US Army Corps
of Engineers
Philadelphia District

New Jersey Department of
Environmental Protection

Lower Cape May Meadows - Cape May Point

Feasibility Study

Volume 1

Feasibility Report

Integrated Environmental Impact Statement (EIS)

Appendix A: Pertinent Correspondence

August 1998

New Jersey Shore Protection Study
Lower Cape May Meadows - Cape May Point

Feasibility Report and Integrated Environmental Impact Statement (EIS)

August 1998
U.S. Army Corps of Engineers
Philadelphia District

Public Notice

US Army Corps of Engineers
North Atlantic Division
Fort Hamilton Military Community
General Lee Avenue
Brooklyn, New York 11252-6700

In Reply Refer to : CENAD-ET-P
Date : 31 August 1998

NOTICE OF COMPLETION OF FINAL FEASIBILITY REPORT
AND
FINAL ENVIRONMENTAL ASSESSMENT
ON
NEW JERSEY SHORE PROTECTION STUDY
LOWER CAPE MAY MEADOWS - CAPE MAY POINT
FEASIBILITY STUDY

COMPLETION OF STUDIES

The District Engineer, Division Engineer, and State of New Jersey have completed a feasibility study for a project that provides ecosystem restoration for Lower Cape May Meadows and storm damage reduction for Cape May Point.

The Lower Cape May Meadows - Cape May Point Feasibility Study is one of six site-specific areas recommended by the New Jersey Shore Protection Study. It was authorized by resolutions adopted by the U.S. House of Representatives and U.S. Senate in December, 1987. This feasibility study was cost-shared between the Federal Government and the State of New Jersey through the New Jersey Department of Environmental Protection (NJDEP) and was conducted under the provisions of the Feasibility Cost Sharing Agreement executed 31 January 1995. This feasibility study was initiated in April 1995.

PLAN OF IMPROVEMENT

Lower Cape May Meadows (henceforth referred to as The Meadows) is an internationally significant coastal wetland situated along the Atlantic flyway and contains both Cape May Point State Park and The Cape May Migratory Bird Refuge, the latter being owned by The Nature Conservancy. The study area is included in the Ramsar List of Wetlands of International Importance, is part of the Western Hemisphere Shorebird Reserve Network, the Delaware Estuary Program, the Coastal Ecosystems Program, and has been identified as an Important Waterfowl Habitat Area under the Atlantic Coast Joint Venture of the North American Waterfowl Management Plan. In addition, this study is included in and endorsed by the Coastal America Program. The Meadows provides a vital resting spot for shorebirds, birds of prey, and songbirds during their seasonal migration as well as providing habitat for residential birds. It is considered by Federal, state and private organizations to be one of the foremost avian viewing areas in North America attracting more than 100,000 birders each year.

Lower Cape May Meadows has been severely impacted by shoreline erosion linked to the Federal navigation project at Cape May Inlet completed in 1911. Erosion has resulted in the direct loss of beach and unique freshwater wetland habitat. Erosion to the dune system has left the remaining freshwater ecosystem in The Meadows substantially degraded through saltwater intrusion and subsequent topographical alteration by allowing oceanwater overtopping during storm events. Since 1991, the dunes protecting the wetlands have been breached six times, resulting in salt water intrusion to the freshwater wetlands. Very few plant or animal species have the adaptations needed to survive such large fluctuations or range of salinities (freshwater to saltwater). The saltwater

intrusion has also encouraged the subsequent proliferation of the nuisance plant species Phragmites australis, also know as common reed. These conditions have significantly reduced the ability of the wetlands to support the wildlife and endangered plant species which reside there. Compounding the problem is the hydraulic/hydrologic relationship between Lower Cape May Meadows and the communities of Cape May Point and West Cape May. Lower Cape May Meadows serves as a buffer during storms between the ocean and the surrounding developed areas. When the Meadows area is inundated during storm events, the flood waters flow into Cape May Point and the developed portions of Lower Township and West Cape May, flooding the low lying areas of these towns. The feasibility study evaluated various alternative plans of improvement based on Environmental Quality (EQ) benefits to The Meadows and storm damage reduction benefits (NED) for Cape May Point and West Cape May.

The selected plan has primary outputs based on ecosystem restoration and secondary outputs for hurricane and storm damage reduction. The selected plan includes:

- Protective dune/berm construction with a berm width of 20 feet at elevation +8.0NGVD (+6.7 NAVD88) and a dune elevation of +18.0 feet NGVD (+16.7 NAVD88). The dune/berm would extend from the 3rd Avenue terminal groin in Cape May City to the Central Avenue groin in Cape May Point at which point the fill translates to tie into the existing beach and dune. The total length of fill is 10,050 linear feet (1.9 miles). Initial sand quantity is 2,372,000cy, which includes initial design fill (1,722,000 cy) plus advanced nourishment (650,000 cy). Periodic nourishment of 650,000 cy would be placed every 4 years. This plan includes planting of 18 acres of dune vegetation.

- Seaward restoration of 35 acres of previously eroded emergent wetland. This will move the Mean High Water (MHW) line seaward a maximum distance of 280 feet.

- Elimination of 95 acres of Phragmites australis through herbicidial spraying and burning.

- Planting of 105 acres of emergent wetland vegetation.

- Excavation of existing drainage ditches to restore freshwater flow.

- Creation of drainage ditches, linking hydrological segments of the project area.

- Installation of 2 weir flow control structures.

- Creation of a total of 6 fish reservoirs within existing ponds.

- Construction of a shallow earthen water retaining structure and installation of a self-regulating tide gate at Cape Island Creek to allow for approximately 25 acres of tidal marsh.

A Section 404(b)(1) evaluation has been prepared and is included in the Environmental Impact Statement and Feasibility Report. This evaluation concludes that the proposed action would not result in any significant environmental impacts relative to the areas of concern under Section 404 of the Federal Clean Water Act.

Ecosystem restoration benefits include a gain of approximately 388 habitat units (HU), 173 average annual acres prevented from erosion, and 175 average annual acres not inundated by saltwater when compared to the without-project condition. Storm damage reduction benefits to Cape May Point and West Cape May total $944,800. Average annual cost of the project is $2,386,000. This information is based on October 1997 price levels.

The protective dune/berm component of the project at Lower Cape May Meadows will be cost-shared consistent with Section 111 of the River and Harbor Act of 1968, as amended by Section 940 of the Water Resources Development Act of 1986. The costs of implementing measures under Section 111 authority are cost-shared on the same percentage as the cost of the project causing the damage. Ecosystem

restoration project features shall be cost-shared 65% Federal, 35% non-Federal in accordance with the Water Resources Development Act of 1996 (Public Law 104-303, Section 210). In accordance with Section 103(c) of the Water Resources Development Act of 1986 (Public Law 99-662), separable project features that provide Hurricane & Storm Damage Reduction (H&SDR) benefits (the protective dune/berm along Cape May Point) will be cost-shared 65 percent Federal and 35 percent non-Federal. Under current law, the above cost sharing percentages apply to both initial construction, and subsequent periodic nourishment

However, the Administration has proposed a new cost sharing policy for the periodic nourishment of shore protection projects. Under the proposed cost sharing policy, periodic nourishment associated with plans to respond to natural erosion and storm damage reduction will generally be cost-shared 35 percent Federal and 65 percent non-Federal. The non-Federal sponsor supports the implementation of the project and supports cost sharing of project features consistent with existing law and implementation of periodic nourishment elements consistent with cost sharing enacted by Congress in law.

Based on October 1997 price levels, the total initial project cost of construction is estimated to be $15,548,000. The Federal share of this first cost is $11,810,000 and the non-Federal share is $3,738,000. Lands Easements, Rights-of-Ways, Relocations and Dredged Material Disposal Areas (LERRD) costs are $145,000 and will be credited against the non-Federal sponsor's cash contribution.

Periodic nourishment is expected to occur at 4 year intervals subsequent to the completion of initial construction (year 0) of the dune/berm component of the project. Based on a volume of 650,000cy for each nourishment cycle, the cost per cycle is $4,740,000 (Oct 1997 price level) for construction years 4, 12, 20, 36, and 44; $4,793,000 (Oct 1997 price level) for construction years 8, 16, 24, 32, 40, and 48; $4,826,000 for construction year 28. (The reason for this variation is due to varying engineering and design (E&D) costs, specifically geotechnical investigations). Over the 50-year project life, the total periodic nourishment cost is estimated to be $58,023,000 (Oct 1997 price level).

The ultimate cost of construction which includes initial construction, project monitoring, and fifty years of periodic nourishment is estimated to be $73,571,000 (October 1997 price levels), cost-shared 79.5% Federal, 20.5% non-Federal, based on Water Resource Development Act (WRDA) 1986 cost-sharing. All costs also include planning, engineering, and design. Operation, Maintenance, Repair, Replacement, and Rehabilitation (OMRR&R) is a non-Federal responsibility. The ultimate cost-sharing percentage may be altered due to Administration proposed WRDA 98 cost-sharing of the periodic nourishment project component.

The selected plan is recommended for implementation subject to the Administration proposed Water Resources Development ACT (WRDA) 98 cost-sharing for the shore protection component of the recommended plan as enacted by Congress in law, with such modifications as in the discretion of the Chief of Engineers may be advisable.

FINDINGS AND RECOMMENDATIONS

The recommendations contained within the report reflect the information available at this time, and current policies governing the formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program, nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for authorizations and/or implementation funding.

COORDINATION

As a result of formal coordination, the recommendations contained in the report are supported by Federal, state, regional, and local agencies. All comment letters and responses are provided in the final report. Sponsorship for the project will be provided by the New Jersey Department of Environmental Protection

(NJDEP). NJDEP has expressed its support for the recommended plan.

PUBLIC INVOLVEMENT

Public involvement and coordination actions during the entire feasibility study were undertaken through newsletters, conferences, presentations, and public notices.

REVIEW AND AUTHORIZATION PROCESS

The report is being forwarded for Washington level policy review and decision-making by the Headquarters, U.S. Army Corps of Engineers and the Assistant Secretary of the Army for Civil Works. This report review is coordinated by the Policy Review Branch of the Headquarters Policy Review and Analysis Division, which administers a review of the report by the affected states and other Federal agencies. Based upon the report review, the Chief of Engineers will prepare a report and forward a recommendation on the project to the Secretary of the Army. If the Chief's recommendation is significantly different from the recommendation coordinated with the State and Federal agencies, the state and Federal agencies will be afforded an opportunity to comment further prior to submission of the Chief's report to the Secretary. Following completion of the Chief of Engineer's report, the Assistant Secretary of the Army for Civil Works, in consultation with the Office of Management and Budget, then establishes the Administration position on whether the proposal should be recommended to Congress for authorization.

VIEWS OF INTERESTED PARTIES

Interested parties may present written views on the report by mailing their comments to the Policy Review Branch, Policy Review and Analysis Division, Kingman Building, Fort Belvoir, Virginia, 22060-5576, in time to reach the Policy Review Branch within 30 days of the date of this Notice. If extension of this date is necessary, a written request stating the reason and additional time desired should be provided to the Policy Review Branch soon after receipt of this notice. Copies of information received by mail will be regarded as public information (unless the correspondent limits its effective value by requesting otherwise), and may be inspected and notations made therefrom by other interested parties, in the office of the Policy Review Branch. The Chief of Engineers will not take final action on the report until after expiration of this notice, or any extension thereof that may be granted, and full consideration of all information submitted in response thereto. Statements submitted should not repeat material contained in the report since this information is already available to the Policy Review Branch. Information submitted should be new, specific in nature, and bear directly on the findings of the report.

REPORT INFORMATION

Further information may be obtained from the District Engineer, U.S. Army Engineer District, Philadelphia, 100 Penn Square East, CENAP-PL-PC, Philadelphia, Pennsylvania, 19107-3390. Mr. Carmen G. Zappile, study manager with the Planning Division, is available at 215-656-6576 to answer questions, but not to accept views on the report recommendations. Interested parties may obtain copies of the Final Feasibility Report and Environmental Assessment, and Technical Appendices from the District Engineer at the cost of reproduction of the Final Feasibility Report and appendices. The report may be reviewed by interested parties at the Philadelphia District office and the New Jersey Department of Environmental Protection, Division of Engineering and Construction offices in Toms River (1510 Hooper Avenue, Toms River, New Jersey 08753).

Please pass along a copy of this Public Notice to anyone who may be interested in the report and has not received a copy.

Jerry L. Sinn
Major General, USA
Commanding

New Jersey Shore Protection Study
Lower Cape May Meadows - Cape May Point

Feasibility Report and Integrated Environmental Impact Statement (EIS)

August 1998

ABSTRACT: This feasibility report/EIS presents the findings of a study to determine the feasibility of implementing a long-term ecosystem restoration and storm damage reduction plan. It provides the findings of economic, social, environmental, and engineering analyses that were used to select a plan of action. The potential impacts, if any, to cultural and environmental resources are evaluated herein in accordance with NEPA and Section 106 of the National Historic Preservation Act of 1966.

