seablite (*Suaeda linearis*) trailing wild bean [beach pea] (*Strophostyles helvula* [*helvola*]) beach morning glory (*Ipomoea imperati*) hog spurge (*Croton punctatus*) sand grass (*Triplasis purpurea*) American beachgrass [beach grass] (*Ammophila breviligulata*) seabeach knotweed [beach knotweed, seaside knotweed] (*Polygonum glaucum*)
Maryland (Ramsey *et al.*, 2000)	sea rocket American beachgrass beach clotbur [cocklebur] (*Xanthium echinatum*) seabeach spurge bitter panic seaside goldenrod (*Solidago sempervirens*)
Delaware (McAvoy, 2000)	American beachgrass sea rocket sanddune sandspur (*Cenchrus tribuloides*) seabeach spurge Russian thistle (*Salsola kali*) sand grass
New Jersey (Service observation and Snyder, pers. comm., 2000)	sea rocket seabeach spurge Russian thistle American beachgrass clotbur seaside goldenrod goosefoot (*Chenopodium* sp.) crab grass (*Digitaria sanguinalis*) sand grass seabeach sandwort [sea sandwort, sea-purselane] (*Honkenya [Honckenya, Arenaria] peploides*) seabeach orach wild bean (*Strophostyles* sp.) seabeach knotweed

[1] Common and scientific names were standardized using the Integrated Taxonomic Information System (http://www.itis.usda.gov/). Taxonomic synonyms, including those used in the source document, are provided in brackets.

New York (U.S. Fish and Wildlife Service, 1996b)	sea rocket seabeach spurge seabeach orach halberd-leaf orache [spear saltbush, spear saltweed, seabeach orach] (*Atriplex patula*) Russian thistle seabeach sandwort beach wormwood (*Artemisia stelleriana*) American beachgrass seabeach knotweed narrowleaf goosefoot (*Chenopodium berlandieri* var. macrocalycium) beach pea (*Lathyrus japonicus*)

Table 6. Re-colonization Dates of Seabeach Amaranth in Five States

State	Date Rediscovered	Date of Last Previously Known Occurrence
New York	July 1990	1950 (Van Schoik and Antenen, 1993)
New Jersey	July 2000	1913 (U.S. Fish and Wildlife Service, 1996b)
Delaware	August 2000	1875 (McAvoy, 2000)
Maryland	August 1998	1967 (Ramsey *et al.*, 2000)
Virginia	September 2001	1973 (U.S. Fish and Wildlife Service, 1996b)

To date, theories of seabeach amaranth's return to the northern part of its range remain speculative. Sites in these five States may have been re-colonized by long-distance transport of seeds by wind or currents. At some sites, seeds may have been long buried in sediments used in beach nourishment projects. This hypothesis requires that seeds can remain viable after prolonged off-shore burial, an unknown factor. In Maryland's Assateague Island National Seashore, the NPS has allowed a previously stabilized foredune system to return to more natural conditions. This change in beach management, and the possible existence of a persistent seed bank, have been cited as factors in the species return to the area (Ramsey *et al.*, 2000).

The current known range of naturally occurring seabeach amaranth is Water Mill Beach on Long Island, New York to Debidue Beach in South Carolina (Young, 2001; Hamilton, 2000a). In 1999, seed and cultivated plants were transplanted to several sites south of Debidue Beach by the South Carolina Department of Natural Resources as part of a restoration program. The southernmost site in the restoration program was at Pritchards Island, approximately 200 km (124 miles) southwest of Debidue Beach (Hamilton, 2000a; 2000b), but to date plants are known to persist from the transplanted seed/cultivars only as far south as Otter Island, roughly 130 km (81 miles) southwest of Debidue Beach.

b. Life History

(1) Life History Strategy

Seabeach amaranth occupies a highly specific and restricted niche as a "fugitive" species in the narrow upper beach zones of newly formed, accreting barrier island ends and non-eroding beach strands. A dynamic, early successional ("pioneer") species, seabeach amaranth is termed a "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). Seabeach amaranth acts as a capable sand binder (Weakley and Bucher, 1992); this also is typical of pioneer beach plants. The species is not likely to be a young or recently evolved species, considering its isolation within the genus (it has no apparently close relatives) and its possession of numerous adaptations to the peculiar environment in which it grows (U.S. Fish and Wildlife Service, 1996b).

Seabeach amaranth habitat exists in dynamic conditions. The same physical forces (*e.g.*, storms, extreme high tides) that create the plant's very specific and ephemeral coastal habitat also destroy it. Existing habitat is eroded away, but new habitat is created by island overwash and breaching. 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 as a "fugitive" species, occupying suitable habitat as it becomes available (U.S. Fish and Wildlife Service, 1996b).

(2) Density and Distribution

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 linear km of beach, though occasionally on accreting beaches, dense populations of 1,000 plants per km can be found. Island-end sand flats generally have higher densities than oceanfront beaches (Weakley and Bucher, 1992). Comparing overwash flats, accreting barrier island ends, and lower foredunes, Chicone (undated) found that seabeach amaranth plants growing in foredune habitats tended to be larger, healthier, and have fewer associates. Seabeach amaranth has been found to have a strongly contagious (clumped) distribution (Hancock, 1995).

Within its primary habitats, seabeach amaranth tends to be concentrated in the line of wrack material deposited by high tides (Mangels, 1991; Weakley and Bucher, 1992; Hancock, 1995; McAvoy, 2000). Anecdotal observations from New Jersey and Maryland suggest that plants within the wrack line tend to be larger (Service observation; Hudson, pers. comm., 2001). Pauley *et al.* (1999), however, found that plots centered on seabeach amaranth had a lower percent area covered by litter material than random plots, suggesting that litter material may be an advantageous microhabitat for seabeach amaranth only when it contains higher levels of organic material and moisture than bare sand, as in the wrack line.

(3) Life Cycle and Phenology

Seabeach amaranth is an annual species. Individual plants live only one season, with only a single opportunity to produce seed. The species over-winters 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, 1996b).

Seabeach amaranth seems capable of essentially indeterminate growth (Weakley and Bucher, 1992). However, 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).

(4) Reproduction

As an annual, seabeach amaranth reproduces solely by sexual reproduction by seed, with no vegetative or clonal form of reproduction. The species is monoecious (male and female flowers on the same plant), and, based on morphology of the flower and inflorescence, probably wind pollinated. Seabeach amaranth is capable of self fertilization, an advantageous adaptation for a pioneer species, allowing the founding of a new colony by a single propagule. Self fertilization likely plays a large, probably dominant, role in seed production (Weakley and Bucher, 1992).

Once past the juvenile stage, seabeach amaranth flowers and fruits continuously until death or senescence. Late-season plants may continue flowering and fruiting with few or no leaves, sometimes producing an aberrant, dense, terminal inflorescence (Weakley and Bucher, 1992). Even very small plants produce flowers under conditions of a short (12 hour) photoperiod (Jolls and Sellars, 2000), likely an opportunistic adaptation to permit small, late germinating plants to reproduce at the end of the growing season. Nearly all adult seabeach amaranth plants produce seeds, and fertility is assumed to be high (Weakley and Bucher, 1992). Fruit production is correlated with plant weight (Hancock, 1995), and large plants are estimated to produce several thousand fertile seeds over a fruiting season (Weakley and Bucher, 1992). Within the genus *Amaranthus*, this is a very low reproductive rate, but seabeach amaranth has apparently evolved a strategy of producing fewer, larger seeds than other members of its genus. Under favorable conditions, seabeach amaranth shows good reproductive success (Weakley and Bucher, 1992).

(5) Seed Dispersal

Seabeach amaranth seeds are dispersed by a variety of mechanisms involving transport via wind and water. The fleshy tissues and air pocket of the utricle cause the fruit to have a lower density than the bare seed. 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 South Carolina indicate that seabeach amaranth seeds are also dispersed in the guts of birds, and deposited with their droppings (Hamilton, 2000b).

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 rocket, and may be an adaptation to dynamic beach conditions. If conditions remain favorable at the site of the parent plant, the seed source for retention of that site is guaranteed. If conditions become unsuitable, other seeds have been dispersed to colonize new sites (Weakley and Bucher, 1992).

(6) Germination

Fresh seabeach amaranth seeds are physiologically dormant (Baskin and Baskin, 1994; 1998). The tough seedcoat requires some physical modification before germination can occur. The primary mechanism(s) for breaking seed dormancy in the field is not known, but possible factors include abrasion, cold, imbibing of water, and gradual breakdown over time (Weakley and Bucher, 1992; Hamilton, 2000c; Jolls and Sellars, 2000; Hancock, 1995; Baskin and Baskin, 1994; 1998). Once dormancy is broken, light and high temperatures (25-35E C) are required for germination (Hancock, 1995; Baskin and Baskin, 1994; 1998). This high temperature requirement causes seabeach amaranth to germinate later in the season than other dune associates, and limits the time in which new seedlings can offset population mortality. Rainfall is also significant in promoting germination (Hancock, 1995).

Initial studies have found that seabeach amaranth seedlings cannot emerge from a depth of more than 1 cm (Hancock, 1995) or 2 cm (Jolls, pers. comm., 2000). Deeper (6 cm) burial suppresses germination and delays emergence (Jolls, et al., 2001). Results of these studies, combined with the finding that light is required for germination, are strong evidence that deep burial may completely prevent germination and seedling emergence. Seabeach amaranth may have less opportunity to emerge and become established compared to other dune species such as sea rocket, as mean emergence of seedlings (growth rate of the newly sprouted seed) is less than predicted for the species seed mass (Hancock, 1995).

(7) Natural Limiting Factors

Except where suitable habitat has persisted long enough for perennials to become established, the primary limiting factors of seabeach amaranth under natural conditions are abiotic. Abiotic limiting factors are expected for a fugitive species that occupies dynamic, early successional habitats. Weather is an important limiting factor, given the relatively narrow temperature and rainfall requirements for germination and seedling establishment. Flooding, drought, or unseasonable temperatures may impair seabeach amaranth survival and reproduction. Weather also limits abundance of the species through its effects on winds, which may cause burial of seeds and plants by sand. In addition to decreasing

germination and seedling establishment, burial may also impact reproduction by covering adult plants prior to seed set. This effect was observed in South Carolina (Hamilton, 2000b), and may have occurred in New Jersey (Service observation) and Maryland (Hudson, pers. comm., 2001).

Coastal storms are probably the single most important natural limitation on the abundance of seabeach amaranth. Storms erode habitat and curtail the reproductive season due to flooding and overwash. However, storm events also permit the species to survive by creating new habitat, and by providing long-distance seed transport. Through these combined effects, storms largely determine the distribution of the species in the landscape. A patchy distribution may itself limit the abundance of seabeach amaranth; colonization of suitable habitats is hampered by long distances to the nearest seed source (Weakley and Bucher, 1992).

Under natural conditions, interspecific competition for water and nutrients, especially with perennials, is perhaps the only significant biotic limiting factor of seabeach amaranth. Weakley and Bucher (1992) cite intraspecific competition as a possible factor in the mortality of young plants, but Hancock (1995) found no evidence of intraspecific density effects. If intraspecific competition does limit seabeach amaranth abundance, its effects are likely small compared to the effects of competition with perennial species, which possess superior abilities to extract water and nutrients from the porous sand. Predators and disease are discussed below under threats.

c. Population Dynamics

(1) Demography

Although the longevity of seabeach amaranth seeds is unknown, several lines of evidence suggest that seed banks may be an important factor in this species life history (Weakley and Bucher, 1992; Baskin and Baskin, 1998). The relative roles of fresh and banked seeds are unknown (U.S. Fish and Wildlife Service, 1996b). In experimental plots in Maryland, a few late-season seedlings emerged from the current year's seed crop (Hudson, pers. comm., 2001), however the contribution of same-season seed to the current year's population and seed crop is likely small.

For a sexually reproducing annual plant, natality is comprised of two components, the seed production rate (or fecundity) and the germination rate. Fecundity of seabeach amaranth under favorable conditions is generally considered high overall (thousands of seeds for a large plant), although reliable means of measuring this parameter in the field have yet to be developed (Jolls and Sellars, 2000). Based upon several laboratory studies, germination rates under favorable conditions are also high, 75-100 percent (Weakley and Bucher, 1992; Hancock, 1995; Jolls and Sellers, 2000; Baskin and Baskin, 1994; 1998).

Mortality rates of both fresh and banked seeds are unknown. More is known about mortality of the plants. Substantial mortality of young plants occurs in some years, prior to reproduction. Storm effects

(*i.e.* flooding, overwash, erosion) during the early growing season or unfavorable weather conditions, such as drought, can substantially reduce survival to reproductive age (Weakley and Bucher, 1992). Hancock (1995) found only 7 percent survival of seedlings to 40 days of age, with mortality caused primarily by high tide flooding. Flooding resulted in almost 100 percent mortality of propagated plants at three of six experimental transplant sites in South Carolina in 1999. At a fourth site, drifting sand covered most of the transplants, with only 10 of 196 plants (about 5 percent) surviving to produce seed (Hamilton, 2000b). Burial by blowing sand may have also affected reproduction in New Jersey and Maryland in 2000 (Service observation; Hudson, pers. comm., 2001). Unfavorable conditions early in the growing season, including drought, burial, and especially flooding and other storm damage, may reduce seed production by 90 percent (Weakley and Bucher, 1992) to 98 percent (Hancock, 1995).

Once past the stage of germination and early growth, mortality rates are generally lower. In the Carolinas, mortality of older plants tends to be caused primarily by webworm predation (Weakley and Bucher, 1992). Larger plants may be able to withstand saltwater inundation better than smaller plants; however, prolonged salt water inundation kills almost all plants, regardless of size (Hancock, 1995). Storms later in the growing season can effectively and abruptly curtail reproduction for the year (Weakley and Bucher, 1992). Plants that have not died from other causes senesce and die in late fall or early winter.

(2) Genetic Variability

Preliminary results from two initial genetic studies of seabeach amaranth suggest that the species genetic variability is low. A study by Hunter (pers. comm., 2001; Hudson, pers. comm., 2001) looked for genetic differences in nuclear DNA within and across three groups: propagated plants from Maryland, wild plants from Maryland, and wild plants from Delaware. Overall, genetic variability was found to be low. Wild and propagated Maryland plants were similar, as might be expected, since the propagated plants were produced from wild plants taken from the same area. Higher levels of genetic variability were found within the sample of plants from Delaware. A second study by Strand (pers. comm., 2000) analyzed non-coding regions of nuclear and chloroplast DNA taken from seed and dry leaf samples from New York, New Jersey, North Carolina, and South Carolina. To date, this study has found no observable genetic variation among any of the samples. Although the results of these two studies are consistent, these results must be interpreted with caution. Lack of detection does not prove a lack of genetic variability, which might be present in other regions of the genome, or detectable through other techniques (Jolls and Sellars, 2000; Jolls, pers. comm., 2000; Strand, pers. comm., 2000).

(3) Population Size and Variability

As might be expected for a fugitive annual plant of dynamic barrier beach habitats, populations of seabeach amaranth at any given site are extremely variable (Weakley and Bucher, 1992). Population size at a site often fluctuates by several orders of magnitude from year to year. 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.

Because variability is so great, a single survey is a poor measure of a population's health. Assessing site-specific population trends is difficult even with several years of surveys. Weakley and Bucher (1992) suggest that a 5-10 year average is a more meaningful measure for assessing the vigor of a local seabeach amaranth population. However long-term, consecutive, annual data are available for only a few sites in New York. Estimates of aggregated population sizes for seabeach amaranth across its range are imprecise given available survey data. Early (pre-1987) survey data are limited. Range-wide surveys were conducted in 1987, 1988, and 1990 (excluding States where the species was considered extirpated at the time). Annual State-wide surveys have been conducted subsequently in New York, but no comprehensive surveys of North or South Carolina have been carried out since 1990. Suitable areas in New Jersey, Delaware, and Maryland were thoroughly surveyed in 2000, but these efforts did not necessarily extend State-wide. Approximately 14 locations in Virginia were surveyed in 2000. No seabeach amaranth was found (Belden, 2000; pers. comm., 2001). In 2001, seabeach amaranth was found on Assateague Island Virginia, most likely the result of a restoration program in Assateague Island National Seashore in Maryland (Davis, pers. comm., 2001). No recent surveys are known from Massachusetts or Rhode Island.