NOTE TO READER: To provide full and convenient access to the environmental, economic, and engineering documentation prepared for the study, the EIS for this project has been integrated into this feasibility report in accordance with Engineer Regulation 1102-2-100 (December 28, 1990). Sections required for compliance with the National Environmental Policy Act (NEPA) are noted by an asterisk (*) in the Table of Contents.

Acknowledgments

The U.S. Army Corps of Engineers would like to thank the numerous agencies and individuals who participated in the study. Although it is not possible to identify by name all of the individuals who provided assistance in the development of this report, we would like to specifically acknowledge the assistance of the following individuals who provided important insights into the needs of the study area as well as critical technical guidance in the identification of problems and potential solutions. The assistance provided by these individuals was extremely valuable in enabling the U.S. Army Corps of Engineers to complete this report.

Borough of Cape May Point
Malcom Fraser, Mayor
Jim Handley, Beach Protection Coordinator

Cape May County Mosquito Commission
Judy Hanson, Superintendent

The Nature Conservancy
Jay Laubengeyer, Delaware Bayshores Office
Elizabeth Johnson

New Jersey Department of Environmental Protection:
Dean Cramer, Superintendent, Cape May Point State Park
Gene Keller, Engineering and Construction
Bernard Moore, Engineering and Construction
Robert Cartica, Office of Natural Lands Management, Division of Parks and Forestry

U.S. Fish and Wildlife Service
Eric Schrading, Biologist

New Jersey Shore Protection Study
LOWER CAPE MAY MEADOWS - CAPE MAY POINT FEASIBILITY STUDY
Feasibility Report and Integrated Environmental Impact Statement (EIS)

EXECUTIVE SUMMARY

This report presents the results of a feasibility phase study to determine an implementable solution and the extent of Federal participation for a project that provides ecosystem restoration for Lower Cape May Meadows and storm damage reduction for Cape May Point.

The Lower Cape May Meadows - Cape May Point Feasibility Study is one of six site-specific areas recommended by the New Jersey Shore Protection Study. It was authorized by resolutions adopted by the U.S. House of Representatives and U.S. Senate in December, 1987. This feasibility study was cost-shared between the Federal Government and the State of New Jersey through the New Jersey Department of Environmental Protection (NJDEP) and was conducted under the provisions of the Feasibility Cost Sharing Agreement executed 31 January 1995. This feasibility study was initiated in April 1995.

Lower Cape May Meadows (henceforth referred to as The Meadows) is an internationally significant coastal wetland situated along the Atlantic flyway and contains both Cape May Point State Park and The Cape May Migratory Bird Refuge, the latter being owned by The Nature Conservancy. The study area is included in the Ramsar List of Wetlands of International Importance, is part of the Western Hemisphere Shorebird Reserve Network, the Delaware Estuary Program, the Coastal Ecosystems Program, and has been identified as an Important Waterfowl Habitat Area under the Atlantic Coast Joint Venture of the North American Waterfowl Management Plan. In addition, this study is included in and endorsed by the Coastal America Program. The Meadows provides a vital resting spot for shorebirds, birds of prey, and songbirds during their seasonal migration as well as providing habitat for residential birds. It is considered by Federal, State and private organizations to be one of the foremost avian viewing areas in North America attracting more than 100,000 birders each year.

Lower Cape May Meadows has been severely impacted by shoreline erosion linked to the Federal navigation project at Cape May Inlet completed in 1911. Erosion has resulted in the direct loss of beach and unique freshwater wetland habitat. Erosion to the dune system has left the remaining freshwater ecosystem in The Meadows substantially degraded through saltwater intrusion and subsequent topographical alteration by allowing oceanwater overtopping during storm events. Since 1991, the dunes protecting the wetlands have been breached six times, resulting in salt water intrusion to the freshwater wetlands. Very few plant or animal species have the adaptations needed to survive such large fluctuations or range of salinities (freshwater to saltwater). The saltwater intrusion has also encouraged the subsequent proliferation of the nuisance plant species Phragmites australis, also know as common reed. These conditions have significantly reduced the ability of the wetlands to support the wildlife and endangered plant species which reside there. Compounding the

problem is the hydraulic/hydrologic relationship between Lower Cape May Meadows and the communities of Cape May Point and West Cape May. Lower Cape May Meadows serves as a buffer during storms between the ocean and the surrounding developed areas. When the Meadows area is inundated during storm events, the flood waters flow into Cape May Point and the developed portions of Lower Township and West Cape May, flooding the low lying areas of these towns.

The feasibility study evaluated various alternative plans of improvement based on Environmental Quality (EQ) benefits to The Meadows and storm damage reduction benefits (NED) for Cape May Point and West Cape May.

The selected plan has primary outputs based on ecosystem restoration and secondary outputs for hurricane and storm damage reduction. The selected plan includes:

- Protective dune/berm construction with a berm width of 20 feet at elevation +8.0 NGVD (+6.7 NAVD88) and a dune elevation of +18.0 feet NGVD (+16.7 NAVD88). The dune/berm would extend from the 3rd Avenue terminal groin in Cape May City to the Central Avenue groin in Cape May Point at which point the fill translates to tie into the existing beach and dune. The total length of fill is 10,050 linear feet (1.9 miles). Initial sand quantity is 2,372,000 cy, which includes initial design fill (1,722,000 cy) plus advanced nourishment (650,000 cy). Periodic nourishment of 650,000 cy would be placed every 4 years. This plan includes planting of 18 acres of dune vegetation.

- Seaward restoration of 35 acres of previously eroded emergent wetland. This will move the Mean High Water (MHW) line seaward a maximum distance of 280 feet.

- Elimination of 95 acres of Phragmites australis through herbicidial spraying and burning.

- Planting of 105 acres of emergent wetland vegetation.

- Excavation of existing drainage ditches to restore freshwater flow.

- Creation of drainage ditches, linking hydrological segments of the project area.

- Installation of 2 weir flow control structures.

- Creation of a total of 6 fish reservoirs within existing ponds.

- Construction of a shallow earthen water retaining structure and installation of a self-regulating tide gate at Cape Island Creek to allow for approximately 25 acres of tidal marsh.

A Section 404(b)(1) evaluation has been prepared and is included in this Environmental Impact Statement and Feasibility Report. This evaluation concludes that the proposed action would not result in any significant environmental impacts relative to the areas of concern under Section 404

of the Federal Clean Water Act.

Ecosystem restoration benefits include a gain of approximately 388 habitat units (HU), 173 average annual acres not eroded, and 175 average annual acres not inundated by saltwater when compared to the without-project condition. Storm damage reduction benefits to Cape May Point and West Cape May total $944,800. Average annual cost of the project is $2,386,000. This information is based on October 1997 price levels.

The selected plan was in-part formulated in response to the adverse impacts of the Federal navigation project at Cape May Inlet. The protective dune/berm component of the project at Lower Cape May Meadows will be cost-shared consistent with Section 111 of the River and Harbor Act of 1968, as amended by Section 940 of the Water Resources Development Act of 1986. The costs of implementing measures under Section 111 authority are cost-shared on the same percentage as the cost of the project causing the damage. Ecosystem restoration project features shall be cost-shared 65% Federal, 35% non-Federal in accordance with the Water Resources Development Act of 1996 (Public Law 104-303, Section 210). In accordance with Section 103(c) of the Water Resources Development Act of 1986 (Public Law 99-662), separable project features that provide Hurricane & Storm Damage Reduction (H&SDR) benefits (the protective dune/berm along Cape May Point) will be cost-shared 65 percent Federal and 35 percent non-Federal.

The Administration has proposed a new cost sharing policy for the periodic nourishment of shore protection projects. Cost sharing of the initial cost of construction is unchanged and will continue to be specified by Section 111 of the River and Harbor Act of 1968, as amended and Section 103 of WRDA 1986. Under the proposed cost sharing policy, periodic nourishment associated with plans to respond to natural erosion and storm damage reduction will generally be cost-shared 35 percent Federal and 65 percent non-Federal. For the Lower Cape May Meadows project, cost sharing of the periodic nourishment associated with the plan to respond to natural erosion (24 percent natural processes) and periodic nourishment associated with the Cape May Point storm damage reduction project would be affected by the proposed cost sharing. The non-Federal sponsor supports the implementation of the project and supports cost sharing of project features consistent with existing law and implementation of periodic nourishment elements consistent with cost sharing enacted by Congress in law.

Based on October 1997 price levels, the total initial project cost of construction is estimated to be $15,548,000. The Federal share of this first cost is $11,810,000 and the non-Federal share is $3,738,000. Lands Easements, Rights-of-Ways, Relocations and Dredged Material Disposal Areas (LERRD) costs are $145,000 and will be credited against the non-Federal sponsor's cash contribution.

Periodic nourishment is expected to occur at 4 year intervals subsequent to the completion of initial construction (year 0) of the dune/berm component of the project. Based on a volume of 650,000 cy for each nourishment cycle, the cost per cycle is $4,740,000 (Oct 1997 price level) for construction

years 4, 12, 20, 36, and 44; $4,793,000 (Oct 1997 price level) for construction years 8, 16, 24, 32, 40, and 48; $4,826,000 for construction year 28. (The reason for this variation is due to varying engineering and design (E&D) costs, specifically geotechnical investigations). Over the 50-year project life, the total periodic nourishment cost is estimated to be $58,023,000 (Oct 1997 price level) and includes E&D monitoring during construction. As stated above, cost sharing for periodic nourishment (relating to natural erosion or shore protection) will either be in accordance with Section 103(c) of the Water Resources Development Act of 1986 or based on Administration proposed WRDA 98 cost-sharing (see Table 7.6.3-3 of this report).

The ultimate cost of construction which includes initial construction, project monitoring, and fifty years of periodic nourishment is estimated to be $73,571,000 (October 1997 price levels), cost-shared 79.5% Federal, 20.5% non-Federal, based on WRDA 1986 cost-sharing (see Tables 7.6.2-2 and 7.6.2-3 for cost-sharing allocation). All costs also include planning, engineering, and design. Operation, Maintenance, Repair, Replacement, and Rehabilitation (OMRR&R) is a non-Federal responsibility. The ultimate cost-sharing percentage may be altered due to Administration proposed WRDA 98 cost-sharing of the periodic nourishment project component.

The selected plan is recommended for implementation subject to the Administration proposed WRDA 98 cost-sharing for the shore protection component of the recommended plan as enacted by Congress in law, with such modifications as in the discretion of the Chief of Engineers may be advisable.

LOWER CAPE MAY MEADOWS - CAPE MAY POINT FEASIBILITY STUDY
DESCRIPTION OF THE SELECTED PLAN

Description: The proposed ecosystem restoration project provides a protective dune and berm to reduce oceanwater inundation to the Lower Cape May Meadows ecosystem and also includes restoration of the internal wetlands at The Meadows through: restoration of emergent wetland, elimination of *Phragmites australis*, planting of emergent wetland vegetation, excavation to restore flow within existing drainage ditches, creation of drainage ditches, linking hydrological segments of the project area, installation of 2 weir flow control structures, creation of 6 fish reservoirs within existing ponds, and construction of a shallow earthen water retaining structure and installation of a self-regulating tide gate to allow for a 25 acre tidal marsh.

Protective Dune/Berm Component:

Volume of Initial Design Fill	1,722,000 cu yds
Volume of Renourishment Fill	650,000 cu yds
Interval of Renourishment	4 years
Length of Fill	10,050 ft
Width of Beach Berm	20 ft
Width of Dune Crest	25 ft
Dune Slopes	1V:3H landward, 1V:5H seaward
Beach Berm to Existing Bottom	1V:25H
Dune Grass	18 acres
Sand Fencing	15,000 linear ft
Piping Plover walkovers	6 acres

Internal Ecosystem Restoration

Seaward restoration of previously eroded wetland	35 acres
Maximum seaward distance of moved MHW line	280 ft
Elimination of *Phragmites australis*	95 acres
Emergent wetland vegetation plantings	105 acres
Ditch Restoration	8,000 linear ft
Bottom width	20 ft
Depth of excavation	4 feet maximum
Side slopes	1V:5H
Weir flow control structures	2

Fish reservoirs	6
Depth of excavation	2 ft
Area	70 sq ft
Side Slopes	1V:5H
Earthen water retaining structure	1,000 linear ft
Top Elevation	+ 4.0 ft NGVD
Side Slopes	1V:6H
Crest Width	15 ft
Total Width	45 ft
Tidal marsh	25 acres
Self-regulating Tide Gate	1

Note: The following information is presented as a requirement for the Environmental Impact Statement (EIS).