Table 7 presents the number of known extant sites and total plants from 1987 to 2000. The level of survey effort (number of sites surveyed) varied widely from year to year. Timing of surveys and survey methodologies were likewise variable from site to site and year to year. The estimated total number of seabeach amaranth plants in 2000 was approximately 140,000 at 39 sites. This figure is almost certainly an underestimate, because many known sites were not surveyed. In 2000, only 30 of 41 known sites were surveyed in North Carolina, and only 3 of 16 known sites were surveyed in South Carolina.

The term "extant" as used in Table 7 refers to a site or "population" with at least 1 plant documented during the growing season. Sites are not included in this total if they were not surveyed during a given year, or if they were surveyed but no plants were found. This later category is not necessarily considered extirpated. Because of natural population fluctuations, populations are not considered extirpated until several consecutive years of negative surveys and/or the habitat becomes strongly unsuitable.

The 2000 population of seabeach amaranth had an uneven geographic distribution, with almost 99 percent of the plants located on Long Island, New York. A single site on Long Beach Island, New York comprised 75 percent of the total plants range-wide. Of the 39 extant sites documented in 2000, 11 had 100 or more plants (7 in New York, 2 in New Jersey, and 2 in North Carolina), and 4 had 1,000 or more plants (all in New York). Seventeen sites had fewer than 10 plants (3 in New York, 1 in Maryland, 11 in North Carolina, and 2 in South Carolina) (Young, 2001; McAvoy, 2000; Hudson, pers. comm., 2001; National Park Service 2001a; 2001b; Jolls and Sellars, 2000; U.S. Army Corps of Engineers, 2001c; Hamilton, 2000a).

Table 7. Number of Documented Extant Seabeach Amaranth Sites [a] and Total Plants, 1987-2000

		1987	1988	1990	1991	1992	1993	1994	1995	1996 [b]	1997 [b]	1998 [b]	1999 [b]	2000 [b]
New York [c]	# sites surveyed			10	12	12	18	14	18	12	16	22	22	19
	# extant sites			10	10	9	9	9	6	7	11	11	12	13
	total # plants			331	2,100	422	195	182	599	2,263	7,990	8,599	19,150	138,600
New Jersey [d]	# sites surveyed									15			3	8
	# extant sites									0			0	4
	total # plants									0			0	1,019
Delaware [e]	# sites surveyed													2
	# extant sites													2
	total # plants													41
Maryland [f]	# sites surveyed											1	1	1
	# extant sites											1	1	1
	total # plants											2	1	4
North Carolina [g]	# sites surveyed	35	40	40	4	14	21	20	21	19	21	20	29	30
	# extant sites	26	36	33	4	13	20	17	18	16	15	17	16	18
	total # plants	10,399	41,851	10,780	1,506	26,588	17,016	10,673	39,457	7,769	973	13,430	739	381
South Carolina [h]	# sites surveyed	17	16	17					1		1	6	2	3
	# extant sites	12	8	9					1		1	56	0	2
	total # plants	1,341	1,800	188					84		77	406	0	4
TOTAL	# sites surveyed	52	56	67	16	26	39	34	40	46	38	50	57	77 [i]
	# extant sites	38	44	52	14	22	29	26	25	23	27	35	29	40
	total # plants	11,740	43,651	11,299	3,606	27,010	17,211	10,855	10,140	10,032	9,040	22,437	19,890	140,049

Table 7 (Continued)

[a] Sites are considered extant if at least 1 plant was documented during the growing season.

[b] Figures for these years include early season survey data from North Carolina. At some sites, substantial decreases in population sizes were noted later in the season, particularly following storms.

[c] Young, 2001.

[d] 1996 data from Snyder, 1996. 1999 surveys conducted by the Service's New Jersey Field Office (NJFO) at Sandy Hook North Beach, Sea Bright North, and Monmouth Beach (which extends a short distance into southern Sea Bright). 2000 data collected during August 2000 surveys by the NJFO and the U.S. Army Corps of Engineers, New York District. Four extant sites are Sandy Hook Gunnison, Sandy Hook South Beaches, Sea Bright North, and Monmouth Beach. Plants were actually found in a nearly continuous distribution across these sites [a stretch of about 15 km (9.3 miles)], interrupted by areas of heavy recreational use or mechanical beach raking. A significant drop in numbers of plants was anecdotally observed in early September 2000; many plants appeared to have been covered by blowing sand. Four additional sites were also surveyed in late August and September by the NJFO, but no plants were found: Sandy Hook North Beach/USCG, Long Beach Island (Barnegat Light to Surf City), Holgate (in the Edwin B. Forsythe National Wildlife Refuge), and Ocean City. Nine new sites were discovered during a 2001 State-wide survey, extending the species range in New Jersey into three new counties, a total of approximately 140 km (90 miles) south.

[e] McAvoy, 2000. Two sites are Delaware Seashore and Fenwick Island State Parks, although the source indicates a fairly continuous distribution of plants across the two sites [a stretch of about 22 km (13.7 miles)].

[f] Hudson, pers. comm., 2001. All plants were found in Assateague Island National Seashore. Figures do not include approximately 1,156 cultivated plants transplanted in experimental plots in 2000.

[g] 1987-1990 data from Weakley and Bucher, 1992. 1991-1995 data from Jolls and Sellars, 2000. 1996-2000 data from National Park Service, 2001a; National Park Service, 2001b; Jolls and Sellars, 2000; and U.S. Army Corps of Engineers, 2001c. In a few cases, the last two sources reported different numbers for the same site, probably due to differences in survey dates. The higher of the two numbers was used.

[h] 1987-1990 data from Weakley and Bucher, 1992. 1995-2000 data from Hamilton, 2000a; Chicone, undated; and Pauley *et al.*, 1999. Where different numbers were reported for the same site, the highest figure was used. Figures do not include 4,033 cultivated plants transplanted in experimental plots in 1999 and 2000, or 54 plants that germinated in 1999 and 2000 from 26,000 seeds sown at 6 experimental sites in 1999.

[i] Includes 14 sites surveyed in Virginia: The Nature Conservancy's Virginia Coast Reserve (11 sites on 7 barrier islands), Fisherman's Island National Wildlife Refuge, Eastern Shore of Virginia National Wildlife Refuge, and the Virginia portion of Assateague Island National Seashore. No seabeach amaranth was found in Virginia (Belden, 2000; pers. comm., 2001). The species was found in the Virginia portion of Assateague Island in 2001, most likely a result of the NPS seabeach amaranth restoration in Assateague Island National Seashore, Maryland (Davis, pers. comm., 2001).

d. Status and Distribution

(1) Reasons for Listing and Continuing Threats

(i) 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 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 in the landscape. In the geologic past, 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, 1996b).

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. When the shoreline is "hardened" by artificial structures (*e.g.* seawalls, 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 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). Any stabilization of the shoreline is generally detrimental to a pioneer, upper beach annual, whose niche or "life strategy" is the colonization of unstable, unvegetated, new land, and which is unable to compete with perennial grasses (U.S. Fish and Wildlife Service, 1996b).

Attempts to halt beach erosion through hard structures (*i.e.*, sea walls, jetties, groins, bulkheads) appear invariably to destroy habitat for seabeach amaranth. In the Carolinas, seabeach amaranth is not found on shorelines where bulkheads, sea walls, or riprap zones have been constructed. Such armoring generally occurs in the primary habitat of the plant, and water and wind erosion lower the profile of the beach seaward of the armoring. The upper beach habitat required by seabeach amaranth (above inundation by tidal action) ceases to exist as the beach is steadily eroded. Groins have mixed effects on seabeach amaranth. Immediately upstream from a groin, accretion sometimes provides or maintains, at least temporarily, habitat for seabeach amaranth; immediately downstream, erosion usually destroys seabeach amaranth habitat. In the long term, groins (if they are successful) stabilize upstream beaches, allowing succession to perennials, and rendering even the upstream side only marginally suitable for seabeach amaranth. Widespread construction of sea walls, jetties, and other hard stabilization

structures in New Jersey, New York, and other northern States is associated with the extirpation of seabeach amaranth from the northern part of its range during the first part of the 20th Century (U.S. Fish and Wildlife Service, 1996b).

Even minor structures and non-structural beach stabilization techniques, such as sand fences and beach grass planting, are generally detrimental to seabeach amaranth (U.S. Fish and Wildlife Service, 1993). Dune stabilization and vertical sand accretion caused by sand fences appear to be detrimental to seabeach amaranth and contradictory to its life history strategy. The effects of dune stabilization by planting vegetation are similar (U.S. Fish and Wildlife Service, 1996b). 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 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 re-applications of fill material (U.S. Fish and Wildlife Service, 1993). However, on the landscape level, beach nourishment is similar to other beach stabilization efforts in that it stabilizes the shoreline and curtails the natural geophysical processes of barrier islands. These effects are detrimental to the range-wide persistence of the species. In addition, beach nourishment may cause site-specific adverse effects by crushing or burying seeds or plants, or by altering the beach profile or upper beach micro-habitats in ways not conducive to seabeach amaranth colonization or survival. Deeply burying seeds during any season can have serious effects on populations; this also applies to the placement of dredge spoil (U.S. Fish and Wildlife Service, 1996b). Burial of the seed bank may be particularly detrimental 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 stabilization with sand fencing and/or beach grass, or if followed by high levels of erosion and scarping of the upper beach.

As a fugitive species dependent on a dynamic landscape and large-scale geophysical processes, seabeach amaranth is vulnerable to habitat fragmentation and isolation of small populations (U.S. Fish and Wildlife Service, 1993). Rendering 50 to 75 percent of a coastline “permanently” unsuitable may doom seabeach amaranth, 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 reestablish itself when the area once again provides suitable habitat. In this way, the species can be progressively 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. Areas of suitable habitat were separated from one another by distances too great to allow re-colonization following natural catastrophes (Weakley and Bucher, 1992).

As noted under the discussion of piping plover species status, New York and New Jersey beaches have been especially affected by past and ongoing habitat modification. New Jersey 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"), New Jersey, America's oldest developed shoreline, is 43 percent hard-stabilized (Pilkey and Wright, undated *in* U.S. Fish and Wildlife Service, 1996b). Although construction of new hard stabilization structures has slowed, the Shore Protection Master Plan documents the State's intent to maintain existing functional structures in many parts of New Jersey.

In addition, almost the entire ocean-front coastline of New Jersey, and much of New York, is included in current or proposed beach nourishment programs (see lists of projects under the piping plover section). Cumulatively, these nourishment projects significantly contribute to continued stabilization of the New York-New Jersey shoreline. In addition, multiple, simultaneous habitat disturbances increase the vulnerability of seabeach amaranth to declining habitat conditions, and to catastrophic events. The extreme degree of shoreline stabilization in New York and New Jersey, and the large-scale, long-term current and proposed beach nourishment programs designed to maintain the *status quo*, are particularly important given the recent seabeach amaranth population shift from south to north, discussed further below.

(ii) Recreational Impacts

Intensive recreational use of beaches can threaten seabeach amaranth populations, both through direct damage and mortality of plants, and by impacting habitat. 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 which receive heavy recreational use. In such areas, seabeach amaranth populations are sometimes eliminated or reduced by repeated trampling. While pedestrian traffic appears to be a minor problem in the Carolinas, the heavier traffic borne by northern beaches near major population centers may have been partially responsible for the past extirpation of seabeach amaranth in those regions (U.S. Fish and Wildlife Service, 1996b).

Off-road vehicle (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 easily broken. Plants generally do not survive even a single pass by a truck tire (Weakley and Bucher, 1992). Sites where vehicles are allowed to run over seabeach amaranth plants often show severe population declines. Dormant season ORV use 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 compete successfully. Extremely heavy ORV use, even in winter, may have some negative impacts, however, 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, which remove trash and vegetation from bathing beaches, do not allow seabeach amaranth to colonize long stretches of beach (U.S. Fish and Wildlife Service, 1996b). In New Jersey, plants were found along a nearly continuous length of beach, noticeably interrupted by stretches that are routinely raked.

(iii) 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 the Carolinas, four species of webworm collected from seabeach amaranth have been identified: beet webworm (*Loxostege similialis*), garden webworm (*Achyra rantalis*), southern beet webworm (*Herpetogramma bipunctalis*), and Hawaiian beet webworm (*Spoladea recurvalis*). In New York, herbivory by saltmarsh caterpillars (*Estigmene acraea*) has been observed (U.S. Fish and Wildlife Service, 1996b). Webworm herbivory of seabeach amaranth has not been documented in Delaware or Maryland.

Although the five webworms so far identified on seabeach amaranth are all native species, their use of barrier islands has probably been altered by changes in the coastal plain landscape (*i.e.*, extensive agricultural use), the development of barrier islands, and the introduction of weedy plants that can also serve as host plants. All five webworms are "weedy" species, probably much more abundant now than they were in pre-Columbian times. For this reason, the level of predation that seabeach amaranth is experiencing is likely unnaturally high (U.S. Fish and Wildlife Service, 1996b). Webworm herbivory is probably a contributing, rather than a leading factor in the decline of seabeach amaranth. However, in combination with extensive habitat alteration, severe herbivory could threaten the existence of the species (Weakley and Bucher, 1992).

(iv) 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, 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 the development of genetically altered, domesticated varieties are potential, but currently unrealized, threats to the species (U.S. Fish and Wildlife Service, 1993).

(2) New Threats

New threats 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 deer (*Odocoileus virginianus*), rabbits (*Sylvilagus floridanus*), and migratory song birds (Van Schoik and Antenen, 1993), as well as feral horses in Maryland (Hudson, pers. comm., 2001). Hancock (1995) suggests that grasshoppers may feed on seabeach amaranth, but does not indicate whether this was actually observed. Hamilton (pers. comm., 2001) observed strong circumstantial evidence for seabeach amaranth herbivory by grasshoppers. Minor insect damage was noted on a few New Jersey plants in 2000, and larval insects were observed feeding on seabeach amaranth in 2001; to date, no species have been identified. In addition, a cluster of New Jersey plants appeared to have been damaged by a congregation of loafing gulls (*Larus* spp.), based upon feathers and droppings. As with webworms, the abundance of these newly documented predators on barrier islands is increased by human activities.

Asiatic sand sedge (*Carex kobomugi*) has been suggested as another potential threat to seabeach amaranth. This sedge is strongly rhizomatous and dune-forming (National Park Service and Maryland Natural Heritage Program, 2000). Asiatic sand sedge was introduced to the east coast (New Jersey to Virginia) from east Asia in the 1930s for erosion control and as a sand stabilizer. The species is known to crowd out native dune species (Virginia Department of Conservation and Recreation and Virginia Native Plant Society, undated). Asiatic sand sedge may be detrimental to seabeach amaranth by direct competition, and by reducing habitat suitability through sand stabilization and dune building.

The first known disease of seabeach amaranth was documented in South Carolina in 2000. During the 2000 growing season, an oomycete (*Albugo* sp.) was observed on seabeach amaranth in several South Carolina sites (Strand and Hamilton, 2000). This pathogen is a white rust or water mold. Lesions developed on the leaves during flowering, starting in July; leaves later fell off (Hamilton, pers. comm., 2001). Effects on infected individuals were significant, resulting in death of the plants 2-4 weeks after lesions were first observed. Anecdotal observations suggest that isolated plants tended to avoid infection (Strand and Hamilton, 2000).

(3) Rangewide Trends

Based on limited data from previous years, 1988 was a highly productive year for seabeach amaranth, and 1989 also began with favorable conditions for the species. Several coastal storms later in 1989 and 1990 caused severe erosion in the Carolinas. Subsequent dune reconstruction and bulldozing caused further damage in some areas (Weakley and Bucher, 1992). These storms may have also been responsible for the transport of seabeach amaranth to New York (U.S. Fish and Wildlife Service, 1993). Due to storm effects (erosion, reconstruction activities, and a curtailed reproductive season due

to flooding and overwash), an approximate 75 percent decrease in population numbers occurred in 1990, even with new sites established in New York (see Table 7). Results from 1991 should be discounted because survey efforts were low in the Carolinas. Total population numbers rebounded in 1992, decreased in 1993, then leveled off at approximately 10,000 plants from 1994 through 1997. This population size is only about 23 percent of the 1988 peak, but is only slightly lower than 1987, which was considered a reasonably productive year (Weakley and Bucher, 1992). Population sizes from 1994 to 1997 reflect increasing survey efforts in New York, almost no surveys of South Carolina, and surveys of only about half of the known North Carolina sites. Despite documented storm losses in North Carolina in 1998 and 1999, a large range-wide population increase occurred in the 3-year period from 1998 to 2000. The 2000 population was more than 300 percent above the earlier 1988 peak. Somewhat increased survey efforts for the period 1998-2000 do not account for the tremendous population increase relative to previous years.