Major Conclusions and Findings

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

Since the primary goal of this project is environmental restoration through the reduction of erosion and storm induced saltwater intrusion, non-structural alternatives generally evaluated for traditional shore protection studies would not be applicable for this project.

Areas of Concern

The protective dune/berm portion of this project will have temporary adverse impacts on water quality and aquatic organisms. Offshore dredging will increase suspended solids and turbidity at the point of dredging and at the discharge (beachfill) site. The areas to be dredged and the area where the material will be deposited will be subject to extreme disturbance. Many existing benthic organisms will become smothered at the beachfill site. Dredging will result in the temporary complete loss of the benthic community in the borrow areas. These disruptions are expected to be of short-duration and of minor significance if rapid recolonization by the benthic community occurs. Dredging will consequently temporarily displace a food source for some finfish.

Several sections of the southern coast of New Jersey have historically been a productive surf clam (Spisula solidissima) fishery. However, the population structure of surf clams below Absecon Inlet comprises less than 5% of the total commercial use during the 1993-1994 season and contains only 17% of the total standing stock. In 1993, the NJDEP, Bureau of Shellfisheries,

conducted a survey of New Jersey's inshore surf clam resources. During this survey, stations below Townsends Inlet were sampled for surf clams. The results of this survey indicate that the surf clam resource below Great Egg Harbor Inlet remains noncontributory to the overall standing stock and continues to provide no evidence of recruitment (NJDEP, 1994). Based on these results and discussions with the Bureau of Shellfisheries, no surf clam tows were done in the proposed borrow areas. Surf clam sampling was included in the benthic sampling of these areas. The results of the benthic sampling show the presence of some clams within the proposed borrow areas. Dredging in these areas has the potential to remove the present population of clams. In addition, periodic maintenance disturbances subsequent to the initial dredging may have adverse effects on any potential recovery of the surf clam population. Despite the fact that surf clams are not present in harvestable numbers, wherever possible, measures will be taken to minimize the impacts to the surf clam population within the borrow areas. These measures may include trying to harvest clams prior to dredging, only dredging in approved sections of the borrow areas, and limiting the number of sites used for renourishment activities. Additional surf clam surveys will be conducted prior to construction. These and any other measures will be fully coordinated with appropriate state and local resource agencies.

Concerns regarding the use of a hopper dredge and its potential impact on Federally listed threatened and endangered sea turtles were raised with respect to this project. A biological assessment, pursuant to Section 7 of the Endangered Species Act, was prepared and submitted to the National Marine Fisheries Service (NMFS). This assessment covers all Philadelphia District dredging projects that may have an impact on threatened and endangered marine species. A biological opinion was provided by the NMFS in November of 1996. As a term and condition of the incidental take statement included in this opinion, the NMFS is requiring monitoring of all hopper dredge operations in areas where sea turtles are present between June and November by trained endangered species observers. The Philadelphia District may also continue the measures used in the past to reduce the likelihood of negatively impacting marine species. These measures may include the use of dragarm deflectors on the dredge, and timing the dredging when sea turtles are known to be absent in the borrow area. These and any other measures will be fully coordinated with NMFS prior to dredging.

Concern over the impact of a beachfill operation on the State and Federally threatened piping plover has been raised with regard to this project. Piping plovers generally nest between April and August on sparsely vegetated, sandy beaches in New Jersey, including portions of the beach in front of The Nature Conservancy's property at The Meadows. For several years now, nesting pairs have been present within this area. If nesting pair(s) are still present within the project impact area at the time of construction, appropriate measures to avoid adversely impacting these and other threatened or endangered birds will be implemented as required by the NJDEP. In addition, since the beachfill was designed to improve, and increase the amount of; nesting habitat for the piping plover, least tern, and other beach nesting birds, it is anticipated that these species will be nesting on the beaches in the future when periodic nourishment is scheduled to occur. If this is the case, all possible steps will be taken to avoid any impact to these species. Mitigative

measures will be coordinated with the U.S. Fish and Wildlife Service and the New Jersey Department of Environmental Protection (NJDEP), Division of Fish, Game and Wildlife. These measures may include the establishment of buffer zones around discovered nests, doing work outside of the nesting season, and conducting beachfill operations around the buffer zone until nesting is completed.

In terms of the interior improvements to The Meadows, concerns were raised in several areas. The removal of Phragmites australis from the site has the potential for several undesirable impacts. The first potential impact is to the endangered plant species located throughout the project area. The spraying and burning of Phragmites australis that is required to properly control the species has the potential to impact and even kill the existing threatened and endangered species. In order to minimize the chance of this happening, several mitigative measures will be implemented. These measures include conducting an updated threatened and endangered plant survey prior to construction, creating buffer zones or taking other measures to protect the plant species during the herbicide application, and creating fire breaks around or otherwise protecting these species during the burning. The removal of Phragmites australis also has the potential to impact other plant species found in the forest, emergent wetlands and field cover types. In order to protect these habitats, buffer zones will be set up around the habitats during both the spraying and burning aspects of the Phragmites australis removal. All phases of the Phragmites australis removal will be done by trained professionals and will be fully coordinated with the proper Federal, State and Local agencies, as well as the surrounding community. If areas exist where the Phragmites australis cannot be efficiently removed without impacting other species, the Phragmites australis will be allowed to remain in those areas.

Other aspects of the selected plan are expected to have only minor temporary impacts on The Meadows area.

Environmental Statutes and Requirements

Preparation of this Feasibility Study and Environmental Impact Statement (EIS) has included coordination with appropriate Federal and State resource agencies. With the distribution of this documents, NJDEP is being asked to provide a consistency determination for the New Jersey Coastal Zone Management Program, in accordance with Section 307(c) of the Coastal Zone Management Act, and the applicable rules guiding issuance of a Water Quality Certificate, in accordance with Section 401 of the Clean Water Act. A Section 404(b) (1) evaluation has been prepared and is included as Section 12 of this document. This evaluation concludes that the proposed action would not result in any significant environmental impacts relative to the areas of concern under Section 404 of the Clean Water Act. The 404(r) exemption criteria have been met and this evaluation concludes that the proposed action would not result in any significant environmental impacts relative to the areas of concern under Section 404. In accordance with the Fish and Wildlife Coordination Act (FWCA), a planning aid letter and draft Section 2(b) FWCA

report were obtained and are provided in Appendix C. A final section 2(b) FWCA report was also obtained following the review of the draft report and is included in Appendix A, Section 2.

Table A provides a list of Federal environmental quality statutes applicable to this statement, and their compliance status relative to the current stage of project review. The Corps will coordinate with the NJDEP, Division of Fish, Game and Wildlife as the ecosystem restoration project proceeds, and will include changes to the project required by Fish, Game and Wildlife.

Table A. Compliance with Environmental Quality Protection Statutes and Other Environmental Review Requirements at the Present Phase of the Project.

Federal Statutes	Compliance w/Proposed Plan
Archeological - Resources Protection Act of 1979, as amended	Full
Clean Air Act, as amended	Full
Clean Water Act of 1977	Full
Coastal Zone Management Act of 1972, as amended	Ongoing
Endangered Species Act of 1973, as amended	Full
Estuary Protection Act	Full
Federal Water Project Recreation Act, as amended	N/A
Fish and Wildlife Coordination Act	Full
Land and Water Conservation Fund Act, as amended	N/A
Marine Protection, Research and Sanctuaries Act	Full
National Historic Preservation Act of 1966, as amended	Full
National Environmental Policy Act, as amended	Full
Rivers and Harbors Act	Full
Watershed Protection and Flood Prevention Act	N/A
Wild and Scenic River Act	N/A

Table A. Compliance with Environmental Quality Protection Statutes and Other Environmental Review Requirements (concluded).

Executive Orders, Memorandum, etc.	
Coastal Barrier Resources Act	N/A
EO 11988, Floodplain Management	Full
EO 11990, Protection of Wetlands	Full
EO 12114 Environmental Effects of Major Federal Actions	Full

Full Compliance - Requirements of the statute, EO, or other environmental requirements are met for the current stage of review.

N/A - Statute, EO, or other policy and related regulations are not applicable.

Ongoing - Coordination is continuing.

Public Concerns

Initial discussions with local, State, and Federal agencies produced the following concerns that were either environmental or socio-economic in nature.

The non-Federal sponsor for this Feasibility study is the New Jersey Department of Environmental Protection (NJDEP). Currently, NJDEP's concern, within the scope of this feasibility study and EIS, is with shore protection, inundation, erosion and habitat loss and degradation problems within the Lower Cape May Meadows.

Selection of a sand borrow area(s) was a primary environmental concern raised for this project. Issues involved with borrow area selection included the presence/absence of significant cultural resources, benthic resources, surf clam stocks, fisheries impacts, threatened and endangered species, water quality impacts, and sand grain compatibilities with beach material. Some of these issues required further investigation and are discussed in later sections of this report. Other concerns raised involved the protection and restoration of valuable fish and wildlife habitat within The Meadows, including threatened and endangered species, migratory raptors, songbirds, and shore birds, compatibility with existing management plans and the restoration of habitat values.

THE SELECTED PLAN

Summary of Environmental Effects of Plan

The primary adverse impact of the beach nourishment alternative is the temporary disturbance and destruction of existing benthic resources resulting from dredging operations at the borrow areas, and fill placement along the shorefront. Dredging in the borrow areas will result in a temporary destruction of the benthic community. For most of the benthic species, rapid recolonization is expected to occur within one year of dredging. Minor shifts in benthic community composition may occur following recolonization. Beachfill operations along The Meadows and Cape May Point will result in temporary degradation of the existing beach habitat during initial construction and periodic nourishments. Existing benthic organisms on the beach would become buried as a result of beachfilling operations. Due to the presence of species adapted to high energy and dynamic conditions, recolonization of the beach area is expected to be rapid. The portion of benthic habitat covered by the 35 acre seaward extension of the beach would represent a long-term loss, however, this would be offset by the creation of similar habitat. Fish and avian utilization of the immediate shoreline area for feeding would be temporarily disrupted, however, they are expected to return immediately after the disturbance. Dredging and the hydraulic placement of beachfill material will result in temporarily higher turbidity levels at the borrow site and in waters along the shoreline during construction.

The primary adverse impact associated with the interior improvements to The Meadows will result from the removal of the Phragmites australis. The application of herbicide and subsequent burning of the dead vegetation will have short term, temporary impacts on wildlife during the construction phase of this project. Impacts will be in the form of temporary habitat disruption and temporary air quality degradation. Minor impacts to water quality and aquatic habitat will be associated with the reconnection of the hydrologic units, the creation of the fish reservoirs and the installation of the water control structures. All impacts associated with these activities are expected to be minor, and only associated with the actual construction activities.

It should be noted that the most substantial impacts associated with this project will be in the form of beneficial habitat improvement for all fish and wildlife species which utilize the habitat at The Meadows. These benefits will be in the form of reducing erosion and saltwater intrusion, returning wetland habitat to quality it once was, restoring water movement within the site, and replacing 35 of the more than 124 acres of habitat that has been lost in the recent past. The restoration will increase the amount of critical nesting, migratory and feeding habitat available for numerous birds and other animals. The restoration represents a gain of approximately 388 habitat units, when compared to the without project conditions.

New Jersey Shore Protection Study

LOWER CAPE MAY MEADOWS - CAPE MAY POINT
FEASIBILITY STUDY

Volume I

Feasibility Report and Integrated Environmental Impact Statement (EIS)

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1. INTRODUCTION

This report presents the results of the fourth site specific study under the New Jersey Shore Protection Study, namely the Lower Cape May Meadows - Cape May Point Feasibility Study. The New Jersey Shore Protection Study is an ongoing study of the shore protection and water quality problems facing the entire ocean coast and back bays of New Jersey. The general objective of the study is to provide recommendations for future actions and programs to reduce storm damage, minimize the harmful effects of shoreline erosion, improve the information available to coastal planners and engineers, and for use by various resource agencies to help prevent further degradation of the coastal waters.

1.1 Study Authorization

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

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

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

> *That the Board of Engineers for Rivers and Harbors is hereby requested to review existing reports of the Chief of Engineers for the entire coast of New Jersey with a view to study, in cooperation with the State of New Jersey, its political subdivisions*

and agencies and instrumentalities thereof, the changing coastal processes along the coast of New Jersey. Included in this study will be the development of a physical, environmental, and engineering database on coastal area changes and processes, including appropriate monitoring, as the basis for actions and programs to prevent the harmful effects of shoreline erosion and storm damage; and, in cooperation with the Environmental Protection Agency and other Federal agencies as appropriate, the development of recommendations for actions and solutions needed to preclude further water quality degradation and coastal pollution from existing and anticipated uses of coastal waters affecting the New Jersey Coast. Site specific studies for beach erosion control, hurricane protection, and related purposes should be undertaken in areas identified as having potential for a Federal project, action, or response which is engineeringly, economically, and environmentally feasible.

1.2 Study Area

The study area is located at the southern tip of New Jersey on the Atlantic Ocean side of the Cape May Peninsula and includes the area known as Lower Cape May Meadows, the Borough of Cape May Point, and the Borough of West Cape May (Figure 1-1).

Lower Cape May Meadows. For the purpose of this report, the Lower Cape May Meadows (referred to hereafter as "The Meadows") will refer to the area between the Lighthouse Avenue groin at Cape May Point and the Third Avenue terminal groin in Cape May City, bounded landward by Sunset Boulevard. The Meadows is approximately 1.3 miles long, currently (based on 1997 aerial photos/GIS) encompasses about 343 acres, and contains both Cape May State Park and the Cape May Migratory Bird Refuge (Photo 1-1). The Meadows contains both freshwater and brackish water wetlands which support a diversity of threatened and endangered species of both plant and animal wildlife.

Lower Cape May Meadows is an internationally significant coastal wetland situated along the Atlantic flyway. This area is included in the Ramsar List of Wetlands of International Importance, is part of the Western Hemisphere Shorebird Reserve Network, the Delaware Estuary Program, the Coastal Ecosystems Program, and has been identified as an Important Waterfowl Habitat Area under the Atlantic Coast Joint Venture of the North American Waterfowl Management Plan. In addition, this study is included in and endorsed by the Coastal America Program. The Meadows provides a vital resting spot for shorebirds, birds of prey, and songbirds during their seasonal migration as well as providing habitat for native species. It is considered by Federal, State and private organizations to be one of the foremost avian viewing areas in North America attracting more than 100,000 birders each year.

The western portion of Lower Cape May Meadows contains Cape May Point State Park. This approximately 153 acre park is administered by the New Jersey Department of Environmental

Protection (NJDEP), Division of Parks and Forestry. Practically all of the state park has been designated as part of the State Natural Areas System in 1978. This portion of the state park was selected for the System because of the unique coastal environment it offers to wildlife, waterfowl and shorebirds.

The eastern portion of The Meadows, approximately 190 acres, is owned by the Nature Conservancy and is known as the Cape May Migratory Bird Refuge. The Nature Conservancy is a nonprofit, tax exempt corporation that preserves plants, animals and natural communities that represent the diversity of life on earth by protecting the lands and waters they need to survive. Incorporated in 1951 for scientific and educational purposes, the Conservancy owns and manages more than 1,300 preserves throughout the U.S., the largest private system of nature sanctuaries in the world.

For an area to be undertaken by the Nature Conservancy, it must be identified as a site sheltering critically threatened plant or animals species/communities. The area must be approved by senior management as clearly supporting the Conservancy's mission before it is acquired.

The Nature Conservancy's staff and volunteers maintain the Cape May Migratory Bird Refuge using a variety of techniques that maintain the area and encourage the growth of endangered plants and animals that live there. As with most Conservancy preserves, the Cape May Migratory Bird Refuge is open for educational and recreation uses such as bird watching, nature study and photography. The location of The Meadows combined with the variety of habitat types it provides has made the area a significant draw for bird watchers from around the country.

The Meadows can be considered an environmentally significant area based on, at least, the following institutional, public, and technical criteria:

Institutional

- The Nature Conservancy owns and manages a portion of The Meadows and has designated it the Cape May Migratory Bird Refuge.
- New Jersey Department of Environmental Protection, Division of Parks and Forestry operates a State Park within The Meadows and has additionally designated the area as a "Natural Area."
- The Meadows is located on the Cape May peninsula which has been designated an area of "exceptional resource value" by NJDEP.
- This feasibility study is endorsed by the Coastal America Program
- The Meadows is included as an Important Waterfowl Habitat Area under within the

Atlantic Coast Joint Venture of the North American Waterfowl Management Plan.

- The Meadows and surrounding Delaware Bay wetlands are included in the Ramsar List of Wetlands of International Importance.

- The Meadows is within the Hemispheric Reserve identified by the Western Hemisphere Shorebird Reserve Network. The category of Hemispheric Reserve is the highest classification given to an area. For this designation, the area must host at least 500,000 shorebirds or 30% of a species flyway population.

- The Meadows is contained in, and contributes to the goals of the Delaware Bay Coastal Ecosystems Program, part of the Coastal Ecosystems Program.

- The New Jersey Audubon Society has established the Cape May Bird Observatory which provides public interest and scientific programs and research relative to the migratory bird communities within the study area.

- Study area greatly contributes to the goals of the Delaware Estuary Program which is part of the National Estuary Program.

- Delineated as a "Conserved Land Center" as part of the Cape May Stopover Project by NJ Division of Fish, Game, and Wildlife - Endangered & Nongame Species Program

Public

- The Lower Cape May Meadows is the most frequented birding area along the East Coast and one of the top avian viewing areas in the world. According to a 1997 survey conducted by the New Jersey Audubon Society's Cape May Bird Observatory, more than 100,000 birders are attracted to the area annually. These birders contribute more than $31,000,000 to the local economy.

- Since 1977, annual visitor attendance to Cape May Point State Park has increased from 87,583 to a high of 728,596 in 1995, an increase of 677 %.

- The World Series of Birding, a birdwatcher's contest sponsored by the Cape May Bird Observatory had 28 corporate sponsors in 1997. There were none when the festival was first held in 1985. This event was covered in USA Today and local newspapers.

- Papers, posters, and informational presentations about the USACOE reconnaissance and feasibility studies have been featured at major conferences such as the 1995 National Estuary Program Conference, Coastal Zone 97, and the New Jersey Audubon Society's

Spring Weekend.

Technical

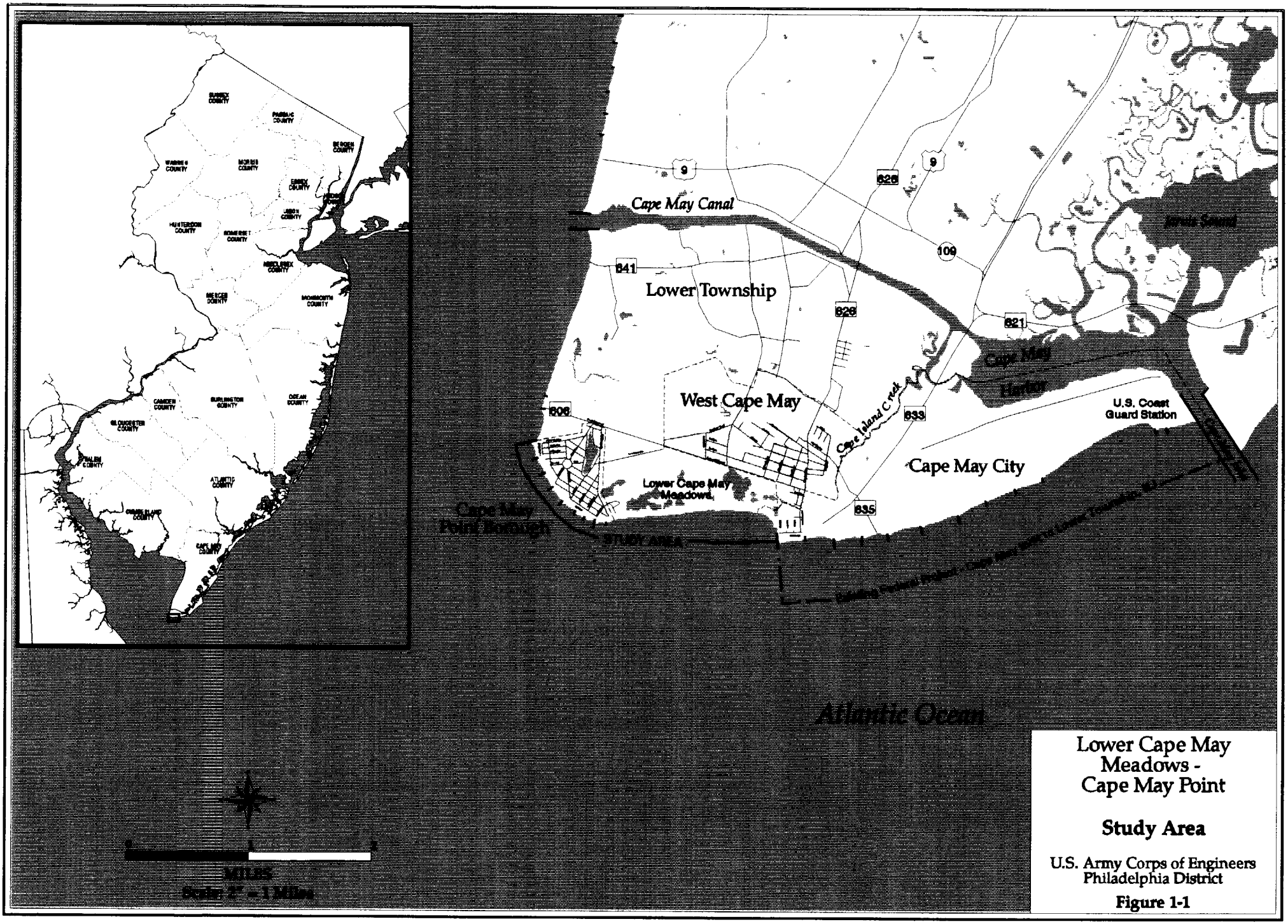
- The Meadows is located along the Atlantic Flyway and is one of the most important migratory bird stopovers in North America for birds of prey, songbirds and various seabirds. Estimates include about 60,000 raptors and over 1,000,000 seabirds migrate through this area each year. In addition, the Meadows is an important breeding and wintering area for both rare and common birds.

- A number of Federally and State listed endangered or threatened transient mammals, birds, reptiles, and fish may be found within the study area.

- The Meadows contains several plant species listed as endangered or rare.

Cape May Point. The Borough of Cape May Point is a 1.1 mile long beachfront community bounded by the Atlantic Ocean to the east and the Delaware Bay to the west (Photo 1-2). The Cape May Point portion of the study is defined as the area from the groin located at Lighthouse Avenue west to the Alexander Avenue groin. This residential community is particularly vulnerable to storm damage due to its location at the southern tip of New Jersey at the confluence of the Delaware Bay and the Atlantic Ocean.

West Cape May. The Borough of West Cape May covers 1.2 square miles and is located inland, adjacent to The Meadows. This area is also highly residential.



Lower Cape May Meadows - Cape May Point

Study Area

U.S. Army Corps of Engineers
Philadelphia District

Figure 1-1

Photo 1-1 Lower Cape May Meadows, looking northeast towards Cape May City, 10/22/96

Photo 1-2 Cape May Point 10/22/96.

1.3 Study and Report Process

The Water Resources Development Act of 1986 (P.L. 99-662) directs the Corps to conduct water resources studies in two phases: reconnaissance and feasibility. Reconnaissance studies are conducted at 100% Federal expense and are normally completed in 12 months. The objective of a reconnaissance study is to enable the Corps of Engineers to determine whether or not planning to develop a project should proceed to the more detailed feasibility stage. This is accomplished through; the definition of problems and opportunities consistent with Army policies; the identification of a potential solution including costs, benefits, and environmental impacts; estimating the time and costs for the feasibility study, and an assessment of the level of interest and support of non-federal interests regarding further study.

In March 1993, the Lower Cape May Meadows Reconnaissance Study was initiated to address the rapid shoreline erosion and consequent ecosystem degradation of a unique coastal wetland system. Due to strong Congressional and local interest in October 1993, the Energy and Water Development Appropriations Bill 1994 added Cape May Point to the existing study area in order to address recent heightened erosion and flooding problems experienced within this community. Given their adjacent locations and common problems, it was determined that the two areas could be more expeditiously addressed under one study rather than two individual study efforts. Additional funding was provided for this expanded study scope and the study duration was extended from 12 months to 17 months. The reconnaissance report was completed in August 1994. It identified problems and opportunities in the study area with the primary focus on ecosystem restoration and recommended to proceed to the next level of study, namely the feasibility phase.

A Reconnaissance Resolution Conference (RRC) was held in the Philadelphia District office on October 27, 1994 to certify the reconnaissance report and provide guidance for the conduct of the feasibility study. The conference was attended by representatives of US Army Corps of Engineers - Headquarters, US Army Corps of Engineers - North Atlantic Division, US Army Corps of Engineers - Philadelphia District, The Nature Conservancy, and the New Jersey Department of Environmental Protection. The reconnaissance report was approved and feasibility study guidance was provided in the Reconnaissance Guidance Memorandum (RGM) dated November 14, 1994.