Total population trends can disguise important regional trends. Recent population increases have occurred entirely in the northern part of the species range (see Table 7). Seabeach amaranth has undergone a geographic expansion, reappearing in five States over 11 years, after decades of extirpation from the entire northern portion of its range. New York sites account for virtually all of the recent increases in total population size rangewide, offsetting low numbers in the south. Although natural population variability and survey effort must be considered, the recent trend in North Carolina is clearly downward. The low 1999 and 2000 plant totals in that State are especially noteworthy given the relatively high survey effort in these years (approximately 75 percent of known sites visited). The 1999-2000 average of 560 total plants is only about 1 percent of the 1988 peak for North Carolina, and only about 3 percent of the 1987-1998 State-wide average (excluding 1989 and 1991 because of insufficient data). The current status of seabeach amaranth in South Carolina is virtually unknown. The species experienced a 90 percent reduction in that State following 1988 storms, including Hurricane Hugo. However, spotty survey efforts in 1998 suggest that populations may have recovered in some areas of South Carolina.

The number of known, extant sites increased from 1987 to 1988 under favorable conditions in the Carolinas. Despite storm losses, the number of extant sites reached a peak of 52 in 1990, due to the species appearance in New York and a high level of survey effort in the Carolinas. The number of sites dropped off in 1992 and remained in the 20s through 1997, probably due to minimal survey effort in South Carolina. Numbers of sites rose in 1998 and 2000 because of a slightly higher survey effort in South Carolina, and expansion of the species into three new States.

Historically, seabeach amaranth was known from 31 counties in 9 States (U.S. Fish and Wildlife Service, 1993). Weakley and Bucher (1992) show 27 counties in the species historic range. Of these, 14 counties in 3 States had extant populations based upon 1987-1990 surveys. Based upon 1998-2001 surveys, at least 19 counties in 7 States have extant populations of seabeach amaranth. Despite the natural variability of seabeach amaranth's population size and distribution and inconsistent survey efforts, some trends can be discerned from the available data. The species has undergone a

significant geographic expansion, both in terms of the number and distribution of occupied States and counties, and, if the lack of surveys in South Carolina are considered, in terms of number of extant sites. Since the first intensive surveys in 1987, the species extant range has increased approximately 650 km (404 miles) to the north, but contracted about 50 km (31 miles) to the south. Numerically, the population has seen a dramatic increase. Equally notable is the geographic shift of the species "stronghold" (in terms of total numbers) from North Carolina to New York.

Despite the geographic expansion and booming New York populations, seabeach amaranth is still vulnerable to local and regional extinction. The primary threat to seabeach amaranth, altered habitat, has not significantly diminished since the species was listed, and new threats have been subsequently discovered. Small population sizes in many locations increase the risk that seabeach amaranth will become locally extirpated. Almost 44 percent of sites documented in 2000 contained fewer than 10 plants, including more than 60 percent of sites in North Carolina (Young, 2001; McAvoy, 2000; Hudson, pers. comm., 2001; National Park Service 2001a; 2001b; Jolls and Sellars, 2000; U.S. Army Corps of Engineers, 2001c; Hamilton, 2000a). The uneven distribution of numbers of plants across the current known range leaves seabeach amaranth vulnerable to catastrophic events (*i.e.*, storms, oil spills, disease). In addition, the shift of the species numerical stronghold from south to north places great importance on its continued survival on northern beaches, which are more stabilized and developed, and experience more intensive recreational use, than southern beaches.

One final trend of note is the propagation of seabeach amaranth in greenhouses and laboratories, and the transplanting of propagated individuals or seed back into the wild. Such programs have been undertaken in Delaware, Maryland, North Carolina, and South Carolina (McAvoy, 2000; National Park Service and Maryland Natural Heritage Program, 2000; Jolls and Sellars, 2000; and Hamilton, 2000b).

C. ENVIRONMENTAL BASELINE

1. Species Status Within the Action Area

a. Piping Plover

Prior to initial beach nourishment in 1994, no piping plovers were known to nest within the Project area for at least a decade (Jenkins, pers. comm., 2000). Subsequent to the completion of Contracts 1A and 1B in Section I, piping plovers have nested in Sea Bright and Monmouth Beach each year since 1997, often in the vicinity of least tern (*Sterna antillarum*) colonies. The first nesting attempt, in 1997, was unsuccessful, but productivity from 1998 through 2000 was strong, surpassing State-wide and range-wide averages, as well as the recovery goal of 1.5 chicks per pair. Although reproductive success was high all three years, it declined each year, and, based on preliminary data, fell further in 2001, dropping below the recovery goal for the first time. Summary piping plover nesting data from the Project area, 1997 to 2000, are shown in Table 8, and preliminary data for the 2001 nesting season are shown in Table 9.

Piping plover nesting areas are not evenly distributed within the Project area. From 1997 through 2001, plover nesting areas were clustered in the two northern municipalities. Within Sea Bright and Monmouth Beach, nests have been clustered in areas away from beach clubs and life-guarded bathing beaches. The locations of piping plover nests from 1999 to 2001 are shown in Figure 9. In 2002, the northern Sea Bright nesting area expanded considerably northward, with plover breeding activity observed all the way to the Sandy Hook border. Also in 2002, piping plovers initiated nesting at the National Guard Training Center in Sea Girt, at the southern end of the Project area (Ariante, pers. comm., 2002). A plover had been observed scraping at this site in 2000, and least terns nested at the northern end of the National Guard property in 2001 and 2002 (U.S. Fish and Wildlife Service, 2001b; Ariante, pers. comm., 2002).

Sandy Hook nesting areas are critical to New Jersey's piping plover population, providing habitat for approximately one-third of the State's total nesting pairs. Sandy Hook piping plover nesting data from 1990 to 2000 are presented in Table 10.

b. Seabeach Amaranth

In July 2000, seabeach amaranth was discovered within the Project area, in Sea Bright and Monmouth Beach. Previously considered extirpated from the State, the species was last observed in New Jersey in 1913, and in Monmouth County in 1899. Seabeach amaranth surveys were conducted on August 15 and 22, 2000. Approximately 900 plants were documented at two sites. Approximately 120 additional plants were found on Sandy Hook during separate surveys by NPS staff (McArthur, pers. comm., 2000). In 2001, seabeach amaranth surveys of the Project area were conducted between August 15 and 17. Approximately 5,200 plants were documented at seven sites. Approximately 560 additional plants were found on Sandy Hook (Lane, pers. comm., 2001). The distribution of seabeach

amaranth and plant numbers within the Project area for 2000 and 2001 are shown in Figure 9 and Table 11, respectively.

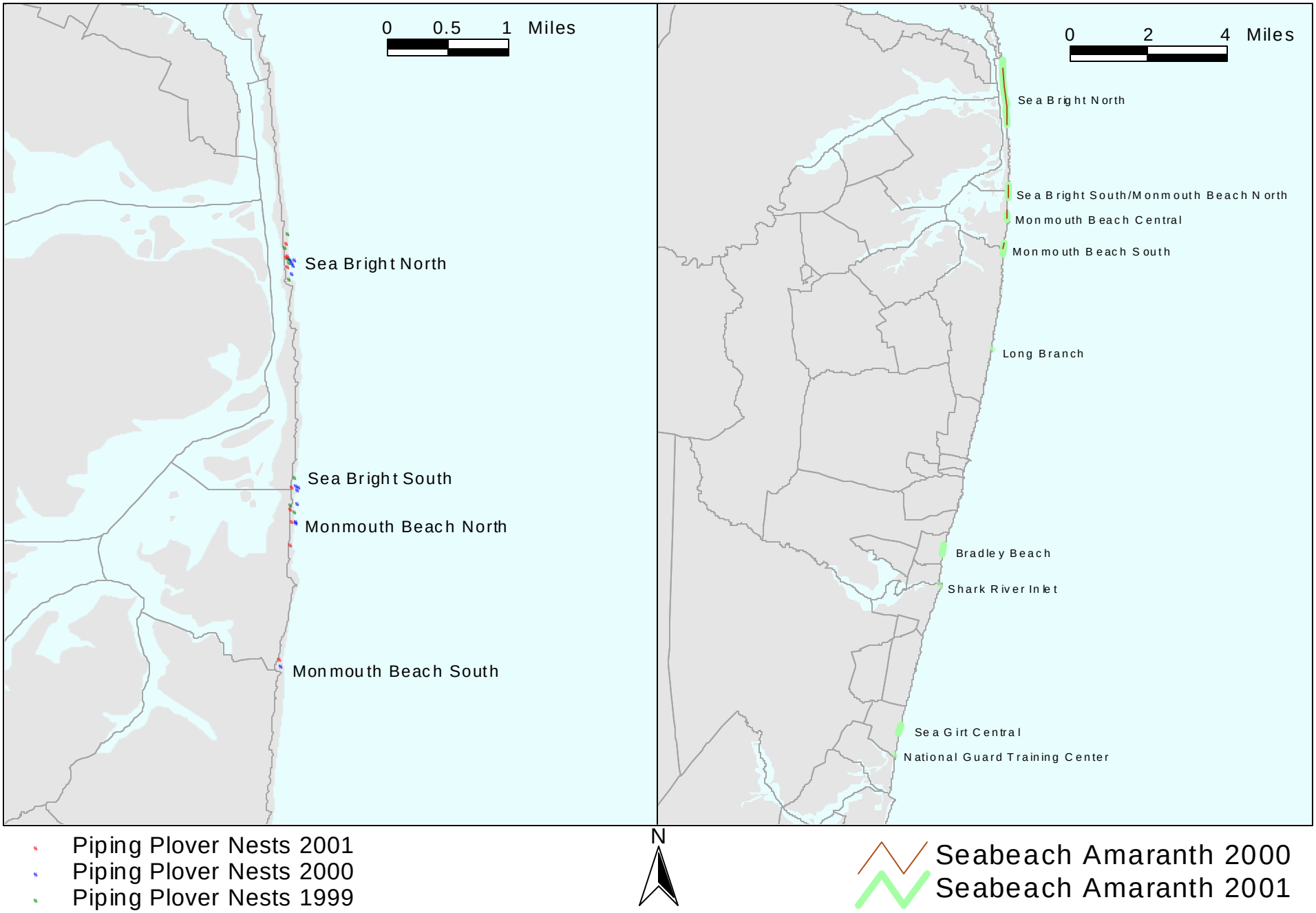

Figure 9. Locations of Piping Plover Nests and Seabeach Amaranth Within the Project Area, 1999-2001

Table 8. Piping Plover Nesting Summary Within the Project Area, 1997-2000

Location [1]	Year	Number Pairs	Number Pairs Hatching Chicks	Number Pairs Fledging Chicks	Number Nests Attempted	Number Nests Hatched	Total Eggs Laid	Number Chicks Hatched	Number Chicks Fledged	Fledge Rate (Chicks Fledged Per Pair)
Sea Bright	1997	0	0	0	0	0	0	0	0	n/a
	1998	2	2	2	2	2	6	6	4	2.00
	1999	4	2	2	6	2	22	6	4	1.00
	2000	4	1	1	8	1	21	4	2	0.50
Monmouth Beach	1997	1	1	0	1	1	4	2	0	0.00
	1998	2	2	2	2	2	7	6	6	3.00
	1999	3	3	3	3	3	12	9	8	2.67
	2000	4	4	4	4	4	16	13	11	2.75
Total	1997	1	1	0	1	1	4	2	0	0.00
	1998	4	4	4	4	4	13	12	10	2.50
	1999	7	5	5	9	5	34	15	12	1.71
	2000	8	5	5	12	5	37	17	13	1.63

Source: U.S. Fish and Wildlife Service, 2001b

[1] In 2000, pairs and nests at the southern end of Sea Bright (SBS) were counted in the total for Sea Bright. In previous years, all pairs and nests in the vicinity of the Sea Bright/Monmouth Beach border were counted in the totals for Monmouth Beach.

Table 9. Preliminary Piping Plover Population and Productivity within the Project Area, 2001

Location	Pairs	Fledged Chicks	Fledge Rate (Chicks Fledged Per Pair)
Sea Bright North	3	4	1.33
Sea Bright South	1	0	0.00
Sea Bright Subtotal	***4***	***4***	***1.00***
Monmouth Beach North	3	2	0.67
Monmouth Beach South	1	4	4.00
Monmouth Beach Subtotal	***4***	***6***	***1.50***
Total	**8**	**10**	**1.25**

Source: Salem, pers. comm., 2001

Table 10. Sandy Hook Piping Plover Nesting Data, 1990 - 2000

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
# nesting pairs	18	20	21	25	36	43	40	42	29	27	29
# eggs	75	83	87	100	146	193	200	195	145	107	124
# eggs hatched	44	53	67	87	111	108	94	28	49	79	92
% of eggs hatched	58	63	77	87	76	54	47	14	34	74	74
# chicks fledged	21	23	35	45	70	57	51	15	29	50	51
% of chicks fledged	48	45	52	52	63	53	54	54	59	63	55
chicks fledged per pair	1.17	1.15	1.70	1.80	1.94	1.32	1.27	0.36	1.00	1.85	1.76

Source: National Park Service, 2001c

Table 11. Numbers of Seabeach Amaranth Plants Within the Project Area, 2000-2001

Year	Location	Seedlings [2]	Mature Plants	Total Plants
2000	Sea Bright North	455	368	823
	Monmouth Beach [1]	35	61	96
	Total	**490**	**429**	**919**
2001	Sea Bright North	1,593	3,108	4,701
	Monmouth Beach [1]	141	341	482
	Long Branch	0	2	2
	Bradley Beach	0	2	2
	Shark River Inlet, Belmar	0	1	1
	Sea Girt Central	0	6	6
	National Guard Training Center, Sea Girt	0	1	1
	Total	**1,734**	**3,461**	**5,195**

Sources: U.S. Fish and Wildlife Service, 2001c; Service observation; J. Kelly, pers. comm., 2001
[1] Includes part of southern Sea Bright and Seven Presidents County Park.
[2] In 2000, based on small size and few rosettes. In 2001, based on <2 cm in diameter, and no flowers present.

3. Factors Affecting Species Environment Within the Action Area

a. Habitat

An overall description of Project area beaches was provided above under the Project Description. Until 2002, occupied piping plover habitat in the Project area was limited to northern Sea Bright, an area spanning the Sea Bright/Monmouth Beach border, and southern Monmouth Beach. In 2002, the National Guard Training Center in Sea Girt was also occupied by nesting plovers. As shown in Figure 9, seabeach amaranth is more widely distributed in the Project area, coinciding with all plover nesting areas, but also occupying the northern portion of Seven Presidents County Park, and small areas of Long Branch, Bradley Beach, Belmar south of the Shark River Inlet, and central Sea Girt.

Based upon 2000 and 2001 habitat assessments carried out through the Endangered Species Management Program, Project area beaches outside of current nesting areas do not currently appear to offer suitable piping plover habitat, primarily because of beach management practices and recreational use, but in certain areas habitat is also impaired by boardwalks and/or unsuitable beach configurations (*e.g.*, steep slopes, narrow berms). Due to extensive upland development, the initial nourishment design profile, and current beach management practices, non-ocean feeding areas for the piping plover are not available anywhere in the Project area. As discussed above, research has shown that these

habitats, including bay side flats and ephemeral pools, are preferred feeding areas, critical to piping plover productivity and carrying capacity. Based upon the first 2 years of observations, seabeach amaranth appears somewhat more opportunistic than piping plovers, and may continue to colonize additional Project area beaches in future years. However, seabeach amaranth will not persist wherever the beach is eroding, or where beach management practices allow beach raking or moderate to heavy ORV use, or where pedestrian traffic is intensive.

The most influential feature affecting suitability of Project area beaches for piping plovers and seabeach amaranth is the extensive system of hard shoreline stabilization structures, which has fundamentally altered the naturally dynamic coastal processes that create and maintain beach strand habitats. Although groins were notched as part of initial nourishment, more than 150 groins and jetties are present, interrupting littoral drift and artificially stabilizing inlets. In addition, 19.5 km (12.1 miles), about 57 percent, of the Project area is backed by seawalls, bulkheads, or revetments. These structures prevent natural shoreline migration and, in some cases, also accelerate erosion. Hard structures result in eventual scarping and narrowed berms, and even total loss of sandy beach in some areas, as observed prior to initial beach nourishment. By attempting to fix the shoreline in place, hard structures also significantly curtail the formation of highly productive piping plover and seabeach amaranth habitats such as inlets and overwash on the peninsula, and overwash of inter-dune and upland areas in the headlands.