The Lower Cape May Meadows - Cape May Point Feasibility study began in April 1995 is being conducted as an ecosystem restoration initiative under the General Investigations program utilizing the New Jersey Shore Protection Study authority. Feasibility studies are cost shared 50% with a non-Federal sponsor. The New Jersey Department of Environmental Protection (NJDEP) is the non-Federal study sponsor.

1.4 Study Purpose & Scope

The purpose of a feasibility study is to ensure the timely and economical completion of a quality feasibility report that is expected to recommend an implementable solution to the identified problems.

This feasibility report presents the results of a feasibility level study conducted pursuant to the previously mentioned resolutions and will accomplish the following:

a. Provide a complete presentation of study results and findings so that readers can reach independent conclusions regarding the reasonableness of recommendations

b. Indicate compliance with applicable statutes, executive orders and policies.

c. Provide a sound and documented basis for decision makers at all levels to judge the recommended solution(s)

This report documents the analysis of existing conditions, without project conditions, plan formulation, and project designs in order to provide ecosystem restoration for The Meadows and hurricane and storm damage reduction for Cape May Point and West Cape May. The evaluations were based on site-specific technical information developed during the course of the study. This included beach and internal wetland surveys, hydraulic and hydrologic evaluations, geotechnical investigations, environmental and cultural resource inventories.

This feasibility report will detail the following for the study area:

a. Define problems and opportunities

b. Identify potential solutions

c. Identify costs, benefits, environmental and social impacts of potential solutions

d. Present the optimized plan for each problem

e. Present the Project Cooperation Agreement (PCA) responsibilities of the non-federal sponsor

This study is being conducted in accordance all applicable guidance including; EC 1105-2-210 dated 1 June 1995 1994, *Ecosystem Restoration in the Civil Works Program* and Policy

Guidance Letter #24, *Restoration of Fish and Wildlife Habitat Resources.*

1.5 Prior Studies, Reports and Related Projects

There exist numerous planned, ongoing and completed shoreline programs and projects for the New Jersey coast. The work has been initiated by various groups including the Federal government, the State of New Jersey, local municipalities and private interests. A description and the status of these projects and studies are presented in Table 1-1.

Federal. The Corps has a long history of involvement in the New Jersey Coast. Before 1930, Federal government involvement in shore erosion was limited to the protection of public property. With the enactment of the River and Harbor Act of 1930 (Public Law 71-520, Section 2), the Chief of Engineers was authorized to perform studies on erosion problems in cooperation with municipal and state governments in order to devise a means for preventing further erosion of the shores. Until 1946, the Federal aid was limited to studies and technical advice. In that year, and again in 1956 (PL 84-826) and 1962 (PL 87-874), the law was amended to provide Federal participation in the cost of a project and allowed limited contribution to the protection of privately owned shores which would benefit the public.

The Cape May Inlet (formerly Cold Spring Inlet) Federal navigation project is located northeast of the project area (Figure 1-1). The inlet jetties, placed parallel to each other, were constructed between 1908 to 1911. The east jetty is approximately 4,550 feet long and the west jetty is about 4,390 feet long. These jetties provide a stable inlet and navigation channel for the large commercial fishing fleet and Coast Guard facilities located in Cape May Harbor, as well as the large population of recreational boaters. Unfortunately, these jetties have also interrupted the natural littoral transport to the downdrift beaches of the U.S. Coast Guard base, Cape May City, and The Meadows, greatly contributing to the beach erosion at these locations.

The Corps has conducted several beach erosion control and navigation studies that examine the problems which ultimately affect the Lower Cape May Meadows - Cape May Point area. Many alternatives have been considered and/or recommended for this area. These alternatives include beach fill, groins, seawall and revetments.

Following the March 1962 Storm, 8,530 linear feet (156,656 cu yds) of emergency sand dune (20-30 ft wide at crest) was constructed by FEMA (Federal Emergency Management Agency) along The Meadows and Cape May Point. This dune has been completely lost to due to storm events and long-term erosion over the past 35 years. Other than the emergency dune, no other project has ever been built by the Federal government to address the erosion at Lower Cape May Meadows and Cape May Point.

In 1976, the New Jersey Inlets and Beaches Study titled *Hereford Inlet to the Delaware Bay*

Entrance of the Cape May Canal contained plans of improvement for Lower Cape May Meadows, Cape May Point, and Cape May City. The plan for Lower Cape May Meadows included the construction of seven groins approximately 850 feet apart between Cape May City and Cape May Point and the placement of beach fill to provide a berm 50 feet wide. The shore protection plan for Cape May Point called for beach fill and dune construction, construction of five groins, extension of three existing groins, construction of dikes along the eastern and western boundaries of the borough, maintenance of existing and proposed structures and periodic nourishment of beaches.

The resulting *Cape May Inlet to Lower Township Phase I GDM* dated August 1980, however, called for beachfill placement (under Section 111 authority) only between Cape May Inlet and the terminal groin at Third Avenue in Cape May City. The Lower Cape May Meadows portion of the project was not approved under the GDM and was subsequently dropped from the GDM recommendations. This action was mainly due to the large costs associated with the construction of the groins and the limited economic benefits (at that time "environmental benefits" alone could not be used for project justification). The Water Resources Development Act (WRDA) of 1986 authorized the project at Cape May Inlet to Lower Township which was constructed between 1989 and 1991 with subsequent renourishment beachfills in 1993, 1995, and 1997.

The Cape May Point portion project mentioned above in the *Hereford Inlet to the Delaware Bay Entrance of the Cape May Canal* report was authorized for Phase I Design Memorandum Stage of Advanced Engineering and Design by WRDA 1976. However, that phase was never funded.

The New Jersey Shore Protection Study was initiated in 1989 to investigate shoreline protection and water quality problems which exist along the entire coast. The Limited Reconnaissance Phase of the New Jersey Shore Protection Study identified and prioritized those coastal reaches which have potential Federal interest based on shore protection and water quality problems which can be addressed by the Corps of Engineers. The limited reconnaissance study report was completed in September 1990 and recommended six study reaches along the New Jersey coast. One of those reaches recommended for further study was *Cape May Inlet to Delaware Bay Entrance of the Cape May Canal.* This reach later became known as *Lower Cape May Meadows - Cape May Point*, the current study area (see Section 1.3 of this report).

A complete list of prior reports can be found in Table 1-1.

Table 1-1
Previous Related Reports

Publication & Date	*Agency*	*Subject or Recommendation*
General Study Area		
Report on the erosion and protection of the NJ beaches (1922)	Board of Commerce & Navigation of NJ	Proposed norms & guides to produce effective coast protective works to combat erosion along the south NJ shores.
Report on the erosion and protection of the NJ beaches (1924)	Board of Commerce & Navigation of NJ	Outlined general details of construction & maintenance of shore protection structures for NJ beaches to supplement report of 1922.
Report on the erosion and protection of the NJ beaches (1930)	Board of Commerce & Navigation of NJ	Contains details of significant types of shore protection structures at specific locations along NJ coast, and conclusions on their effectiveness; updating the report of 1922 and 1924.
Preliminary Examination Report, New Jersey Coast Flood Control (31 Dec 1945)	Corps of Engineers	Determined that construction to protect areas from floods due to tide & wind was not economically feasible.
Preliminary Examination Report, New Jersey Coast Flood Control (31 Dec 1945)	Corps of Engineers	Determined that construction to protect areas from floods due to tide & wind was not economically feasible.
Preliminary Examination Report, New Jersey Coast Flood Control (31 Dec 1945)	Corps of Engineers	Determined that construction to protect areas from floods due to tide & wind was not economically feasible.
General summary description of coast protection requirements (Jan 1949)	State Beach Erosion Commission	Proposed plan for shore protection structures to protect communities along Atlantic Ocean between Sandy Hook & Cape May Point.
Regional Study of the Atlantic Coast of New Jersey (preliminary draft - 1954)	Beach Erosion Board	Covers the subjects of geomorphology, littoral materials, littoral force & littoral measurements.
Shore of New Jersey - Barnegat Inlet to Cape May Canal, Beach Erosion Control Study (1959)	Corps of Engineers	Recommended shore protection projects for various communities from Barnegat Light to Delaware Bay.
Postflood Report - Coastal Storm of 6-7 March 1962 Souther NJ & Delaware (Dec 1962)	Corps of Engineers	Described the March 1962 storm and the effects on the Atlantic Coast of NJ south of Manasquan Inlet, the bay shores of NJ & DE, and the Atlantic Coast of Delaware.
Hurricane Study - Atlantic Coast of Southern New Jersey and Delaware (1965)	Corps of Engineers	Recommended that the proposed plan of protection (stone revetments/seawalls) from storms and hurricanes for Atlantic Coast of NJ & DE not be adopted.
New Jersey Coastal Inlets and Beaches - Hereford Inlet to Delaware Bay Entrance to Cape May Canal (1969). House Document No. 94-641, 94th Congress, 2nd Session.	Corps of Engineers	Examined shoreline from Hereford Inlet to Delaware Bay entrance of the Cape May Canal. For the Cape May Meadows area, beach fill with berm and groins were recommended. Also proposed groins, dikes and beach fill with berm and dune for Cape May Point.
Cape May Inlet to Lower Township, NJ-Phase I General Design Memorandum (Aug 1980)	Corps of Engineers	Successor report of above. Shore protection measures at Cape May Meadows were found not to be economically justified.

Table 1-1
Previous Related Reports

Publication & Date	*Agency*	*Subject or Recommendation*
Cape May Inlet to Lower Township, NJ - Phase II General Design Memorandum (June 1983)	Corps of Engineers	Modified the project features from Phase I. Primary departures consist of an adjustment in the maximum berm width for the feeder beach, provision of additional initial beachfill to account for erosion subsequent to completion of the Phase I GDM, modifying the design profiles and lengths for the two groin extensions, the addition of 12 storm sewer outfall extensions, and the addition of a shoreline monitoring plan for Cape May City.
A Study of Sand Bypassing Options at Cape May Inlet, New Jersey (June 1987)	Corps of Engineers	Supplements the Phase I (1980) and Phase II (1983) General Design Memoranda (GDM) for the Cape May Inlet to Lower Township, NJ project. This report presents a least-cost analysis of sand bypassing options based on technical and economic analyses. The option recommended was the same as recommended in the Phase I and II General Design Memorandums for the Cape May Inlet to Lower Township project
Cape May Inlet to Lower Township - Benefits Reevaluation Study (Sept 1987)	Corps of Engineers	Reevaluated plan recommended by the 1980 GDM based on NED Benefits. Also found Cape May Meadows area not economically justified.
New Jersey Shore Protection Limited Reconnaissance Report (1990)	Corps of Engineers	Recommended further study at various locations along the NJ coast including Cape May Meadows and Cape May Point.
Lower Cape May Meadows - Cape May Point Reconnaissance Report (1994)	Corps of Engineers	Recommended progression to the feasibility phase of study.
Cold Spring Inlet		
Preliminary Examination of Cold Spring Inlet, New Jersey (1894)	Corps of Engineers	Recommended no improvement of Cold Spring Inlet.
Survey Report, Cold Spring Inlet, New Jersey (1907) House Document No. 388, 59th Congress, 2d Session	Shore Protection Board	Recommended entrance channel 25 feet deep and 2 jetties.
Survey report on Cold Spring Inlet, New Jersey submitted to OCE (July 1931)	Corps of Engineers	Unfavorable report on shore erosion.
Survey Report, Cold Spring Inlet (Cape May Harbor, New Jersey) (1953) House Document No. 206, 83rd Congress, 1st Session.	Corps of Engineers	Recommended placement of sand on shore of Cape May City and timber groins along with a stone revetment for Meadows & Cape May Point. Proposed deferred construction at the discretion of Federal, local agencies and local governments.

State Involvement. The State of New Jersey has been involved in providing technical and financial assistance to its shore towns for decades. The State officially tasked the Department of Environmental Protection (NJDEP), formerly the Department of Conservation and Economic Development, to repair and construct all necessary structures for shore protection in the early 1940's (N.J.S.A. 12:6A-1). An annual appropriation of one million dollars was established and maintained until 1977. Due to extensive destruction and erosion of the shoreline from frequent severe storms, an additional $30 million was appropriated in 1977. In addition to initiating their own research and construction efforts, the State of New Jersey also cost-shares portions of many Federal projects including the Cape May Inlet to Lower Township beachfill project which is located adjacent to the current study area.

The NJDEP has been involved in various areas of local shore protection along the coast of New Jersey. Shore protection is presently handled by the Division of Natural and Historic Resources, Engineering and Construction Element.