Several factors make abandonment or removal of hard stabilization structures in the Project area unlikely in the foreseeable future. Such structures provide flood and storm protection to extensively developed, largely urbanized upland areas, including private property and public infrastructure valued in the millions of dollars. The State of New Jersey has furnished financial and technical assistance to construct and maintain these hard shoreline stabilization structures since 1922, and the State's 1981 Shore Protection Master Plan calls for the maintenance of existing functional hard structures throughout the Project area. The Corps analysis of Project benefits assumes that, although storm recession may temporarily extend beyond seawalls and roadways, long-term erosion will not be allowed to interdict these structures permanently, for humans will intervene.[1] In addition, the proposed Project includes seawall rehabilitation and maintenance as needed in Section I [2] (U.S. Army Corps of Engineers, 1990).

Another key factor affecting baseline habitat conditions within the Project area is the BECP itself. Initial nourishment, completed in all but one constructable reach, has created the sandy beach described above in the Project Description. The proposed Project is intended to maintain the design profile through 2051 (Section I) or 2053 (Section II) through periodic renourishments (U.S. Army Corps of

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[1] Future State, local, or private efforts to maintain beach stabilization structures requiring federal authorization or utilizing federal funding will require separate consultation between the federal action agency and the Service, pursuant to Section 7(a)(2) of the ESA.

[2] The proposed Project's effects on listed species through perpetuation of hard structures are considered in this Biological Opinion.

Engineers, 1990; 1995). Initial nourishment has profoundly affected the suitability of habitats within the Project area, creating habitat for piping plovers and seabeach amaranth in some areas where none previously existed, and improving or maintaining habitat in other areas by widening the berm. Although the Project created suitable habitat, it is not ideal habitat for piping plovers or seabeach amaranth. Initial nourishment created a relatively narrow, generally eroding beach along a shoreline that is highly stabilized by extensive development and a series of hard structures. No non-ocean feeding areas, such as tidal pools, are available in the project area. Although Sea Bright and Monmouth Beach feature riverside areas, the river shoreline of the peninsula provides very little foraging habitat due to extensive bulkheading, and these areas are unavailable to unfledged plover chicks due to intervening structures including the sea wall, Route 36, and residential development. Creation or widening of beaches has resulted in both colonization of the Project area by federally and State-listed species and increased human recreational use of the same narrow strip of habitat.

b. Beach Management

The majority of beaches in the Project area are managed by municipalities. The Corps, the Service, and the NJDEP have been working cooperatively with municipal officials and beach managers to minimize disturbance of listed species. However, several practices continue to affect piping plovers and seabeach amaranth directly, and to impact their habitats. Although it is not called for in the Corps (1990; 1995) EIS/GDMs, several municipalities have erected sand fencing and planted beach grass to promote dune formation and stabilize the upper beach. Over-stabilized beaches do not provide suitable habitats for piping plovers or seabeach amaranth. Dense vegetation provides cover for piping plover predators and eliminates seabeach amaranth through competition.

Motorized vehicles (*e.g.*, public works, life guard, and emergency vehicles, and mechanical rakes) impact piping plovers and seabeach amaranth both directly and indirectly through habitat modification. Much of the Project area is mechanically raked on a regular basis. This practice removes shell fragments, sparse vegetation, and wrack material, all of which characterize habitat favored by piping plovers. The motorized rakes can also directly disturb nesting birds. Based upon the distribution of seabeach amaranth in the Project area in 2000, intensive raking has most likely precluded seabeach amaranth from colonizing certain areas, possibly by removing seedlings. Mechanical raking is generally limited to private beach clubs and life-guarded municipal beaches; however, raking has also been observed in the vicinity of Sea Bright and Monmouth Beach plover nesting areas (U.S. Fish and Wildlife Service, 2001b). Some Project area municipalities also conduct transfers of sand using bulldozers and other earth-moving equipment.

In addition to mechanical rakes, vehicles are driven on Project area beaches by police and other emergency personnel, lifeguards, clean-up crews, and trash collectors. No private vehicles are permitted on Project area beaches. Vehicles can run over small, camouflaged piping plover chicks. Vehicles also create tire ruts that can trap flightless chicks, or become an impediment to chick foraging and predator avoidance. Twice during the 2001 nesting season, severe disturbances of piping plover

chicks by law enforcement vehicles were observed in Sea Bright (Salem, pers. comm., 2001). In addition, seabeach amaranth has on two occasions been observed in tire tracks, evidence that vehicles have driven over the plants (U.S. Fish and Wildlife Service, 2001b).

Through the Endangered Species Management Program, the NJDEP and the local field monitor have worked cooperatively with Sea Bright and Monmouth Beach municipal officials to limit beach raking and emergency and public works vehicle use in the nesting areas, but some problems continue. Lifeguard vehicles generally do not disturb nesting areas in Sea Bright or Monmouth Beach, as these are not guarded beaches; however, lifeguard vehicles are present on other Project area beaches. Overall, motorized vehicles reduce habitat suitability for both the piping plover and seabeach amaranth in many parts of the Project area (U.S. Fish and Wildlife Service, 2001b).

Several additional management practices affect listed species on municipal beaches in the Project area. Although most municipalities have ordinances prohibiting pets on the beach, leashed and unleashed dogs are commonly encountered by the local monitor. Municipal enforcement of these laws is lacking. In addition, individual residents have been permitted to manipulate the beach and erect semi-permanent structures in the vicinity of the Sea Bright North and Monmouth Beach South nesting areas. Manipulations include string-and-post fencing and mounding sand into dunes. Structures include several small huts, a wooden fence, and a volleyball net. Several individuals have also been permitted to store small boats on the beach. These activities, some of which may be in violation of State Coastal Zone regulations, impair endangered species management efforts. Finally, construction equipment, both related to the BECP and from unrelated projects, has been observed at multiple locations in Section II of the Project area, often causing significant habitat disturbance (U.S. Fish and Wildlife Service, 2001b).

Two Project area beaches are not managed by municipalities. Seven Presidents County Park in Long Branch is managed by Monmouth County. The lifeguarded portion of beach is wide and flat, and could provide suitable habitat for piping plovers and seabeach amaranth, but is intensively raked and devoid of any shell or wrack material (U.S. Fish and Wildlife Service, 2001b). The 2001 habitat evaluation revealed other portions of the County beach roped off as natural areas, and shell, wrack, and vegetation were beginning to return. The northern natural area was already colonized by seabeach amaranth by mid-August 2001, and a least tern colony was established in the southern natural area in 2002. These areas may provide suitable habitat for piping plovers in the future.

The National Guard Training Center is managed by the New Jersey Army National Guard, which is comprised of both federal and State components. Seabeach amaranth was documented at this site in August 2001, and piping plovers attempted nesting within a tern colony at the northen part of the property in 2002. The Training Center beach receives only moderate levels of recreational use; however, it was occasionally raked and severely impaired by vehicle tire ruts from lifeguard traffic during the 2000 nesting season. The Service, the Corps, and the NJDEP are working cooperatively with the National Guard to improve management at this site. The National Guard has curtailed

mechanical beach raking in the nesting area. The NJDEP has provided outreach to National Guard personnel, and a Corps-funded interpretive sign has been installed at the access to the southern part of the beach, which is guarded by Sea Girt lifeguards. The NJDEP, the National Guard, and Sea Girt Public Works Department are jointly considering several options to minimize lifeguard vehicle traffic in front of the nesting area. Symbolic fencing and other management tools continue to be employed by the local monitor at the site as needed (U.S. Fish and Wildlife Service, 2001b).

c. Recreational Use

Recreational use of Project area beaches ranges from light to intensive. Activities primarily include walking and sunbathing, but also include volleyball and other active uses. In addition, several municipalities host annual fireworks displays. Intensive recreational use tends to be concentrated in the vicinity of beach clubs, guarded municipal beaches, municipal pools, high-rise residential facilities, boardwalks, and Seven Presidents County Park.

Beaches occupied by piping plovers, to date, generally receive only light to moderate use. Human disturbance of nesting birds has not been considered a significant factor affecting piping plover productivity. This is due largely to the intensive management and coordination provided by the Endangered Species Management Program. Areas where recreational activity is intense, such as beach access trails and a volleyball "court" were devoid of seabeach amaranth plants, while the species had colonized adjacent "low foot-traffic" areas. Therefore, it appears that high density recreational activity is precluding colonization of seabeach amaranth in certain areas. As a precaution against trampling, the local monitor provided by the Endangered Species Management Program has maintained fencing around plants in certain high traffic areas. The plant's geographic expansion in 2001 included colonization of more intensively used areas.

d. Predation

Predation has been identified as the most significant factor reducing piping plover productivity in the Project area since 1999. Crow predation has severely impaired reproductive success, particularly in Sea Bright. Grackles (*Quiscalus* sp.), European starlings (*Sturnus vulgaris*), and gulls may also be affecting productivity, but to a much lesser extent. In 2001, evidence of mammalian predators was observed for the first time. Evidence of feral or free-ranging domestic cats (*Felis silvestris*) was observed in Monmouth Beach. Foxes were the likely cause of severe least tern nest losses at the National Guard Training Center in 2001 (Salem, pers. comm., 2001). Predator populations have been artificially inflated by development and recreational beach use in the Project area.

Evidence of minor insect predation of seabeach amaranth was observed within the Project area in 2000 and 2001. Isolated occurrences of chewed leaves were noted in both years, and insect webs as well as feeding larval insects, were observed in 2001. To date, no predator species have been identified, and insect damage has appeared minimal. However, webworm predation is known to cause significant reductions in plant survival and reproductive success in the southern part of the plant's range, and may be expected to increase in the Project area in coming years without intervention.

e. Other Beach-nesting Birds

Piping plovers often nest in association with least tern colonies, benefiting from the aggressive behaviors of terns in driving away predators. Burger (1987) found that piping plovers in New Jersey derived anti-predator benefits from nesting near terns, and plovers nesting in tern colonies often had higher success than those nesting out of tern colonies. Seabeach amaranth also benefits from the presence of least tern colonies, since restrictions on public access in the nesting areas provide protected areas where plants can become established (Weakley and Bucher, 1992). Least terns are listed as endangered by the State of New Jersey.

From 1996 to 1999, least terns nested only in Sea Bright and Monmouth Beach. From 1997 to 1999, the colony at the border of these towns was the largest in the State, numbering around 1,300 birds. Least tern populations in the Project area crashed in 2000, primarily because of crow predation (U.S. Fish and Wildlife Service, 2001b). From 2000 to 2002, five new colonies were established, although one site used in 2000 and 2001 had been abandoned by 2002. The large colony at the Sea Bright/Monmouth Beach border was also abandoned during these years. Preliminary numbers for 2001 indicate that total population numbers in the Project area have not begun any significant recovery, despite establishment of the new, smaller colonies. The largest new colony, at the National Guard Training Center, suffered severe fox predation twice in 2001 (Salem, pers. comm., 2001). Total least tern numbers from 1996-2000 on Sandy Hook are shown in Table 12, and nesting summary numbers from 1996-2001 in the Project area are shown in Table 13.

Table 12. Least Tern Total Numbers on Sandy Hook, 1990-2001

Year	Total Least Terns
1990	483
1991	180
1992	210
1993	356
1994	466
1995	613
1996	159
1997	not available
1998	152
1999	258
2000	318
2001	194

Sources: Canale, 2000 and Lane, pers. comm., 2001

Table 13. Least Tern Nesting Summary Within the Project Area, 1996-2001

Location	Year	Number Adults	Number Fledged Chicks
Sea Bright North	1997	12	3
	1998	150	56
	1999	100	68
	2000 [1]	0	0
	2001	38	22
Sea Bright North/ Monmouth Beach South	1996	250-300	160
	1997	600	200
	1998	800	469
	1999	1,300	472
	2000 [1]	110	20
	2001	0	0
Monmouth Beach South	1999	26	35
	2000	82	25
	2001	12	0
Belmar (Shark R. Inlet)	2000	7	2
	2001	57	46
Sea Girt (Wreck Pond)	2001	24	9
National Guard Training Center	2000	15	15
	2001	197 [2]	14
Total	1996	250-300	160
	1997	612	203
	1998	950	525
	1999	1,426	575
	2000	214	62
	2001	328	91

Sources: U.S. Fish and Wildlife Service, 2001b and Pover, pers. comm., 2001

[1] Numbers for reflect colony size after mid-June, when numbers stabilized.

[2] Site was abandoned; birds re-locating to other sites may have been double-counted.

f. Endangered Species Management Program

The Endangered Species Management Program described under Conservation Measure (3), and implemented cooperatively by the Corps, the Service, and the ENSP, provides substantial benefits to piping plovers and seabeach amaranth within the Project area. This program provides for annual habitat assessments and species surveys, as well as daily monitoring of piping plovers and weekly monitoring of seabeach amaranth during the nesting/growing seasons.

The program also addresses several of the factors cited above that affect listed species. Specifically, the Project area is monitored for evidence of piping plover predators, and predator nest exclosures are employed as needed. Predation of seabeach amaranth is likewise monitored, and will be managed if possible and appropriate in future growing seasons. Through signs, string-and-post fencing, and on- and off-site education and outreach, the program minimizes disturbances to nesting piping plovers from recreational beach uses. These benefits also extend to seabeach amaranth, primarily by protection from disturbance within fenced nesting areas. The Endangered Species Management Program also includes least terns, which in turn can impart further benefits to piping plovers and seabeach amaranth as discussed above. Finally, the program provides a liaison to municipal, County, State, and federal beach managers within the Project area to address beach management practices.

The benefits of the Endangered Species Management Program are based upon adequate Corps funding; cooperative participation of the Corps, the Service, and the ENSP; and the presence of a full-time, local field monitor to closely observe federally listed species, interface with beach users, identify problems, and coordinate management activities. The program could be further strengthened by greater participation from municipal and County beach managers.

D. EFFECTS OF THE ACTION

In evaluating the effects of the federal action under consideration in this consultation, 50 CFR 402.2 and 402.14(g)(3) require the Service to evaluate both the direct and indirect effects of the action on the species, together with the effects of other activities that are interrelated or interdependent with the 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 project justification. Interdependent actions are those that have no independent utility apart from the action under consideration. The proposed Project will provide benefits to piping plovers and seabeach amaranth in the action area; however, the Project will also cause direct and indirect adverse effects to these species within the Project area. Both beneficial and adverse effects are discussed below.

1. Beneficial Effects

a. Maintenance and Enhancement of Habitat Within the Project Area

Prior to initial beach nourishment, all but one of the areas now occupied by piping plovers and seabeach amaranth provided no suitable habitat for these species due to previous shoreline stabilization efforts. Sandy beach habitats had eroded, and new habitats were precluded from forming by the extensive system of hard stabilization structures and upland development. In Sea Bright and Monmouth Beach, a majority of the shorefront property had no dry beach at all. The southern part of Section I had very little beach width except for sand fillets south of groins (U.S. Army Corps of Engineers, 1990). In all but one area of Section II, including the National Guard Training Center, beach widths were significantly reduced by erosion. The exception was northern Belmar, which was accreting due to sediment trapped by the southern jetty of the Shark River Inlet (U.S. Army Corps of Engineers, 1995); this area is now occupied by seabeach amaranth.

Prior to initial construction, no piping plovers had nested within the Project area as long as intensive monitoring of this species has been conducted in New Jersey, starting in 1986 (Jenkins, pers. comm., 2000). No seabeach amaranth had been documented in Monmouth County since 1899. With little or no beach width remaining, Project area habitats were highly unsuitable for these species, and natural formation of suitable sandy beach habitat (*i.e.*, breaching of the peninsula, or overwashing of man-made structures) was unlikely. Therefore, initial beach nourishment directly benefited piping plovers and seabeach amaranth by creating suitable habitat within the Project area, and making possible the subsequent colonization of the area by 8 pairs of piping plovers and almost 5,200 individual seabeach amaranth plants by 2001. Implementation of the proposed Project is expected to benefit piping plovers and seabeach amaranth by maintaining sandy beach habitats in the Project area through 2053 (6 years after the last renourishment).

Weakley and Bucher (1992) observed that seabeach amaranth is dependent on a terrestrial, upper beach habitat that is not flooded during the growing season. Piping plovers likewise require a zone of dry, upper beach, seaward of the dunes. This zone is absent on beaches that are eroding due to artificial stabilization and human-induced interruption of sand transport. Habitat observations of northern Monmouth Beach in 2001 indicate that elimination of this critical beach zone by erosion has begun. The area contains a low, heavily vegetated, flat-topped dune. Early in the 2001 growing season, seabeach amaranth plants were observed at the toe of this dune line (Madera, pers. comm., 2001). However, by mid-August, the plant was completely absent from this area, and the wrack line coincided exactly with the base of the dune, indicating that the plants had been destroyed by flooding. The planned 2002 renourishment will restore the dry, upper beach, foredune zone to northern Monmouth Beach and prevent its loss in Sea Bright. Continuation of such benefits through 2053 is expected from full implementation of the proposed Project.

b. Increased Sand Transport to Sandy Hook

As predicted, sand transport to Sandy Hook has increased appreciably due to initial beach nourishment. The artificially stabilized southern Sandy Hook beaches (Fee Beach, Hidden Beach, and the Critical Zone) have been the primary recipients of the additional sand. At the Critical Zone, the NPS has calculated that the annual sand deficit has been reduced from approximately 200,000 cubic yards to 55,000 cubic yards, although this site continues to erode. Fee Beach and Hidden Beach, which were previously eroded back to the seawall except for groin fillets, have accreted significantly since initial nourishment. The NPS estimates these beaches are now about 150 m wide (Lane, pers. comm., 2001). As shown in Tables 14 and 15, the additional sand reaching these hardened southern Sandy Hook beaches has directly benefited piping plovers and seabeach amaranth by creating suitable habitat that supported 11 pairs of piping plovers and 530 seabeach amaranth plants during the 2001 season. Piping plover pairs have decreased at the Critical Zone because erosion continues at this site, though at a slower rate. Continuation of these benefits through 2051 (6 years after the final renourishment in Section I) is expected from implementation of the proposed Project.

Table 14. Numbers of Piping Plover Pairs at Southern Sandy Hook Beaches, 1992-2001

Year	Critical Zone	Hidden Beach	Fee Beach	Total
1992	5	1	0	6
1993	5	0	0	5
1994	5	0	0	5
1995 (Initial nourishment Section I complete)	6	0	0	6
1996	2	0	0	2
1997	0	6	0	6
1998	0	4	1	5
1999	0	4	2	6
2000	0	3	6	9
2001	1	3	7	11

Source: Lane, pers. comm., 2001

Table 15. Numbers of Seabeach Amaranth Plants at Southern Sandy Hook Beaches, 1999-2001

Year	Critical Zone	Hidden Beach	Fee Beach	Total
1999 (Only historic records exist from Monmouth Co.)	0	0	0	0
2000	7	57	41	105
2001	53	286	192	531

Source: Lane, pers. comm., 2001

2. Direct Adverse Effects

Beach nourishment as proposed in this Project involves set-up and operation of a pipeline to pump thousands of cubic yards of sand on the beach, and subsequent contouring of the pumped sand by earth-moving equipment. Plans provided by the Corps show the construction template stretching from immediately in front of the seawall to the intertidal zone in some areas. Even in other areas where sand placement will only occur seaward of the present high-tide line, significant disturbance of the upper beach from equipment and crews can be expected. Therefore, beach nourishment during the nesting/growing seasons would likely result in significant adverse effects to piping plovers and seabeach amaranth where they occur. However, conservation measures proposed by the Corps, if effectively implemented by sufficient numbers of skilled monitors, are expected to avoid direct disturbance of piping plovers almost entirely and to offset losses of seabeach amaranth.

a. Disturbance of Nesting Piping Plovers

Given the seasonal restrictions and other measures included in the Project to protect piping plovers, the Service anticipates only minimal direct disturbances to nesting birds. According to the BA, the Corps prime intent is to conduct all beach nourishment activities outside the nesting season, between the date of the last fledged chick and March 15 (U.S. Army Corps of Engineers, 2001a). Construction during this period would avoid all direct effects to piping plovers. Disturbances to piping plovers from the contingency plan outlined under the first part of Conservation Measure 5(iii) are considered unlikely, as thorough monitoring will precede any work within occupied reaches, but outside nesting areas.

The contingency plan outlined under the second part of Conservation Measure 5(iii) would allow work to proceed in a nesting area during the nesting season on two occasions over the life of the Project, with numerous protective measures in place, including a seasonal restriction to prevent work during the most critical part of the nesting season (April 16 through July 31) and a system of protective buffers. The proposed protective measures and buffers are sufficient to eliminate most direct disturbances to nesting birds. For early-season work (March 16 through April 15), the Corps proposes 200-m nest buffers for sand placement, with a monitor present. The 200-m buffer is consistent with distances generally recommended by the Service for such highly disruptive activities. Courtship and territorial areas are

likewise afforded 200-m buffers by the Corps, an appropriate precaution as total site abandonment is the most likely result of severe disturbance during the earliest part of the nesting season.

For late-season work (August 1 through fledging of the last chick), the proposed 1,000-m buffer around unfledged chick foraging areas is adequate and appropriate. This buffer size is also consistent with the Service's Guidelines for motorized vehicle use in nesting areas, which cite observations from five authors of chicks moving 400 to 1,000 m after hatching (U.S. Fish and Wildlife Service, 1994), and one observation of a brood in Maryland moving more than 1,000 m from its nest (Loegering, 1992). On Cape Cod, Jones (1997) observed 2 out of 101 broods more than 1,000 m from their nests on 5 occasions, with a record distance of 1,300 m. In other seasons on outer Cape Cod, broods have been observed moving up to 1,600 m from their nest and back in one day, and have moved maximum distances of 4,000 m before fledging. Jones (1997) concluded that 500-m buffers would protect 95 percent of broods in his study area from vehicles. However, the risk of injury and death for any chicks that might be in the vicinity of the sand placement area is extreme. In light of Service Guidelines, the severity of disturbance in sand placement areas, and maximum brood movements greater than 1,000 feet observed by Jones (1997) and Loegering (1992), the proposed 1,000-m buffers for sand placement, with a monitor on site, are warranted. Based upon the patterns of brood movement observed within the Project area to date, 1,000-m buffers are adequate, if accompanied by intensive monitoring of unfledged chicks.

On each occasion of in-season work in a nesting area, the Service anticipates that nesting piping plovers will be disturbed one time. After one disturbance, the Corps protective measures should function to enable field monitors and construction crews to respond by adjusting buffers and/or construction activities as needed to avoid a second disturbance. The Service anticipates that the nature of each disturbance will be minor and brief, and will not result in actual injury or death of birds (*i.e.*, temporary interruption of courtship behaviors or foraging, flushing an incubating bird off its nest, brief defensive display of adults or distress behavior of chicks). Direct effects of beach nourishment are not expected to affect reproductive success during the one or two nesting seasons in which the disturbances occur, nor to impact the population of piping plovers in the Project area. This low level of anticipated direct effects to piping plovers from beach nourishment is dependent on strict adherence to all conservation measures, vigilant field monitoring during in-season work in occupied reaches, and full knowledge and cooperation of project engineers and construction crews in implementing protective measures.

b. <u>Increased Predation of Piping Plovers During Sand Placement</u>

Sand pumped onto Project area beaches from borrow areas is likely to contain dead or dying benthic organisms that may attract predators such as gulls, crows, raccoons, red foxes, and Norway rats. During each renourishment of a piping plover nesting area, the number of predators in the area is likely to increase. However, Conservation Measure 5 provides that piping plover nesting areas, including 1,000-m buffers, will be renourished outside the nesting season on all but two occasions. During

routine renourishments, the Service expects these buffers to be sufficient to prevent exposure of piping plovers to increased levels of predation. On up to two occasions if and when the Corps exercises the contingencies under Conservation Measure 5(iii), the Service expects slightly increased egg predation lasting up to 1 month on each occasion. The Service does not anticipate increased predation of piping plover chicks on these occasions, due to the 1,000-m buffers provided under Conservation Measure 5(iii).

c. Destruction of Seabeach Amaranth Plants

Based upon the Project description, significant mortality of plants in each constructable reach is expected during each renourishment cycle, primarily due to crushing by vehicles and work crews, and burial with fill material. The actual level of plant mortality will depend on several factors, including the specific construction template for each renourishment cycle, the degree to which the Corps is able to implement Conservation Measures for avoiding and salvaging plants, and the time of year in which each renourishment is carried out.

The construction template for each renourishment cycle will influence plant mortality based on the length of beach to be nourished, the volume of fill involved, and where along the beach profile the fill will be placed. For example, the 1.9-km stretch of beach in Sea Bright where no renourishment is planned in 2002 contained a significant number of the 2001 seabeach amaranth population, comprising approximately 70 percent of total plants in the Project area, or more than 3,500 plants. Likewise, the volumes of fill needed in each renourishment, and where that material is placed along the beach profile, are important in affecting plant mortality. The greater the volume of sand, and the further up on the existing berm it is placed, the more plants are expected to be killed by burial. Within each area slated for renourishment in 2002, the percentage of plants falling within the construction template, and therefore subject to burial, is unknown. However, the NPS found that approximately half the 2001 population of plants falls within the construction template of a fill planned for fall 2002 in Sandy Hook's Critical Zone (National Park Service 2001d).

Conservation Measure (6)(ii) provides for a 3-m fenced buffer around all plants, if practical, and avoidance of delineated seabeach amaranth areas during construction, where feasible. Although these steps will likely reduce direct plant morality, the Corps could make no reliable estimate of the extent to which avoidance will be possible; therefore, the Service must assume that construction activities will not be able to avoid seabeach amaranth. Conservation Measure (6)(iii) states that the Corps will transplant individual plants likely to be destroyed by burial to a similar habitat near or within the Project area. Although no data are available regarding transplantion of seabeach amaranth, the Service expects survival rates of transplanted individuals to be low, based upon the anticipated difficulty of removing plants within an intact volume of sand. In addition, given the large number of plants found within some reaches, transplanting all plants would be difficult. Even with Conservation Measures (6)(ii) and (6)(iii), direct effects to seabeach amaranth from beach nourishment within the growing season will be significant, resulting in destruction or removal of all or nearly all plants in the constructable reach. Survival of fenced plants (if any can be feasibly avoided) and transplanted plants will likely be minimal.

The number of plants destroyed will be highly dependent on the time of year construction takes place. Between December 1 and May 15, no direct plant mortality is expected, as the species exists only in seed form during this period. Between May 15 and July 1, mortality of a small number of plants is expected. Low mortality during this period is expected because significant numbers of seedlings were observed in the Project area in 2000 and 2001 only after early July. Observations did not include intensive early-season monitoring, therefore, no quantitative estimate of plants likely to be destroyed during this period is available.

Beach nourishment between November 1 and December 1 is likely to affect only small numbers of plants. Of 20 plants monitored on West Hampton Island, New York in 2000, only 3 lived through November 8, and only 1 lived through November 25. None survived through December 10 (Young, 2001). On Assateague Island, Maryland in 2000, less than 10 percent of 1,156 artificially propagated plants transplanted into the wild survived into November, and none survived into December (Lea and King, 2001). Based on these figures, the Service estimates 10 to 15 percent of the population would persist during November and would be subject to mortality from construction.

Construction between July 1 and October 31 would cause the most direct plant mortality, with potentially significant impacts to seabeach amaranth populations in the Project area. Germination peaks from mid-July through mid-August, plant numbers peak from mid-August through mid-September, and seed production peaks from early September through mid-October. Total destruction or removal of all plants in a renourished area during these periods would likely result in complete reproductive failure in the area. As the Corps has proposed no seasonal restrictions to protect seabeach amaranth, the Service's analysis of effects must be based upon a worst-case scenario (*i.e.*, construction between July 1 and October 31).

Based upon the Project description, impacts to the entire beach zone supporting seabeach amaranth are expected to be significant in all renourishment areas, and in many places habitat will be completely buried. Given a high level of uncertainty regarding the construction template, Conservation Measures, and time of year for each planned renourishment, the Service's analysis of effects to seabeach amaranth assumes 100 percent mortality of all plants in a constructable reach during each renourishment cycle.

For an annual plant, the effects of direct plant mortality are much less important than the effects of reduced seed production, which impairs the species ability to persist into the next growing season. Conservation Measure (6)(iv) (seed collection and redistribution) is intended to offset anticipated destruction of plants and seed, and thus ensure persistence of seabeach amaranth within the Project area after each re-nourishment cycle. Based entirely upon this conservation measure, the Service anticipates that seabeach amaranth populations in a constructable reach will eventually recover from even 100 percent plant mortality.

With sufficient commitment and funding from the Corps, seabeach amaranth populations can likely be restored to approximately pre-construction numbers and distributions within one growing season. Detailed information on the distribution of seabeach amaranth in the Project area has been collected annually through the Endangered Species Management Program, although this undertaking requires an intensive effort. Restoration programs in Maryland and South Carolina, and experiments in North Carolina, have shown that seabeach amaranth can be propagated in a laboratory or greenhouse, and cultivated plants can be successfully restored back into the wild (Lea and King, 2001; Hamilton, 2000b; Jolls and Sellars, 2000). Survival rates of reintroduced cultivars are highly variable, but can exceed 80 percent (Jolls and Sellars, 2000). One species expert estimates that approximately 10,000 seedlings would be required to restore a pre-construction population of approximately 6,000 plants (Skaradek, pers. comm., 2001).

For the 2002 renourishment, the Corps intends to work with the U.S. Department of Agriculture Cape May Plant Materials Center to restore approximately 5,000 plants to the project area in spring 2003 (Burlas, pers. comm., 2002). Future levels of Corps funding or effort for post-construction restoration are not known. In addition, the restoration techniques have not been tested in the Project area. Implementation of Conservation Measure (6)(iv) will require careful planning and execution by qualified practitioners in order to obtain, prepare, store, and germinate sufficient seed, and return a significant number of seedlings to the Project area. If renourishment of a seabeach amaranth area is proposed during any time of year other than late fall, Conservation Measure (6)(iv) will require further planning to collect seed during the previous growing season and/or salvage and artificially propagate young plants in order to produce sufficient seed. Due to these challenges and the uncertain level of Corps future effort and funding, a reduction in the overall population and distribution of seabeach amaranth is anticipated for at least one growing season following each future renourishment. However, based on the 2002 renourishment plans, and the 2003 restoration as currently proposed by the Corps, the Service does not anticipate significant population decreases from 2002[1] to 2003.

Although the Service expects numbers of plants to recover within 1 year of each renourishment, the possibility exists that repeated episodes of plant mortality may reduce genetic diversity of the seabeach amaranth population in the Project area. Preliminary studies suggest that genetic diversity between seabeach amaranth populations is low, even between populations from different States (Hunter, pers. comm., 2001; Strand, pers. comm., 2000). Based on these studies, it may be expected that intra-population genetic variation is also low. However, sufficient information regarding the genetic diversity of this species is not available to conclude that no genetic variants will be lost. Therefore, loss of genetic diversity is another potential adverse Project effect to seabeach amaranth, although the extent of the effect is unknown and may be minimal.

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[1] Through the Endangered Species Management Program, the Corps, the Service, and the NJDEP will cooperate to conduct an annual seabeach amaranth survey of the Project area in late August and early September 2002. The Corps will conduct a pre-construction survey of any area(s) to be renourished prior to then (Burlas, pers. comm., 2002).

d. Burial of Seabeach Amaranth Seed Bank

As previously discussed, seabeach amaranth cannot germinate from depths of more than a few (1-2) centimeters (Hancock, 1995; Jolls, pers. comm., 2000). Burial at depths of only 6 cm suppresses germination and delays emergence (Jolls, *et al.*, 2001). Based upon construction templates, the Service anticipates that most or all of the seabeach amaranth seed bank will be buried at depths sufficient to significantly reduce or completely prevent germination for one or more growing seasons following renourishment. Burial of 100 percent of the seed bank, and complete failure of germination for at least one growing season, is expected following each renourishment (*i.e.*, eight times in each constructable reach over the life of the Project).