In 1978, the legislature passed a Beaches and Harbors Bond Act (P.L., 1978, c.157) and instructed the NJDEP to prepare a comprehensive Shore Protection Master Plan in order to reduce the impacts and conflicts between shoreline erosion management and coastal development. Released in 1981, it has served as a guide to suitable alternatives for the mitigation of erosion and to develop a list of priorities among the engineering plans.

After the Halloween Storm of 1991 devastated the New Jersey shoreline, $15 million was appropriated as an amendment to the State Economic Recovery Fund for Shore Protection. Soon thereafter, the January 1992 storm struck, overwhelming State fiscal resources and prompting a Presidential Disaster Declaration.

The issue of providing stable funding for shore protection at the State level had been raised on several occasions. The two storms during the winter of 1991-92 prompted a Governor's Shore Protection Summit in February of 1992. As a result, the Shore Protection and Tourism Act of 1992 was passed, thereby creating the first stable source of funding for shore protection equaling, at a minimum, $15 million annually.

The State of New Jersey has been involved with storm protection along this specific study area for some time. The State, County and Borough of Cape May Point constructed sixteen closely spaced steel sheet pile groins around Cape May Point between 1930 and 1932. Under a Works Progress Administration project, the borough constructed three precast concrete block groins 150 feet long between 1936 and 1940. In 1943, the state and borough added a stone extension 300 feet long to the groin constructed at Alexander Avenue in 1937. All of these groins, with the exception of the Alexander Avenue groin, have been destroyed. A timber and steel bulkhead was constructed at the eastern end of the Cape May Point shoreline in 1934, and largely replaced with a stone seawall in 1954. From 1960 to 1962, timber and stone groins were constructed by the state at Cape, Coral and Whilden Avenues. Between 1964 and 1968, timber and stone groins

were constructed at Lighthouse, Lehigh, Ocean, Central and Stites Avenues for a total of nine groins spaced 500 to 800 feet apart. Nearly all of these groins have been extended since their initial construction. Beach nourishment and dune construction accompanied the completion of the groin field.

Following both storm events and as a preventive measure, the state has repaired the dunes which front The Meadows and Cape May Point. These repairs are small scale, stopgap measures. The narrow berm width and small, frequently breached and overtopped dune do not provide sufficient protection from anything other than a low level storm.

In 1996, the State once again rebuilt the dunes fronting The Meadows using I-5 stone (NJDOT gradation) and recycled concrete as the dune core. Tensar mattresses were also installed adjacent to the Lighthouse Avenue groin to provide erosion protection. Breaching of the dune near the State Park Pavilion during the February 1998 storm necessitated the repair of the dunes. In addition, the Tensar mattresses were extended towards the bunker.

A complete list of recent projects can be found in Table 1-2.

Municipal. The shoreline of The Meadows, which is part of Lower Township, is normally maintained entirely by the NJDEP. The Borough of Cape May Point, typically in collaboration with NJDEP, has been very active over at least the past thirty years in shore protection despite limited financial resources. While in many cases the borough simply contributes funding to state sponsored projects (25%), they have also been active in singularly implementing shore protection and storm damage reduction measures that are within their financial capabilities. They have maintained an extensive dune system on the western side of Cape May Point, provided protection for these dunes in the forms of lengthy dune walkovers and sand fences, and have also provided emergency repairs to the dunes when possible. Beach profile conditions are monitored through regular surveys. In addition, between 1993 and 1994, the borough placed approximately 1,500 tons of recycled concrete in front of the deteriorating seawall located at Lehigh Ave. With funding from FEMA, they have also constructed an intake structure and a 24" outfall pipe at Shallow Pond East in The Meadows to help alleviate flooding into Cape May Point during storm events.

In June 1994, Breakwaters International installed a Beachsaver Reef off of Cape May Point. This submerged artificial reef is approximately 1000 ft long and extends from the groin at Lehigh Ave west to the groin at Coral Avenue. It is composed of interlocking concrete units, each having a length of 10 feet and weighing approximately 21 tons. These breakwaters are the second in a series of three pilot installations along the New Jersey coast. This project was funded by the State of New Jersey and the Borough of Cape May Point and was monitored by the Stevens Institute of Technology's Davidson Laboratory. The results of the two year monitoring study show a net gain of sand volume (3,258 cu yds) during the two year monitoring period (1994-1996) with accretion (4,746 cu yds) during the first year and volume loss (1,488 cu yds)

during the second year of monitoring. The Borough is currently considering placement of additional Beachsaver Reefs.

Besides the above mentioned completed shore protection projects, The Borough consistently develops new ideas for protecting their community from storm damages. Currently, they have plans to increase their storm water storage capabilities at Lake Lily by lowering the elevation of the lake prior to a severe storm. This is intended to lessen the flooding that occurs when oceanwater breaches the dunes at The Meadows and then flows into Cape May Point.

Private. The eastern portion of the Lower Cape May Meadows, the Cape May Migratory Bird Refuge, is owned by the Nature Conservancy. The main function of the Nature Conservancy is to manage the natural resources of the area whether it be vegetation management (nuisance plant control, etc.) or the protection of unique or endangered species, such as piping plovers. Dune repair has been accomplished by NJDEP in conduction with repairs to the dunes fronting Cape May Point State Park. Internal maintenance such as herbicidal spraying of Phragmites autralis is performed by The Nature Conservancy

Table 1-2
Recent Non-Federal Projects
Lower Cape May Meadows - Cape May Point

Agency	*Location*	*Project*	*Year*	*Quantity/Cost*[1]
NJDEP	Meadows	Dune repair	1986	47,000 cu yd/$332, 019
NJDEP	Meadows	Dune repair	1986	40,000 cu yd/$258,347
NJDEP/CMP	Cape May Point	Beachfill	1991	50,000 cu yd/ $192,300
NJDEP	Meadows - Cape May Point	Dune repair - beachfill	1992-93	98,000 cu yd/$388,888
NJDEP/CMP	Lehigh Ave groin	Dune restoration	1993	$87,000
CMP	Lehigh Ave groin	Seawall repair using recycled concrete	1994	$20,000
NJDEP/CMP	Between Coral Ave & Lehigh Ave groins	Beachsaver reef installation	1994	$300,000
NJDEP/CMP	State Park ocean frontage to Lighthouse Ave groin	Dune reinforcement using recycled concrete as core. Installation of Tensar mattress overtop reinforced core near Lighthouse Ave.	1996	$429,000
CMP	Cape May Point	Emergency repairs to dunes and groins	1996	$34,741
CMP	Cape May Point	Repairs to dunes	1996	$20,000
CMP	Cape May Point	Repairs to dunes	1997	$35,000
NJDEP	State Park ocean frontage	Extension of Tensar mattress to bunker	1998	Not available at press time

CMP=Borough of Cape May Point

[1] Costs include engineering design and administrative fees

1.6 Related Institutional Programs

Study efforts have been coordinated with the following agencies and organizations: New Jersey Department of Environmental Protection (NJDEP) including the Bureau of Coastal Engineering and the Division of Parks & Forestry, U.S. Fish and Wildlife Service, New Jersey Division of Fish & Game, The Borough of Cape May Point, The Borough of West Cape May, The Nature Conservancy, U.S. Army Corps of Engineers Waterways Experiment Station - Environmental Laboratory, U.S. Army Corps of Engineers-North Atlantic Division. In addition, the study area is relevant to the following programs:

Coastal America Program. In response to the need to protect, preserve and restore our coastal heritage, The Coastal America Partnership was established by a memorandum of understanding in 1992. This partnership for action is comprised of those Federal agencies with statutory responsibilities for coastal resources or whose operational activities affect the coastal environment. The partners are committed to a national effort which is guided by the concepts of ecosystem management and sustainable development in addressing primary coastal concerns, including habitat loss and degradation, nonpoint source pollution, and contaminated sediments. The Partnership focuses on regional activities that provide direct local and watershed action.

The purpose of Coastal America is to: (1) protect, preserve, and restore the Nation's coastal ecosystems through existing Federal capabilities and authorities; (2) collaborate and cooperate in the stewardship of coastal living resources by working together and in partnership with other Federal programs, and by integrating Federal actions with state, local, tribal government, and non-governmental efforts; and (3) provide a framework for action that effectively focuses expertise and resources on jointly identified problems to produce demonstrable environmental and progmatic results that may serve as models for effective management of coastal living resources.

In October 1996, The Lower Cape May Meadows - Cape May Point Feasibility Study was officially endorsed by the Mid-Atlantic Regional Implementation Team. Aspects of the study were further discussed during a Coastal America workshop at the Coastal Zone 97 Conference (as well as presented in the official conference poster session). Involvement with the Coastal America Program has enabled Federal agencies to become aware of the problems at the study area and give input and assistance to solutions. Many of these agencies would not have been aware of the study if not for Coastal America. It is expected that increased partnership with member agencies will be accomplished in the future as specific problems solutions are finalized.

In October 1997, Coastal America's Annual Retreat was held in Cape May NJ. A tour of The Meadows was given and information regarding potential restoration features was presented.

North American Waterfowl Management Plan. Recognizing the importance of waterfowl and wetlands to North American and the need for international cooperation to help in the recovery of a shared resource, the Canadian and the United States governments developed a strategy to restore waterfowl

populations to levels seen in the 1970's through habitat protection, restoration, and enhancement. This strategy was documented in the North American Waterfowl Management Plan signed in 1986 by the Canadian Minister of the Environment and the Secretary of the Interior of the United States. The program calls for 11.1 million acres of wetlands and associated uplands to be protected and 14.7 million acres to be restored or enhanced.

The Plan is international in scope but is implemented at a regional level. The Plan's success depends on partnerships involving federal, state, provincial, and local governments, businesses, conservation organizations, and individual citizens, called joint ventures. Joint ventures develop implementation plans focusing on areas of concern identified in the Plan. Plan partners not only advance waterfowl conservation, but make substantial contributions toward the conservation of all wetland-dependent species.

There are 11 habitat joint ventures in the United States and 3 in Canada. The Meadows is contained in the Atlantic Coast Joint Venture.

Protection and restoration of The Meadows is critical to the survival of the various species of migrating waterfowl and contributes significantly to the goals of the North American Waterfowl Management Program.

Western Hemisphere Shorebird Reserve Network (WHSRN). The WHSRN links wetland and grassland sites essential to migratory shorebirds in a voluntary, nonregulatory program of research, training, and collaborative effort for habitat management and protection. Launched in 1985 through the efforts of the World Wildlife Fund (WWF), the International Association of Fish & Wildlife Agencies (IAFWA), and the Academy of Natural Sciences of Philadelphia (ANSP), the Network brings together wildlife agencies, private conservation groups, and other organizations to solve challenges faced by migratory shorebirds and their habitats.

The Network works to achieve 5 main goals:

1.) Protect sites critical to the Western Hemisphere's migratory shorebirds.

2.) Promote and support the development of strong conservations and their efforts to protect shorebirds and shorebird habitats.

3.) Build strong public support for wetlands and shorebird conservation through education and public awareness.

4.) Develop and support international, national, and local policies to help ensure the long term protection and management of the hemisphere's migratory shorebirds and critical wetlands.

5.) Compile, improve, and disseminate information on shorebird distribution, migration, habitat,

and biology in the Western Hemisphere.

In 1986, the Delaware Bay, Delaware-New Jersey Hemispheric Reserve was dedicated. "Hemispheric Reserve" status is given when the area hosts at least 500,000 shorebirds annually or 30% of a species flyway population. The Meadows is part of this reserve. Restoration of The Meadows ecosystem would contribute significantly to the goals of the WHSRN.

The Convention On Wetlands of International Importance (Ramsar, Iran, 1971). This is an intergovernmental treaty which provides the framework for international cooperation for the conservation and wise use of wetlands and their resources. There are presently 93 Contracting Parties to the Convention, with over 808 wetland sites, totaling more than 53,000,000 hectares, designated for inclusion in the Ramsar List of Wetlands of International Importance. The specific criteria for designation are numerous and are based on; representative or unique wetlands, plants or animals, waterfowl, and fish.

In May, 1992, over 126,000 acres of Delaware Bay wetlands were dedicated as a Wetland of International Importance. The Meadows is included in this area. Restoration of The Meadows would satisfy many of the concepts of the Convention especially, "Wetlands should be restored and rehabilitated, whenever possible."

National Estuary Program - Delaware Estuary Program. The National Estuary Program (NEP) was established by Congress under the Water Quality Act of 1987, section 317. The purposes of the NEP are: (1) to identify nationally significant estuaries threatened by pollution, development, or overuse; (2) promote comprehensive planning, conservation and management of nationally significant estuaries; and (3) encourage the preparation of management plans and enhance coordination of estuarine research. These goals are to be achieved for estuaries in the NEP through Comprehensive Conservation and Management Plan (CCMP).

The NEP is managed by the United States Environmental Protection Agency (EPA). The Administrator of the EPA selects estuaries for the program in response to nominations by State Governors, or, in the case of interstate estuaries, at the initiative of the EPA. Selection is based on issues of significant national concern regarding water quality, biological diversity, and recreational activities.

The Delaware Estuary Program (DELEP) started as a five-year Federally-funded program which has been undertaken by the States of Delaware, New Jersey, and Pennsylvania and the EPA. The DELEP was included into the NEP in 1988. A Management Conference was officially convened in July 1989, and five goals were established:

- Provide for the restoration of living resources of the Delaware Estray and protect their habitats and ecological relationships for future generations

- Reduce and control point and nonpoint sources of pollution, particularly toxic pollution and nutrient enrichment, to attain the water quality conditions necessary to support abundant and

diverse living resources in the Delaware Estuary

- Manage water allocations within the Estuary to protect public water supplies and maintain ecological conditions in the Estuary for living resources

- Manage the economic growth of the Estuary in accordance with the goal of restoring and protecting the living resources of the Estuary

- Promote greater public understanding of the Delaware Estuary and greater participation in decisions and programs affecting the Estuary

The final Comprehensive Conservation and Management Plan (CCMP) was completed in 1997. It documented actions for each of the priority areas of focus of the Delaware Estuary Program. The priority focus areas are; Land Management, Water Use Management, Habitat and Living Resources, Toxics, and Education and Involvement.

The Meadows is within the boundaries of the Delaware Estuary Program. Ecosystem restoration at the Meadows greatly contributes to the ecosystem goal of the Program.

Coastal Ecosystems Program. This program is focusing the U.S. Fish and Wildlife Service's efforts in bays, estuaries and watersheds around the U.S. coastline. The goal of this program is to conserve fish and wildlife and their habitats to support healthy coastal ecosystems. The program is guided by three ecological principals:

- Maintain natural coastal ecosystem diversity, functions, and productivity

- Promote natural, self-sustaining populations of native species within their historic ranges

- Provide for ecologically sound levels of public uses, economic benefits, and the enjoyment of natural resources

The Delaware Bay Coastal Ecosystems Program is one of the 11 Coastal Ecosystem Programs. Its objectives are to identify important fish and wildlife habitats, assess threats to these resources and develop partnerships to protect, enhance, and restore priority habitats throughout the Delaware River drainage basin and vicinity. The Meadows is located within this program. Restoration of The Meadows ecosystem would contribute significantly to the goals of the Coastal Ecosystem Program.

The Cape May Stopover Project. This program is administered by the Endangered and Nongame Species Program of the New Jersey Department of Fish, Game, & Wildlife and is part of their Landscape Project - a proactive, ecosystem-level effort to protect New Jersey's rare species without the need for additional legislation or extensive land acquisition.

The Cape May Stopover Project is a two-year phased project whose goal is to prevent further degradation and loss of migratory bird habitat on the lower Cape May peninsula while establishing public policy guidelines for land use decisions in critical habitat areas. The following two objectives, when realized, will help to reach this goal.

Objective 1. The development of habitat protection strategies based on existing state protection guidelines and the implementation of these strategies through local planning boards.

Objective 2. The delineation and expansion of existing Conserved Land Centers - large contiguous land areas conserved through ownership (federal, state, county or conservation group) or regulation.

2. BASELINE EXISTING CONDITIONS

2.1 Socio-economic Resources

Land Use and Population. Cape May Point and the areas of West Cape May delineated in Figure 2.1.1 are the focus of the socio-economic and economic analysis portions of the study. They are located in Cape May County at the southern tip of New Jersey. The Atlantic Ocean borders the county to the east and the Delaware Bay borders the county to the west. According to the New Jersey Department of Commerce and Economic Development approximately 265 square miles or 58% of the total land area in Cape May County is in use. Farm or forest areas account for 48% of the land in use; industry for 13%; and residential development for 39%. The remaining areas consist of waterways, meadowlands, tide marshes, and beaches. The main transportation arteries in Cape May County are the Garden State Parkway and Route 9 which run north and south. Most of the developed areas are short distances from these roads. The main access roads to Cape May Point and West Cape May are Routes 633 (north-south) and 606 (east-west).

In 1990, Cape May County had a permanent population of 95,089, this represents a 15.6% increase from its 1980 population of 82,266. This is more than three times the state's rate of population growth of 5% during the same period. Almost all of Cape May County's population growth during the 1980s was a result of in-migration. In fact, the county has enjoyed steady growth over the past 50 years. This trend is projected to continue in the future. As shown in Table 2.1.1, the largest increase in population occurred between 1970 and 1980 when the number of persons residing in Cape May County increased by 22,712 or 38%. The number of people 65 years old and over living in Cape May County in 1990 was 19,131, or 20% of the total population. In 1990 over 45% of Cape May Point residents were 65 years old or older. This was much higher than the 13% proportion in the state.

The Boroughs of Cape May Point and West Cape May are two of the smallest municipalities in Cape May County. They encompass areas of 0.3 and 1.2 square miles, respectively. The populations of these communities declined slightly from 1980 to 1990. Cape May Point and West Cape May experienced a 3% and 6% population decline, from 255 and 1,091 persons to 248 and 1,026 persons, respectively. By 1995 the population in West Cape May had rebounded, while the number of year round residents in Cape May Point continued to decline.

Since these areas are in such close proximity to the beach and therefore considered resort communities, their population increases tremendously during the summer. The 1990 summer populations of Cape May Point and West Cape May are compared in Figure 2.1.2 to their permanent populations. Also, the weekend population increases between the Easter and Thanksgiving holidays. Many of the residences in these shore communities and the county are used as rental properties or second homes.

Table 2.1.1
Population Trends - Historical and Projected

Year	Cape May County	Cape May Point	West Cape May
1940	28,919	126	943
1950	37,131	198	897
1960	48,555	263	1,030
1970	59,554	204	1,005
1980	82,266	255	1,091
1990	95,089	248	1,026
1995	98,340	223	1,097
2000	111,197	288	1,099
2010	125,695	308	1,128
2020	139,833	329	1,157

Source: Cape May County Department of Planning

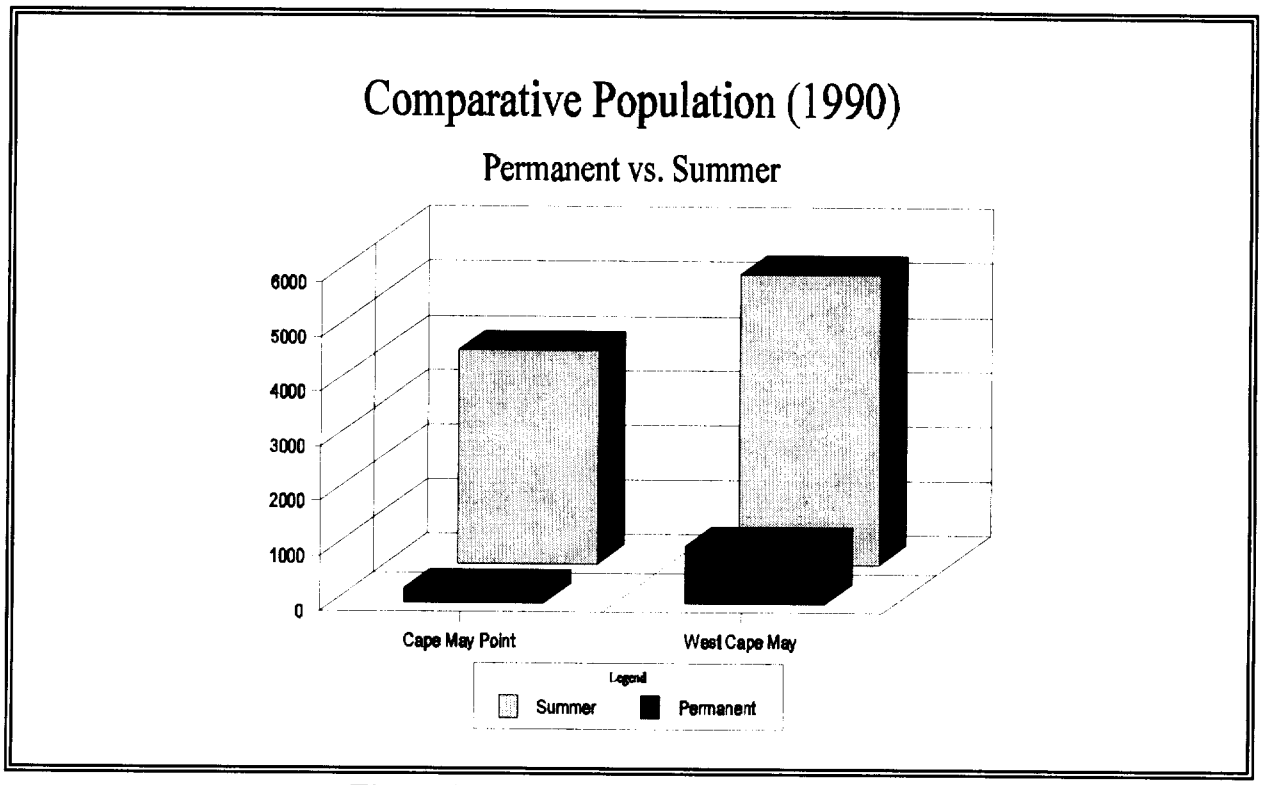


Figure 2.1.2. Source: Cape May County Dept. of Planning

Table 2.1.2
Housing Units by Usage Category
New Jersey & Cape May County (1990)

	New Jersey		Cape May County	
Usage Category	Housing Units	Percentage	Housing Units	Percentage
TOTAL	3,075,310	100.0%	85,537	100.0%
Occupied	2,794,711	90.9%	37,856	44.3%
Owner Occupied	1,813,381	59.0%	27,242	31.8%
Renter Occupied	981,330	31.9%	10,614	12.4%
Vacant	280,599	9.1%	47,681	55.7%
For Rent	78,771	2.6%	6,401	7.5%
For Sale Only	46,271	1.5%	1,531	1.8%
Rented or sold	21,519	0.7%	1,469	1.7%
Seasonal, Recreational, or Occasional Use	100,591	3.3%	36,448	42.6%
For Migrant Workers	267	0.0%	15	0.0%
Other Vacant	33,180	1.1%	1,817	2.1%

Source: Cape May County Department of Planning

As indicated in Table 2.1.2, housing units categorized as seasonal, or recreational in 1990 accounted for nearly half of the available units in Cape May County.

In Cape May Point, almost one hundred additional housing units were constructed between 1980 and 1990. As shown in Figure 2.1.3, there are approximately 550 residential structures in Cape May Point. The availability of developable land is limited. Approximately sixty lots which could be developed are located between existing residences in Cape May Point. However, there are no plans in the near future for any new construction in the study area.

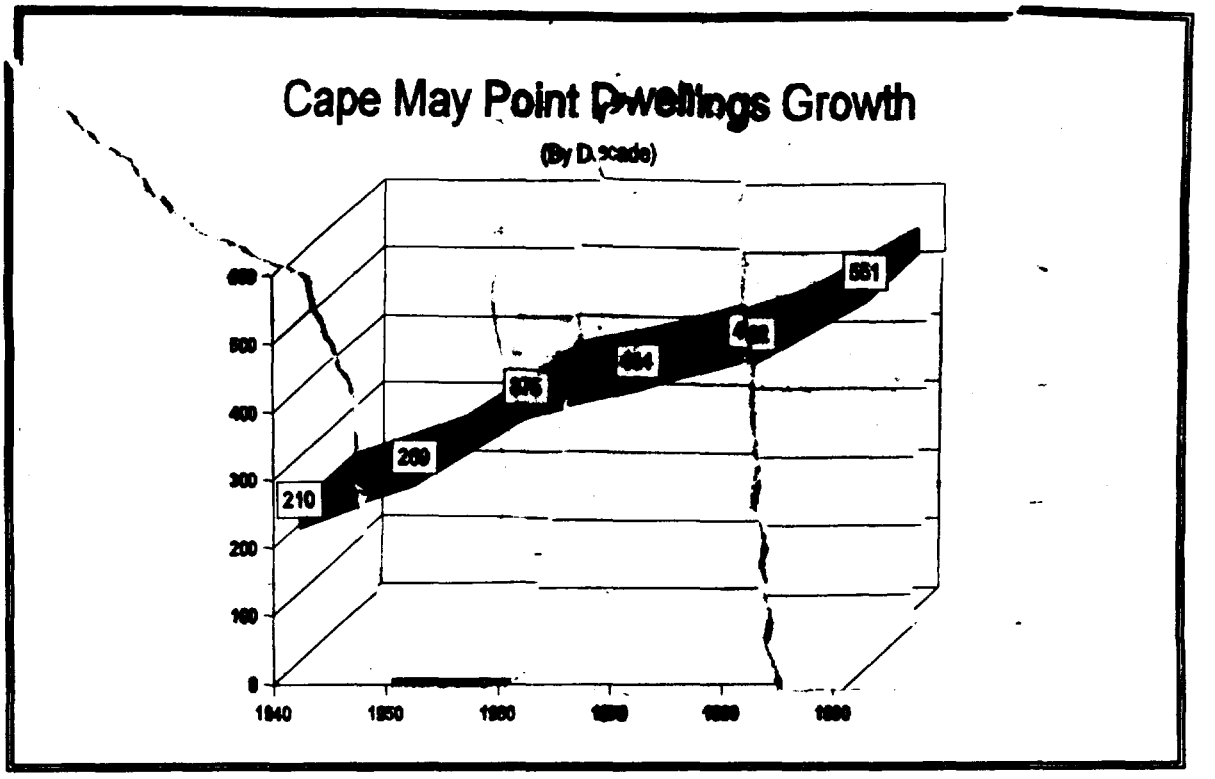


Figure 2.1.3. Source: Bor. of Cape May Point

Employment and Income. According to 1990 census data, the majority of the civilian labor force in Cape May County worked in the managerial/professional specialty, and the technical, sales and administrative support occupations. The educational attainment of the residents of the study area is fairly high. Approximately 34% of the residents of Cape May Point who are over 18 years of age have a bachelor's, graduate, or professional degree.