In some areas, seabeach amaranth populations have persisted and even thrived following beach nourishment (U.S. Fish and Wildlife Service, 1996b). However, given the shallow burial depths required for germination, persistence of the plant at such sites is most likely due to re-colonization of project sites from populations outside the immediate beach nourishment areas. Based upon the 2001 distribution of seabeach amaranth, plants in the Project area constituted almost 90 percent of the total seabeach amaranth population in New Jersey. Significantly, a large portion (about 70 percent) of these plants were located in a stretch of beach not slated for renourishment in 2002. However, the specific areas to be renourished within each constructable reach during each cycle are not known, leaving the potential for a substantial portion (easily more than half) of the State's population to be effected in any one renourishment year. Under these circumstances, natural re-colonization of a constructable reach from outside seed sources is unreliable, as there may be insufficient plants close enough to the effected areas.

Preventing or considerably reducing germination in any constructable reach, especially Sea Bright and Monmouth Beach, would likely cause severe and long-lasting effects to populations of seabeach amaranth in the Project area and in the State. Species experts believe that seabeach amaranth seeds are long-lived, and buried seeds in the Project area may remain viable long enough after renourishment to eventually germinate after being exposed by erosion. However, the Service cannot assume that viable seeds will remain, or that the beach profile or growing conditions will be suitable when seeds are finally exposed. Even if delayed germination does occur several years after renourishment, seabeach amaranth populations would be depressed in the interim. Given the extreme variability of this species, and its vulnerability to random catastrophic events, several seasons of depressed populations are likely to have severe adverse effects on populations of this species at some time over the long life of the Project.

Conservation Measure (6)(iv) proposes to offset adverse effects by collecting, storing, propagating, and returning seed and/or seedlings after each renourishment to restore seabeach amaranth in each constructable reach. The Service anticipates that even complete burial of the naturally occurring seed bank in a constructable reach, with complete loss of germination the following year, will not entirely eliminate seabeach amaranth populations from the area since the Corps Conservation Measures will

ensure that plants and/or seeds are restored to affected sites.
Based on the 2003 restoration proposed by the Corps, the Service does not anticipate a reduction in the overall population and distribution of seabeach amaranth due to 2002 renourishment activities. However, the Service does expect reductions for at least one growing season following each future renourishment, as the extent of future Corps restorations is not known and may be insufficient to offset losses from seed burial.

Although potential population decreases will be offset by Corps restoration efforts, a reduction or elimination of germination of the natural seed bank every 6 years represents a potential loss of additional genetic diversity. The Corps restoration effort will use plants propagated from selected source plants, which may have contained only a portion of the total genetic variation present in the seabeach amaranth population in each constructable reach. Therefore, potential exists to lose further genetic diversity from burial of the seed bank.

Given the possibility for delayed emergence of buried seed, long-term losses due to seed bank burial may be further offset if renourishment occurs after mid-October, allowing the current year's seed crop to mature. However, as no seasonal restrictions have been proposed by the Corps to protect seabeach amaranth, the Service must assume a worst-case scenario: renourishment between mid-July and early October, completely burying plants prior to seed set and completely eliminating an entire season of natural reproductive output. The Service reiterates that careful planning will be necessary to implement Conservation Measure (6)(iv) if renourishment will occur any time other than late fall.

3. Indirect Adverse Effects

a. Preclusion of Natural Habitat Formation

Any activity that artificially stabilizes dynamic beach strand habitats is detrimental to piping plovers and seabeach amaranth. The most highly productive habitats for these species are found in areas of recent inlet formation or overwash. Such habitats are prevented from forming by shoreline stabilization projects. Due to erosion, establishment of predators and competitors, and lower prey densities, stabilized beach strands are generally less productive habitats for piping plovers and seabeach amaranth than more dynamic, unstabilized beaches, particularly inlets and overwash areas.

The proposed Project will adversely affect piping plovers and seabeach amaranth by contributing to the perpetuation of the highly stabilized Monmouth County coastline. The 50-year program of beach nourishment provided by the BECP affords protection to existing seawalls, bulkheads, and upland development by buffering these structures from storm tides and wave attack. The proposed Project also includes rehabilitation of the seawall in Sea Bright and Monmouth Beach by the State of New Jersey, as well as repair and maintenance of certain other seawalls and bulkheads. Through these means, the Project perpetuates a system of shoreline stabilization structures that has essentially stopped the natural process of shoreline retreat and, consequently, prevents the natural formation optimal

habitats for piping plovers and seabeach amaranth (*e.g.* inlets and overwash areas).

The adverse effects of a stabilized Monmouth County shoreline on piping plovers and seabeach amaranth are difficult to quantify, as they depend on where, when, and how new habitats would form if stabilization efforts were halted, and to what degree these habitats would permit expansion of current populations. However, within the New York-New Jersey piping plover Recovery Unit and the entire range of seabeach amaranth, development and subsequent shoreline stabilization to protect developed areas are considered the most significant threats to these species. While difficult to quantify, the effects to these species from continued shoreline stabilization due to Project implementation are clearly long-term, lasting at least until 2053.

Although the effects of a stabilized shoreline on federally listed species are significant and long-lasting, the extent to which the proposed Project contributes to the perpetuation of shoreline stabilization over existing baseline conditions is relatively modest. No new hard stabilization structures are proposed as part of the Project. All existing stabilization structures in the Project area have been in place for many years, in some cases decades. Economic consideration of the extensive upland infrastructure and development receiving storm protection from the existing hard structures further suggests that their abandonment is unlikely in the foreseeable future, irrespective of the proposed Project. In addition, initial nourishment was accompanied by groin notching, which substantially reduced the stabilization effects of many groins, and partially restored littoral drift in the action area. Additional groin notching is included as part of the proposed Project.

b. Burial of Piping Plover Prey Base

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 flies and other insects, but also diurnally burrowing Talitrid amphipods (Gibbs, 1986)), and benthic intertidal infaunal invertebrates. On ocean-front habitats, terrestrial invertebrates, mainly flying insects, tend to be concentrated in the wrack line (Loegering and Fraser, 1995; Hoopes *et al.*, 1992), a favored piping plover foraging area, particularly for chicks (Goldin, 1993; Hoopes, 1993; Hoopes *et al.*, 1992), and especially at sites where ephemeral pool and bay-side foraging areas are not available. Renourishment will potentially completely remove or bury the wrack line in a constructable reach.

Except where curtailed by mechanical beach raking or delayed by scarping, recovery of the wrack line can be expected by the nesting season following renourishment. Recovery rates of the terrestrial insect prey resource associated with the wrack line are unknown; however, the Service expects that the wrack line prey resource within each constructable reach will not be depressed for more than one nesting season following renourishment. This assumption is based upon the close proximity of each reach to un-nourished beaches (Sandy Hook and other constructable reaches), and the presumably high dispersal capabilities of flying insects. Therefore, adverse effects in the form of a depressed wrack

line prey base for up to one nesting season are anticipated following each renourishment.

Within Section II of the Project area, the intertidal infaunal assemblage is dominated by ribbon worms (Nemertea or Rhynchocoela), polychaetes (especially *Scolelepis squamata*), oligochaetes, the mole crab (*Emerita talpoida*), and a number of haustoriid amphipods (U.S. Army Corps of Engineers, 2001d). On three southern New Jersey beaches, Staine and Burger (1994) found that polycheate abundance is highest in piping plover foraging areas, and concluded that polychaetes are the plovers main source of food in these locations. Hoopes *et al*. (1992), Gibbs (1986), and Cairns (1977) also documented that piping plovers feed on polychaetes. Based on a positive, though weak, correlation between density of foraging birds and density of amphipods, and a preponderance of amphipod remains in plover droppings, Gibbs (1986) concluded that piping plovers on Seawall Beach, Maine were feeding primarily on amphipods (both terrestrial and intertidal infaunal species). Loegering (1992) found amphipods and mole crabs abundant in the saturated intertidal zone of the ocean beach on Assateague Island National Seashore in Maryland, 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 at this site.

Based upon the known intertidal infaunal assemblage in Section II and known piping plover prey items, plovers in Sea Bright, Monmouth Beach, and National Guard Training Center nesting areas most likely feed on polychaetes (especially *S. squamata*) and amphipods in the intertidal zone. Ribbon worms and oligochaetes are probably not important food resources, due to their small size (Ray, pers. comm., 2001). Despite their abundance in the Project area, it is unclear whether mole crabs serve as piping plover prey due to their relatively large size (25 mm long and 19 mm wide), although juvenile mole crabs are smaller (less than 10 mm) (Ray, pers. comm., 2001).

The Service expects that 100 percent of the intertidal infaunal prey base within renourishment areas will be covered by sand placement, based on the Project Description. For the 2002 renourishment cycle, sand placement is planned for all three nesting areas in Sea Bright and Monmouth Beach, although part of the recently expanded northern Sea Bright nesting will not receive sand. In its Biological Monitoring Program (BMP) for Section II, in 1997 and 1999 the Corps found that, following initial nourishment of Section II in 1997 and 1999, complete recovery of the infaunal assemblage in the intertidal zone took between 2.0 and 6.5 months. Recovery times in this range are dependent on a good match between the sediments on the existing beach and the fill material. Recovery can take considerably longer, up to a year, when fill material contains substantial amounts of silts and clays (U.S. Army Corps of Engineers, 2001d).

The surf zone macrofaunal community after re-colonization of a nourished beach 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). However, this does not appear to be the case in Section II of the Project area, with biomass composition and species

composition returning to reference conditions within 5 months.

Recovery times for the following parameters were calculated by the Corps (U.S. Army Corps of Engineers, 2001d):

abundance	49 days (1997), 189 days (1999)
biomass	38 days (1997), 176 days (1999)
taxa richness:	178 days
biomass composition	145 days
species composition	approximately 5 months

The BMP found that intertidal abundance varies seasonally; with highest abundance in the summer and lowest in mid-winter. These observations are consistent with other studies of Atlantic Coast intertidal infauna. The longer recovery time observed after the 1999 renourishment was attributed to the time of year during which construction took place. The 1997 renourishment was completed by early October, while the 1999 renourishment was not finished until mid-December. Infaunal populations decline precipitously between November and January, suggesting that in 1997 sufficient time was available for colonization to be completed before the onset of the decline. In 1999, nourishment was not completed until the natural seasonal decline was well underway; few invertebrates were available to colonize the disturbed sediments. Sites where filling did not conclude until the low point in the seasonal cycle took the longest to recover (U.S. Army Corps of Engineers, 2001d).

Based on the BMP and other studies, the Service anticipates that the effects of prey resource burial on piping plovers will be highly dependent on the time of year in which renourishment takes place. The intertidal infaunal community may recover within 2.0 months following renourishment carried out between early August and early October. Therefore, renourishment during this period will likely have little or no adverse effect on piping plovers due to reduced prey availability. Recovery time following renourishment in mid- to late-October is expected to fall within the range of 2.0 to 6.5 months. Renourishment between November and January would coincide with the period of sharp seasonal decline in abundance, and the infaunal community would not be expected to recover for at least 6.5 months. Renourishment between mid-October and January, therefore, may result in reduced productivity, or possibly abandonment of nesting areas from reduced prey resources. The BMP provides no estimates of recovery time for Project area beaches renourished between February and July, although sand placement during late spring or early summer could be expected to interfere with invertebrate recruitment (U.S. Army Corps of Engineers, 2001d). Renourishment between February and July, would likely result in more sharply reduced productivity and/or abandonment of nesting areas due to depression of prey resources close to or during the nesting season.

As the timing of each renourishment cycle is not known, except as constrained by Conservation Measure (5), the Service must base its analysis of effects on a worst-case scenario. Based on available information, renourishment starting in December or January and finishing close to March 15 would probably have the most severe adverse effects on piping plovers from depression of the intertidal prey resource. With work beginning during the period of low invertebrate abundance, and ending at the start

of the nesting season, renourishment during this period allows the least amount of recovery time. Under this scenario, recovery of the intertidal infaunal community would probably not be complete until after the end of the nesting season. Therefore, the Service anticipates the possibility of up to eight full nesting seasons of reduced intertidal infaunal prey availability in each nesting area, causing reduced productivity and/or nesting area abandonment in each instance.

The above assessment of effects to piping plovers from reduced intertidal prey availability applies to routine renourishments which, according to Conservation Measure (5)(ii), will be completed by March 15 in occupied reaches. Additional effects are expected on two occasions over the life of the Project pursuant to Conservation Measure (5)(iii), which allows two episodes of nesting-season work in a nesting area. Both episodes may occur during a single nesting season, or may occur in separate years. During each episode, work may occur either between March 16 and April 15, or between August 1 and the date of the last fledged chick.

The available data suggest that early-season work is likely to have much more severe effects to piping plovers from burial of the intertidal prey resource than late-season work. Immediately following nourishment, intertidal infaunal abundance and biomass can go to zero (U.S. Army Corps of Engineers, 2001d; Reilly and Bellis, 1983). Reilly and Bellis (1983) found that 15 to 30 days passed before <u>any</u> infaunal invertebrate recruitment occurred at a nourished transect in North Carolina. Sand placement in a nesting area between March 16 and April 15 would result in the lowest levels of prey availability (possibly several weeks of zero biomass), precisely coinciding with the period of bird arrival. Sharply reduced prey availability during this period could cause reduced reproductive success from undernourishment of adults, or abandonment of the nesting area. Therefore, the Service anticipates abandonment of, or severely reduced productivity in, one nesting area for one season on up to two occasions due to burial of intertidal prey resources from renourishment within nesting areas between March 16 and April 15. Sand placement during this period will also reduce or eliminate the terrestrial wrack-line prey resource just as birds are arriving, and may also reduce food availability for north-bound migrants.

Late-season work is likely to have a far less severe impact on plovers from prey burial than early-season work, in large part due to the 1,000-m protective buffer for unfledged chick foraging areas. These buffers will prevent sand placement directly in brood feeding areas. However, Reilly and Bellis (1983) found that intertidal benthic fauna near the nourishment activity, but not subject to actual burial, were stressed. The authors attributed this finding to increased turbidity. On two occasions, transects just outside the nourishment area during sand placement revealed fewer intertidal benthic invertebrates than in reference areas. No estimate is given regarding the duration this “edge” effect persisted (Reilly and Bellis, 1983). The BMP found that short term elevations in turbidity occur along about 500 m of beach front during sand placement. Dispersal of suspended sediments is prominent in the swash zone in the immediate vicinity of the operation (U.S. Army Corps of Engineers, 2001d).

Within the Project area, the 500-m zone of increased turbidity will probably extend further north than south due to prevailing long shore currents. Therefore, the Service anticipates that an "edge" effect depressing intertidal invertebrates may extend for up to, but probably less than, 500 m into the 1,000-m buffer around chick foraging areas. The area of encroachment will depend on whether the sand placement is up-drift or down-drift of the nesting area. However, the Corps proposed 1,000-m buffers will be measured from the entire area being used by the brood, resulting in little or no adverse effects to nesting piping plovers from late-season intertidal prey depression. Work during this period may have some adverse effect on south-bound migrants, especially juvenile birds, although the likely extent of such impacts is unknown and may be minimal.

c. Creation of a Potential Piping Plover Population Sink

The creation of new habitat is not necessarily a purely beneficial effect of beach nourishment programs on beach nesting birds. Colonization of a new area may actually be detrimental if indirect adverse effects are sufficient to result in reproductive rates below those needed for stable or recovering populations. Habitat that is physically suitable may create a "population sink" by recruiting individuals to the area each season, only to yield reproduction below replacement levels. This may particularly affect piping plovers on sites close to highly protected habitats, such as those on Sandy Hook. Potential exists for newly renourished beaches within the Project area to lure piping plovers which would have otherwise nested on protected Sandy Hook beaches.

Reproductive data for piping plovers indicate that initial nourishment has not created a population sink in the Project area. From 1998-2000, piping plover productivity within the Project area was above the State-wide average each year, the replacement level of 1.245, and the population-wide recovery goal of 1.5. On average, Project area productivity is slightly higher than that on Sandy Hook, but only due to exceptional success in 1998 (Table 16).

Table 16. Comparison of Piping Plover Productivity in the Project Area and in Sandy Hook

Year	Project Area	Sandy Hook
1997	0.00	0.36
1998	2.50	1.00
1999	1.71	1.85
2000	1.63	1.76
2001	1.25	1.58
1997-2001 average	1.42	1.31

Sources: U.S. Fish and Wildlife Service, 2001b; National Park Service, 2001c; Lane, pers. comm., 2001

By maintaining the design profile, the Proposed project will continue to attract both federally listed species and people to a relatively narrow, generally eroding beach fronting extensively developed communities. In this way, the proposed Project will continue to expose piping plovers and seabeach amaranth to indirect adverse effects such as sub-optimal beach profiles, recreational impacts, adverse beach management practices, and predation. Based on past reproductive output and with full implementation of the Endangered Species Management Plan, these effects are not expected to reach the level of creating a plover population sink. They must nonetheless be factored into the Service's Biological Opinion.

d. Creation of Sub-Optimal Beach Profiles

The Corps BA asserts that, since seabeach amaranth currently occurs in the Project area, restoration of the sandy beach berm to the design profile will continue to provide suitable growing habitat (U.S. Army Corps of Engineers, 2001a); the same reasoning can be applied to piping plovers. However, piping plovers did not nest in the Project area until 2 years after the initial 1995 nourishment, and successful nesting did not occur until 3 years after initial nourishment. Seabeach amaranth was not discovered in the Project area until 5 years after initial nourishment. Therefore, the Service cannot assume that the construction template necessarily provides a suitable physical beach configuration for piping plovers or seabeach amaranth during the first few years after renourishment. Delayed colonization of the Project area after initial nourishment may have been due to plover fidelity to other sites and chance amaranth seed dispersal; alternatively, it may have been caused by unsuitable conditions in the Project area lasting a few seasons after nourishment. Based upon the current presence of these species in the Project area, the nourished beach clearly offers suitable habitat by at least year 3 for plovers, year 5 for amaranth.

High-quality piping plover and seabeach amaranth habitat is generally characterized by sparse vegetation, a well-developed wrack line, and, for plovers, abundant shell material. These habitat features will most likely return to a renourished beach within one or two nesting/growing seasons, at least in areas not mechanically raked. However, other features of high quality habitat may take longer to develop on a renourished reach. Piping plovers and seabeach amaranth both favor beaches with gentle slopes from the foredune to the water, a configuration which dissipates wave energy and provides a wider inter-tidal plover feeding area. The slope of the beach in the intertidal zone is generally steeper after nourishment until the beach reaches a more stable profile, and there is often a distinct scarp that forms in this zone as the beach fill adjusts (National Research Council, 1995).

The construction template calls for a completely flat berm (0 upper beach slope) and an inter-tidal beach at a slope of 1:10 in Section I and 1:20 in Section II, or 10 and 5 percent, respectively. This configuration bears similarities to the gently sloping areas preferentially chosen as plover nest sites on Cape Cod, Massachusetts. Jones (1997) found that upper beach slope at piping plover nest sites averaged only 5.6 percent, significantly less than random points that averaged

8.3 percent. He further found that intertidal slope was also less steep adjacent to nests (11.2 percent) than random points (12.8 percent). Strauss (1989) also found that piping plovers preferentially choose areas with shallower than average foredune slopes for nesting sites.

There are important differences, however, between a natural beach profile and the constructed, stabilized Project area beaches. The construction template creates a sharp discontinuity of slopes between the upper beach (0 percent) and the intertidal zone (10 percent) that may inhibit the movement of piping plovers, especially chicks, into intertidal foraging areas. In addition, temporary scarping may occur. By steepening the intertidal slope, scarping may reduce the size of the intertidal foraging area, further inhibit adult and chick movement into the intertidal zone, and possibly delay the formation of an upper beach wrack line, an important habitat component for both piping plovers and seabeach amaranth.

The Service anticipates that the physical configuration of the construction template will hinder the ability of unfledged piping plover chicks to forage in the intertidal zone for 1 to 3 years following construction, possibly causing slight decreases in productivity, but probably not resulting in abandonment of nesting areas. The configuration of the construction template is not likely to adversely affect seabeach amaranth, as the wide, flat berm should provide ample habitat following renourishment. Additional adverse effects to both species are likely if scarping occurs; however, these effects would not be expected to last more than one season per renourishment cycle.

In addition to the selected construction and design templates, dunes that have formed within the Project area also affect the physical suitability of beach habitats for piping plovers and seabeach amaranth. The construction templates and design profiles in the EIS/GDMs do not show the creation or maintenance of any dunes, and expected Project performance and benefits do not rely on dune formation (U.S. Army Corps of Engineers, 1990; 1995). However, dunes have begun to form in many parts of the Project area, in several areas through stabilization efforts (sand fencing and/or vegetation planting) of local beach managers. The 2002 construction template shows the horizontal berm starting in front of the existing dune line. Although existing dunes will be shorter relative to the new berm elevation after nourishment, they will persist and will likely continue to grow, in part through continued stabilization activities.

Steep, stabilized primary dunes provide unsuitable habitats for seabeach amaranth and piping plovers (Weakley and Bucher, 1992; Jones, 1997). No seabeach amaranth was found in stabilized dunes during Project area surveys, and piping plovers are not known to use these portions of the Project area (Service observation). Immediately following renourishment, the wide flat berm provides ample foredune habitat. However, as erosion proceeds and the dunes grow between nourishment cycles (both in total volume and in height relative to berm elevation), piping plovers and seabeach amaranth may be eliminated where the high tide line meets or scarps a steep dune face. This occurrence was observed for seabeach amaranth in northern Monmouth Beach in 2001.

Unstabilized dunes provide more potential piping plover and seabeach amaranth habitat than stabilized dunes. Unstabilized dunes tend to have a more gently sloping foredune face than stabilized dunes. Blowouts (breaks, often formed during storms) in the primary line of unstabilized dunes provide marginal habitat for seabeach amaranth (Weakley and Bucher, 1992) and high quality habitat for piping plovers (Strauss, 1989; Jones, 1997). Inter-dune and gently-sloping foredune habitats are particularly important towards the end of an inter-nourishment period, when the berm has been narrowed by erosion.

The Service anticipates that, without direct intervention by the Corps, dune stabilization over much of the Project area will continue. Dune formation, and especially dune stabilization, are expected to adversely affect both species during the one to two seasons prior to each renourishment cycle by further limiting the amount of available habitat, which will already be shrinking due to erosion. Based on the current distribution of seabeach amaranth and piping plovers in the Project area, the Service expects that these effects will be localized, and will not significantly limit population sizes. However, at such times in the renourishment cycle, the presence of stabilized dunes may affect reproductive success of piping plovers and seabeach amaranth through loss of plover foraging habitat, and increased exposure of both species to recreational pressures and flooding in the narrow berm. Additional, on-going adverse effects of dune stabilization include increased cover for plover predators, and promotion of vegetation, especially beach grass, that reduces habitat suitability for both species.

e. Recreational Impacts

As discussed under the Environmental Baseline, recreational use of current piping plover nesting areas is generally low to moderate, and human disturbance is not considered a significant factor affecting reproductive success. Even moderate levels of disturbance, however, are greater than those on Sandy Hook, where key nesting areas are completely closed to recreation during the breeding season. Recreational use in other portions of the Project area is intensive, and limits the suitability of many areas as plover habitat.

The level of recreational impacts within current piping plover nesting areas is expected to increase only slightly in the near term. Sea Bright and Monmouth Beach are extensively developed already, and few areas remain where additional high-density developments can be constructed. In addition, except at Monmouth Beach North, all nesting areas in these municipalities are located far enough from convenient parking and recreational centers to receive only light to moderate use. However, the Service cannot make any reliable estimates of long-term recreational patterns in Sea Bright and Monmouth Beach over the 50-year life of the Project.

Recreational impacts to piping plovers that may nest in other parts of the Project area are also difficult to reliably estimate. Plovers nesting at the National Guard Training Center are expected to receive only modest recreational disturbances, based upon the location of the 2002 nesting area relative to the bathing beach, and on the high level of cooperation demonstrated by the

Army National Guard to date. However, recreational impacts at this site would be more severe if piping plovers colonize the southern bathing beach. Many other currently unoccupied portions of the Project area receive far more intensive recreational use than Sea Bright and Monmouth Beach, and plovers nesting in such areas would be exposed to much greater disturbance. In some areas, such as beach clubs and elevated boardwalks, intensive early-season recreational use may prevent plovers from establishing courtship territories or initiating nesting.

Studies have found a negative correlation between the number of people present within 50 m 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 per pair in areas of low disturbance compared to 0.5 chicks 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 management. The Endangered Species Management Program is providing similar benefits to piping plovers in the Project area, which also extend to seabeach amaranth.

Within Sea Bright and Monmouth Beach, some evidence of recreational impacts to seabeach amaranth has been observed in areas of intensive use, such as beach access paths and around a volleyball net. Observations suggest that high levels of activity are precluding colonization in these areas. Trampling of plants is expected to increase throughout the Project area in the near term, as the plant will likely continue to expand into higher traffic areas. In 2001, plants were observed in close proximity to foot paths in the southern part of the Project area, and at the southern bathing beach on the National Guard Training Center (Kelly, pers. comm., 2001). As with piping plovers, long-term recreational impacts to seabeach amaranth in the Project area cannot be reliably estimated.

Based upon the performance of the Corps-funded Endangered Species Management Program to date, the Service anticipates that indirect effects to piping plovers and seabeach amaranth in the short term will continue to be minimized through intensive monitoring, fencing, and public outreach. This expectation assumes that endangered species management efforts will be increased or adjusted in future years to respond to changes in recreational patterns and/or species conditions. In the longer term of the proposed Project, however, recreational use of Project area beaches may eventually outstrip the ability of even the best management program to avoid adverse effects to piping plover and seabeach amaranth reproductive success. If, and to what extent, such impacts may occur cannot be predicted with any confidence over the 50-year Project life.

f. Adverse Beach Management Practices

The current effects of adverse beach management practices on piping plovers and seabeach amaranth are more significant than recreational impacts. Although strong communication has been established between the Service, the NJDEP, and the Corps, and municipal officials in Sea Bright and Monmouth Beach, full participation and cooperation of beach managers in these towns has not yet been achieved regarding endangered species protection. Practices such as mechanical beach raking and municipal vehicle use, and lax enforcement of pet ordinances and State Coastal Zone regulations have significant effects on piping plovers and seabeach amaranth in these municipalities.

Within Sea Bright and Monmouth Beach, seabeach amaranth has been observed in tire tracks on two occasions, fencing has been knocked down twice by vehicles in Sea Bright, and severe disturbances of piping plover chicks by a Sea Bright law enforcement vehicle occurred twice in 2001 (U.S. Fish and Wildlife Service, 2001b; Service observation; Salem, pers. comm., 2001). Construction of structures, boat storage, and physical sand manipulation by private citizens hinder implementation of the Endangered Species Management Program (Salem, pers. comm., 2001). The distribution of seabeach amaranth suggests that it is being eliminated from certain areas by beach raking, and mechanical raking has also occurred in close proximity to piping plover and least tern nesting areas (U.S. Fish and Wildlife Service, 2001b). Without additional efforts to secure municipal cooperation, these effects are expected to worsen over the short term; long-term effects cannot be reliably predicted.

At the National Guard Training Center, beach management practices are expected to continue the improvement begun in 2001 through the cooperation of the Army National Guard. However, conflicts may arise at this site if federally listed species colonize the southern bathing beach, where one seabeach amaranth plant has already been documented (Kelly, pers. comm., 2001).

Through the Endangered Species Management Program, the NJDEP initiated communication with Belmar and Spring Lake in 2001 to address the establishment of least tern colonies in these municipalities. Via the Endangered Species Management Program, the Service has initiated coordination with Seven Presidents County Park, Long Branch, Bradley Beach, Belmar, and Sea Girt regarding seabeach amaranth. Seabeach amaranth surveys of the Project area found that most plants were within 1 m of being raked or run over (Kelly, pers. comm., 2001). To date, Project area beach managers contacted regarding seabeach amaranth protection have been cooperative; however, the effectiveness of amaranth protective measures, and overall level of future local cooperation, are unknown.

The Endangered Species Management Program succeeds in avoiding and minimizing some adverse effects of beach management practices. However, based upon its performance to date, the program is insufficient to address management issues fully. Therefore, the Service anticipates indirect adverse Project effects from unfavorable beach management practices to increase in the near future. As with recreational impacts, effects in the more distant future cannot be estimated with any confidence.

g. Predation

Predation, primarily by crows, is the most significant factor affecting piping plover reproductive success within the Project area (U.S. Fish and Wildlife Service, 2001b; Salem, pers. comm., 2001). In addition, the first significant evidence of foxes and cats was observed in the Project area in 2001 (Salem, pers. comm., 2001). Piping plovers within the Project area are protected from predation by the Endangered Species Management Program through management actions such as use of predator exclosures around plover nests, and close monitoring.

Studies have shown exclosures to be effective in reducing piping plover nest predation, producing 74-92 percent hatching rates compared to only 12-25 percent rates for unexclosed nests (Elias-Gerken, 1994; MacIvor, 1990; Melvin *et al.*, 1992; Rimmer and Deblinger, 1990). However, the use of exclosures entails inherent risks, including direct destruction of eggs during deployment, nest abandonment, and injury of adult birds. Exclosures may also result in increased effects from "smart" predators that learn to key in on exclosures, eventually finding a way in, waiting for the brood to emerge, or causing nest abandonment by stressing the parents. It is important to note that predator exclosures are effective only in reducing loss of nests and eggs. Chicks are mobile within hours and rarely re-enter exclosures. Thus, exclosures do not reduce chick mortality from predation.

Based on results to date, the Service expects the Endangered Species Management Program to continue effectively minimizing the indirect effects of predation on piping plover nests through monitoring and the use of exclosures. However, if predation rates in the Project area continue to climb, these methods alone may be inadequate to stop continued declines in productivity. Active predator control in the Project area may become the only viable option for enhancing piping plover productivity. The Endangered Species Management Program will not be effective in implementing predator control measures without the cooperation and support of municipal officials and local beach managers. Without further efforts to increase municipal involvement in endangered species protection, the Service expects the indirect Project effects from exposing piping plovers to high predation rates to worsen in the short term. Long-term Project effects from predation cannot be accurately surmised.

Effects of herbivory on seabeach amaranth in the Project area to date have been minimal. Predation rates will likely increase as the plant becomes established, and insect herbivores increasingly exploit this new food source. With adequate Corps support, the Endangered Species Management Program should be able to respond effectively if herbivory begins to impair reproductive output significantly. If necessary, pesticides might be applied under appropriate conditions. To date, however, the Program has not addressed the issue of seabeach amaranth herbivore control.

E. CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, local, or private actions that are reasonably certain to occur in the action area considered in this Biological Opinion. Future federal actions that are unrelated to the proposed action are not addressed here because they require separate consultation pursuant to Section 7 of the ESA. Although the Service has concerns regarding other relevant effects to piping plovers and seabeach amaranth, none meet the regulatory definition of "cumulative effects," and therefore were not considered in this Biological Opinion. These other factors affecting piping plovers and seabeach amaranth do, however, merit at least cursory mention.

The tenuous status of piping plovers in the New York-New Jersey Recovery Unit is exacerbated by the extreme degree of stabilization of New Jersey's coastline. Although currently expanding, the long-term recovery potential of seabeach amaranth in New Jersey is also severely limited by the minimal opportunities for formation of highly productive, self-maintaining, early successional habitats. New Jersey 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"), New Jersey, America's oldest developed shoreline, is 43 percent hard-stabilized (Pilkey and Wright, undated *in* U.S. Fish and Wildlife Service, 1996b). Although construction of new hard stabilization structures in New Jersey has slowed, the Shore Protection Master Plan documents the State's intent to maintain existing functional structures in the Project area. In addition, almost the entire ocean-front coastline of New Jersey is scheduled for beach nourishment through federal, State, or local programs over the next 5 to 10 years, further contributing to shoreline stabilization, and further exposing beach strand species to the kinds of direct and indirect effects discussed above. Togther, these proposed beach nourishment programs may also increase the risk of species declines or extirpation in New Jersey by rendering significant proportions of habitat unsuitable at any given time (*i.e.*, through construction effects on habitat, and burial of plover prey and amaranth seed). These widespread, simultaneous habitat disturbances limit the ability of these species to disperse and recover from productivity declines or catastrophic events in the few remaining areas of suitable habitat.

Within the action area, further development and increased recreational beach use over the long Project life is likely, although not "reasonably certain to occur." Recreational beach impacts and conflicts over beach management may, at some time prior to 2053, reach levels at which piping plover and seabeach amaranth populations slip below replacement levels despite conscientious management efforts both on Sandy Hook and within the Project area.

F. CONCLUSION

After reviewing the current status of the piping plover and seabeach amaranth, the environmental baseline for the action area, the effects of the proposed beach nourishment project, and cumulative effects, the Service's Biological Opinion is that completion of the Sections I and II of the BECP in Monmouth County, New Jersey, is not likely to jeopardize the continued existence of the piping plover or seabeach amaranth. The Service's evaluation of the effects of the proposed Project on federally listed species was based largely on a Project Description that includes an extensive set of conservation measures to effectively avoid or minimize most significant direct and indirect effects to piping plovers and seabeach amaranth. The Corps proposes to include these conservation measures as part of its agency action; therefore, they were considered as an integral part of the proposed Project and are nondiscretionary over the life of the Project.

The subject Project perpetuates the long-standing series of hard coastal structures and extensive development that preclude natural coastal processes from creating optimal piping plover and seabeach amaranth habitats in the 34-km (21-mile) Project area. However, the Service's analysis recognizes that the Project will provide some compensatory benefits by creating and maintaining suitable, but sub-optimal, habitats.

No critical habitat has been designated for these species; therefore, no critical habitat will be affected.

IV. INCIDENTAL TAKE STATEMENT

A. DEFINITION OF INCIDENTAL TAKE

Section 9 of the ESA and federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened wildlife species, respectively, without special exemption. *Take* is defined as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct." *Harm* is further defined by the Service to include significant habitat modification or degradation that results in the death or injury to listed species by significantly impairing essential behavioral patterns such as breeding, feeding, or sheltering. *Harass* is defined by the 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, carrying out 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 a prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

B. EXTENT OF ANTICIPATED TAKE

1. Life of the Project

Over the 52-year life of the Project, taking of piping plovers will occur due to perpetuation of coastal development and shoreline stabilization structures that preclude formation of optimal habitats that support the highest densities of nesting pairs, with the highest productivity. The Project justification provided by the Corps does not project a near-term risk of overwash or breaching in the Project area; therefore, no attempt to quantify this take has been made. However, the Service notes that, during the life of the Project, prevention of natural habitat formation over the 34 km (21 miles) of the Project area will be a factor affecting the vulnerability of the Atlantic coast piping plover population to extinction, especially the New York-New Jersey Recovery Unit.

Conservation Measure (1) states that the Corps will reinitiate consultation with the Service prior to each planned renourishment cycle. In addition, several of the Project effects discussed above cannot be reliably quantified over the next 52 years. Therefore, in the course of future streamlined consultations under the auspices of this programmatic Biological Opinion, the Service will issue additional Incidental Take Statements, as necessary and appropriate, for future renourishments undertaken by the Corps as part of the subject Project.

2. 2002 Renourishment

The Service provides this Incidental Take Statement only for the planned 2002 renourishment of Sea Bright, Monmouth Beach, and part of Spring Lake, and all associated Project activities in Sea Bright

and Monmouth Beach during the 2002-2007 inter-nourishment interval.
The Service anticipates the following types and extent of incidental take of piping plovers from implementation of the 2002 renourishment:

1. Up to two brief, minor instances of harassment due to direct disturbance of nesting birds from Project activities, if construction occurs during the 2002 or 2003 nesting season within two separate nesting areas. (No further nesting-season work could occur within any piping plover nesting areas over the life of the Project without reinitiation of formal consultation.)

2. Twenty-five percent reduction in productivity due to reduced prey availability during the 2003 nesting season if renourishment of nesting areas is completed between November and January. Based on 8 pairs of piping plovers and a 5-year (1997-2001) average productivity rate of 1.42, lost productivity equals up to 3 chicks.

   OR

   Fifty percent reduction in productivity due to reduced prey availability during the 2003 nesting season if renourishment of nesting areas is completed between February and March 15. Based on 8 pairs of piping plovers and a 5-year average productivity rate of 1.42, lost productivity equals up to 6 chicks.

   OR

   Abandonment of, or a 100 percent reduction in productivity in, up to two separate nesting areas supporting up to seven pairs of plovers, due to reduced prey availability and increased exposure to predators in the 2003 nesting season, if sand placement continues in these areas through April 15. (No further nesting-season work could occur within any piping plover nesting areas over the life of the Project without reinitiation of formal consultation.) Based on 2001 populations, a worst-case scenario would be loss of 11 chicks: abandonment or 100 percent loss at two nesting areas (Sea Bright North and Sea Bright South/Monmouth Beach North) from work between March 15 and April 15, and a 50 percent productivity reduction at the remaining nesting area (Monmouth Beach South) from work between February and March 15.

3. Impairment of the ability of up to 11 chicks to access intertidal foraging areas during the 2003 nesting season due to discontinuity of slopes of the construction template, based on 8 pairs of piping plovers and a 5-year average productivity rate of 1.42.

4. Ten percent reduction in productivity at the end of the inter-nourishment interval (2002-2007) season resulting from dune stabilization and removal of wrack material from mechanical beach raking. Based on 8 pairs of piping plovers and a 5-year average productivity rate of 1.42, lost productivity equals up to 1 chick per year in 2006 and 2007.

5. Up to four instances of harassment per year for 6 years (a total of 24) of 1 to 4 chicks per year, caused indirectly by creating habitat that will expose nesting birds to recreational

impacts and unfavorable beach management practices.

C. EFFECT OF THE TAKE

The Service has determined that the level of take anticipated, as described above, from the proposed action is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

D. REASONABLE AND PRUDENT MEASURES

The measures described below are non-discretionary, and must be undertaken by the Corps for the exemption in section 7(o)(2) to apply. The Corps has a continuing duty to implement the activity covered by this Incidental Take Statement. If the Corps: (1) fails to implement the terms and conditions or (2) fails to require all contractors to adhere to the terms and conditions of the Incidental Take Statement, the protective coverage provided by Section 7(o)(2) to the Corps, contractors, and to local beach managers 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.

The Service concludes that the following reasonable and prudent measures are necessary and appropriate to minimize take of piping plovers:

1. Work cooperatively with the Service to schedule sand placement in nesting areas to minimize the potential for direct disturbance of nesting birds and to allow maximum recovery time of benthic prey resources, development of the wrack line, and adjustment of the beach profile.

2. Locate pipelines to avoid adverse effects to piping plovers.

3. Ensure that all Project engineers, contractors, and construction staff are fully informed of and compliant with all Conservation Measures, Reasonable and Prudent Measures, and Terms and Conditions.

4. Continue the adaptive management practices of the Endangered Species Management Program.

5. Ensure that appropriate Service, State, Corps and other field staff have continued access to all portions of the Project area necessary to carry out the Endangered Species Management Program over the life of the Project.

6. Work with local beach managers to encourage their increased cooperation and participation in endangered species protection.

7. Obtain quality data on the effects of renourishment on piping plover prey resources in Project area nesting areas.
8. Avoid direct impacts to piping plovers from physical and biological monitoring, and other Project activities other than actual sand placement.

9. Terminate incompatible dune stabilization activities in nesting areas.

10. Allow development of the wrack line in nesting areas.

11. Avoid direct adverse effects to least terns, which extend documented benefits to piping plovers.

12. Report direct take of piping plovers to this office.

E. TERMS AND CONDITIONS

In order to be exempt from the prohibitions of Section 9 of the ESA, the Corps must comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are nondiscretionary.

1a. Sequence renourishment within Constructable Reaches 1A and 1B (Monmouth Beach and Sea Bright), to provide maximum avoidance of nesting areas during the nesting season and to allow maximum recovery time of prey resources and adjustment of the beach profile, by conducting renourishment of known piping plover nesting areas as soon as possible following fledging of the last chick in each nesting area (preferably late August or September 2002).

1b. Remove any material or equipment staged or stored within nesting areas by March 15, 2003.

2. During the nesting season, locate all pipelines outside of piping plover nesting areas or floated off-shore. On-shore pipelines, either buried or on the surface, may impede piping plover foraging.

3a. Provide all Project engineers, contractors, and construction staff with a written summary of this Biological Opinion (including all Conservation Measures and Terms and Conditions), a written statement that all Conservation Measures, Reasonable and Prudent Measures, and Terms and Conditions contained herein are non-discretionary, and maps of current piping plover "nesting areas" as defined in this Biological Opinion.

3b. Schedule a meeting prior to the start of construction among the Service, Corps planning

staff and supervisors, the selected field monitor(s), and appropriate representatives of Project engineers, contractors, and construction staff to discuss implementation of Conservation Measures and Terms and Conditions.

3c. Provide appropriate documentation to the Service at least one week prior to exercising any contingencies for work in an occupied reach during the nesting season. Documentation must demonstrate that clear channels have been established among the Corps, the Service-approved field monitor(s), and other contract personnel to halt or modify construction activities immediately based upon detection, movement, disturbance, or imminent harm of piping plovers as reported by the field monitor(s), requiring buffers to be implemented or adjusted. Documentation must name the Corps staff person(s) responsible for issuing sudden changes to work orders necessary to protect piping plovers and comply with the terms of the Biological Opinion, and must indicate that the field monitor(s) and other affected Corps and contract personnel will be equipped with adequate communication capabilities to respond immediately to any changed condition that may affect plovers. This documentation must also include provisions for Service notification within 24 hours of any such developments.

3d. For any work in an occupied reach during the nesting season, provide this office, the ENSP, and construction contractors a weekly report of piping plover activity indicating the geographic extent of "nesting areas" as defined in this Biological Opinion. Also provide this office and the ENSP a weekly report of the location of sand placement activities, both current and planned over the coming week, as well as the results of the pre-construction monitoring described under Conservation Measure (5)(iii) indicating the area surveyed. Notify all parties immediately if a nesting area expands, or if there is a change to the planned location of sand placement activities.

4. Evaluate the Endangered Species Management Program annually, and, with Service input, adapt the Program as needed to maintain species protection at levels at least equal to those of the 2000-2002 nesting seasons. As species distributions and/or threats may change, different levels and/or methods of species management may be necessary to maintain current levels of protection (*i.e.*, more or less effort than one full-time, seasonal, local monitor may be needed).

5. Obtain legal easements or authorizations allowing Service, State, and Corps field staff, or their official representatives, continued access to all portions of the Project area for the life of the Project, including private property within the beach-dune ecosystem, for the purposes of carrying out endangered species management activities, including, but not limited to, installation of fencing, observation, and data collection. Provide documentation of these easements or authorizations to appropriate field staff, municipal officials, and private parties as needed.

6. Work cooperatively with municipal officials in each Project area municipality with known occurrences of federally or State-listed species to develop and implement a Service-approved endangered species management plan. For Seven Presidents Park and the National Guard Training Center, plan development should be coordinated with Monmouth County Park System and New Jersey Army National Guard, respectively. Plans must be completed prior to the start of the next scheduled renourishment of Contracts 1A and 1B (Monmouth Beach and Sea Bright), planned for 2007. Management plans must be approved by town councils or other appropriate bodies, and must be developed with full input of those local officials or staff directly responsible for beach management including mechanical beach raking, trash removal, life guards, and law enforcement. Plans must be consistent with the Service's 1994 "Guidelines for Managing Recreational Activities in Piping Plover Breeding Habitats on the U.S. Atlantic Coast to Avoid Take Under Section 9 of the Endangered Species Act," and must address issues including but not limited to: symbolic fencing (on both public and private portions of the beach), mechanical beach raking, trash collection and beach clean-ups, sand fencing, vegetation management, predator control, enforcement of pet laws and State Coastal Zone regulations, operation of vehicles on the beach, possible designation of portions of beach as natural areas, and the local role in endangered species management.

7. Monitor the response of the wrack line and intertidal infaunal invertebrate communities during and after sand placement within nesting areas. Place special emphasis on species likely to be piping plover prey items (*i.e.*, flying insects, polycheates, amphipods, young mole crabs), and produce estimates of total recovery time, as well as recovery rates, of abundance, biomass, and composition of piping plover prey items.

8a. Schedule or locate monitoring of physical or biological beach parameters, especially the use of "sleds" to take beach profiles, outside of the nesting season (March 15 to fledging of the last chick), or at least 300 m outside of areas known to support courting, territorial, and/or breeding plovers during any of the three most recent nesting seasons, except as needed to implement #7. Ensure that a Service-approved monitor is present when conducting activities within 1,000 m of such areas during the nesting season.

8b. Within occupied reaches, schedule repair and maintenance of seawalls, bulkheads, and other structures, and any other construction or activity requiring motorized vehicles or equipment, outside the nesting season (March 15 to fledging of the last chick).

9. Prohibit further sand fencing or vegetation planting within areas known to support courting, territorial, and/or breeding plovers during any of the three most recent nesting seasons.

10. Prohibit mechanical beach raking and removal of natural organic materials within 200 m of areas known to support courting, territorial, and/or breeding plovers during any of the three most recent nesting seasons. Litter may be manually removed from such areas. If no nesting activity occurs in such an area by July 1, mechanical beach raking may resume, except as constrained by State regulations regarding Coastal Zone Management.

11. Work with the ENSP to schedule and implement beach nourishment and associated activities to avoid direct adverse effects to least terns, including no sand placement within 200 m of an active colony.

12a. Report the extent of direct incidental take of piping plovers to the Service within 30 days of completing renourishment, in addition to the notification procedures outlined under Conservation Measures (5)(iii). Through the Endangered Species Management Program, document annually the extent of observed indirect incidental take of piping plovers from recreational activities and unfavorable beach management practices.

12b. 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 or 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:

Senior Resident Agent
U.S. Fish and Wildlife Service
Division of Law Enforcement
Sea Land Building, 2nd Floor
1210 Corbin Street
Elizabeth, New Jersey 07201
(973) 645-5910

Upon locating an abandoned nest or non-viable egg specimen, initial notification must be made to the following Service office:

Supervisor
U.S. Fish and Wildlife Service
New Jersey Field Office
927 N. Main Street, Bldg. D
Pleasantville, New Jersey 08232
(609) 646-9310

The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize incidental take that might otherwise result from the proposed action. If, during the course of the action, the aforementioned level of incidental take is exceeded, such incidental take would represent new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. The Corps 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. The Service will not refer the incidental take of any piping plover for prosecution under the Migratory Bird Treaty Act of 1918, as amended (16 U.S.C. §§ 703-712) if such take is in compliance with the terms and conditions specified herein.

V. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. The Service recommends the Corps carry out the following actions to further piping plover and seabeach amaranth recovery.

1. Design and construct a beach profile in nesting areas, with technical assistance from the Service and the ENSP, to maximize habitat suitability for piping plovers. Possible design features include gradual slopes, de-stabilized dunes, and non-ocean feeding areas, such as tidal pools.

2. Monitor numbers of known piping plover predators (*i.e.*, gulls) in the vicinity of active sand placement operations, and conduct a comparison of predator densities on various sections of beach before, during, and after fill.

3. Initiate research into the diet and foraging habits of piping plovers in the Project area.

4. Investigate the option of controlling avian predators in Sea Bright and Monmouth Beach and implement appropriate measures to be jointly determined by the Corps and the Service.

5. Continue periodic aerial photography of the entire Project area, and extend this effort to include Sandy Hook. Provide the Service and the NPS with digital and printed copies of the photographs.

6. Investigate factors determining the distribution of piping plovers (nest site selection) within the Project area.

7. Implement a program of long-term storage of seabeach amaranth seeds collected from the Project area as insurance against catastrophic population declines.

8. Conduct a statistically defensible experiment of various methods for restoring seabeach amaranth seed and cultivated seedlings to the Project area to determine which treatments are most efficient and effective.

9. Conduct a DNA analysis of seabeach amaranth from the Project area, other sites in New Jersey, and other States to investigate if differences exist between populations. Genetic studies will contribute to future species recovery activities, and may lead to lower cost

restoration programs, both in the Project area and elsewhere.

VI. REINITIATION - CLOSING STATEMENT

This concludes formal consultation on the completion of Sections I and II of the BECP. 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 is 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.

Specific circumstances requiring reinitiation of consultation include, but are not limited to, designation of new borrow areas, a change in the composition of fill material (percent sand), a drop in piping plover productivity within the Project area below replacement levels (1.245 chicks fledged per pair) for 3 consecutive nesting seasons, or a drop of 50 percent or more in seabeach amaranth populations persisting for 3 consecutive growing seasons. These circumstances would constitute modification of the proposed Project or new information not considered in this opinion. A change in borrow areas or composition of fill material may expose listed species to environmental contaminants, and may change recovery times of the piping plover prey base. A change in borrow areas may also alter coastal processes effecting Sandy Hook. Prolonged drops in piping plover productivity and/or seabeach amaranth populations may indicate that the Project area has become a population sink (reproductive output below replacement levels). In addition to and consistent with the regulatory requirements for reinitiation described above, several specific conditions for reinitiation of consultation are included in the Corps Project Description.

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