The summer resort season with its increase in employment remains critical to the local economy in Cape May County. The 1993 tourist season showed a marked improvement over the rainy 1992 tourist season. The civilian labor force in the County increased from 41,500 in 1980 to 45,200 in 1993. The growth in labor force exceeded the increase in employment, causing the number and percentage of unemployed people to rise. Figure 2.1.4 compares the unemployment rates of New Jersey, Cape May County, Cape May Point and West Cape May. The county, and the coastal communities have usually had a higher annual unemployment rate due to the seasonal resort economy. It is common for the unemployment rate to peak around 14% to 17% in the winter and drop to single digits in the summer.

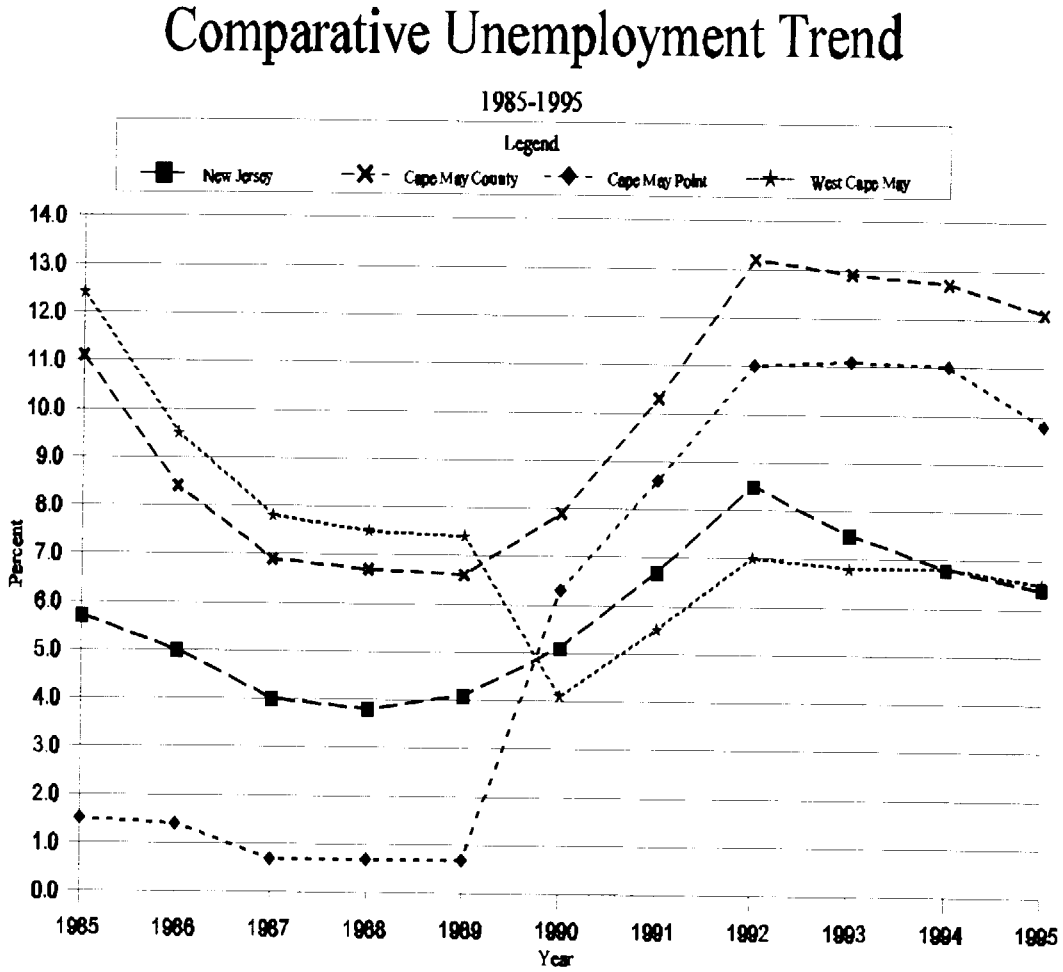


Figure 2.1.4. Sources: U.S. Dept. of Labor & N.J. Dept. of Labor

In 1990 a higher per capita income was reported for residents of Cape May Point than for residents of West Cape May or Cape May County as a whole. As shown in Table 2.1.3, the median value of single family homes is much higher in Cape May Point than West Cape May. In general, Cape May Point which is closest to the beach has slightly larger, more ornate homes than West Cape May. Many of the homes in West Cape May are one story ranches with the exception of more recent development and houses located on major roads such as Sunset Boulevard and Broadway Avenue.

Table 2.1.3
Comparative Income & Housing Value (1990)

	INCOME		SINGLE FAMILY UNITS	
Location	**Per Capita**	**Median Household**	**Median Value**	**Median Rent**
Cape May County	$15,538	$30,435	$112,800	$474
Cape May Point	$16,753	$23,125	$197,800	$450
West Cape May	$13,186	$24,353	$119,600	$423

Source: Cape May County Economic Development Center & Department of Planning

Regional Economy and Development. The commercial fishing and tourism industries contribute a great deal to the health of Cape May County's economy. This is particularly true along the Atlantic coast where most of the County's population resides. Agriculture is more prevalent inland from the shore.

In 1995 the commercial fishing industry provided employment for almost 2,900 fishermen. Also, food processing was Cape May County's largest manufacturing industry. According to National Marine Fisheries Service statistics, approximately 177 million pounds of seafood was harvested in 1995 and valued at approximately $96 million. The seafood industry is extremely important to the regional and national economy as evidenced from its national ranking. New Jersey is the leading national and world supplier of surf clams and ocean quahogs which are used in the production of chowders, sauces, and breaded strips. The consumption of seafood is expected to increase as people continue to be concerned about their health and diet.

The port in Cape May City is one of six major commercial fishing ports in New Jersey. In 1995 it was the leading port in the region, harvesting approximately 75 million pounds valued at $30.5 million. Cape May processors harvest a variety of seafood. There were approximately 1,800 full and part-time commercial fishing boats in New Jersey in 1994. The completion of a $60-million expansion to a seafood processing plant in Lower Township in 1993 was a significant development highlight for Cape May County. This expansion resulted in the creation of an

estimated 250 factory jobs. The demand for seafood and pending shortfall in supply has led the state to take initiative in the development of aquaculture. Plans for an $8 million aquaculture research project to produce techniques for cultivating shellfish and fin fish in "farm" facilities have been approved.

Tourism and Recreation. A wealth of natural resources and historical landmarks attract thousands of vacationers to Cape May County each year. The ambiance and sense of nostalgia motivates them to return time and time again. Cape May County has been a popular tourist haven for over 200 years. As early as 1766, advertisements were placed in newspapers to lure tourists to the local beaches. The resort business in Cape May City began to thrive with the development of motor transportation. It became known as the "country town by the seashore". The area has retained this quaint atmosphere. The neighboring community of Cape May Point is home to the Cape May Point State Park and the 134 year old Lighthouse. The park provides nature trails, access to the beach, picnic areas, a small sea animal museum, and an educational facility. The number of visitors to the State Park has increased from nearly 590,000 during fiscal year (July to June) 1993 to almost 730,000 during fiscal year 1995.

Tourists's dollars contribute directly and indirectly to the regional economy. In 1992, the New Jersey Travel Research Program reported that travel and tourism generated 346 thousand jobs in the state with a total payroll of $7.6 billion. Cape May County collected $1.1 billion in tourism revenues ranking fourth place among the 21 counties in New Jersey. In 1993 Cape May jumped to second place (behind Atlantic County) with $1.9 billion in tourism receipts. Tourism also generated over 20,000 jobs and a payroll of nearly $500 million.

Birding: According to the 1991 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, of the 54.7 million primary residential[1] participants, in the nonconsumptive recreational activity category, who reported observing wildlife around their homes, 51.3 million watched birds. Furthermore, 82% of all primary nonresidential[2] participants engaged in bird watching activities. Bird watching or birding, as it is called, has become a very popular activity and is of particular importance to Cape May County and the Lower Cape May Meadows area. According to the American Birding Association there has been an increase in the number of bird

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[1] Activity within one mile of home with a primary purpose that is wildlife-related: (1) closely observing or trying to identify birds or other wildlife, (2)photographing wildlife, (3)feeding birds or other wildlife on a regular basis, (4)maintaining natural areas of at least one-quarter acre for which benefit to wildlife is the primary purpose, or (6)visiting public parks within one mile of home for the purpose of observing, photographing, or feeding wildlife.

[2] Trips or outings at least one mile from home for the primary purpose of observing, photographing, or feeding wildlife. Trips to zoos, circuses, aquariums, and museums are not included.

books, bird finding guides, commercial magazines and wild bird franchises. Specialized birdwatching tour agencies have also become more common.

Cape May is well known as a rest stop for migrating birds. Cape May Point has been touted by birding enthusiasts as having some of the best bird watching in the mid-Atlantic states. The southern portion of Cape May County is a highly visited site. Birding has received considerable media attention recently. The appearance of a rare bird in Lower Cape May Meadows immediately drew the attention of birders and the news media. Special events such as weekly tours, and seasonal birdwatching weekends are sponsored by the New Jersey Audubon Society's Cape May Bird Observatory. An estimated 300 to 500 visitors attend the Spring and Autumn Birdwatching Weekends.

A survey conducted by the Observatory in 1997 estimated that more than 100,000 birders are attracted to Cape May annually. The survey authors consider the Cape May peninsula one of the most valuable resting and feeding sites for migrating birds in eastern North America. In fact, Cape May is listed among the top five birding locales in North America in terms of visitation and economic impact (estimated $31 million). One of the objectives of the survey was to determine how much money birders contribute to the local economy. Birders from a wide range of places travel to Cape May. According to survey results, the majority (57.0%) of birders visited Cape May between September and February and stayed for an average of four nights. Birders contributed to the profits of motels/hotels, bed-and-breakfasts, restaurants, gas stations, specialty stores, and bookstores.

2.2 Real Estate

An evaluation of the current ownerships, using tax maps and TRW Redi database, and a review of the deeds of affected owners, was completed using the study limits contained in the Reconnaissance Study dated August 1994. This evaluation encompasses the ownerships from the western end of Cape May Point to the eastern end of the Nature Conservancy.

In a reasonable protective dune/berm project scenario, out of a possible 84 acres, 83 acres would need to be acquired under dune and beachfill easements and 1 acre is to be acquired under a temporary work area easement (Estate No. 15). However, the temporary work area easement will be situated on lands owned and controlled by the local sponsor.

Since it is anticipated that beach work along the Borough of Cape May Point will take place sea-side of the existing dune line, no residential ownerships in this community are affected. The beach fronting this neighborhood is owned by the Borough of Cape May Point. However, ownerships along the first street fronting the beach/ocean have been identified. Should any work affect the first properties along the beach; it will impact sixty ownerships (seventy-four tracts). The sixty ownerships consist of two condominiums, four public ownerships, seven tracts of vacant land, and forty-seven residential tracts.

Other than the area owned by the Borough of Cape May Point, outlined above, the other two areas affected by the project consist of Cape May Point State Park and the Nature Conservancy. The Nature Conservancy, incorporated in 1951, is a nonprofit, tax exempt corporation that preserves plants, animals, and natural communities that represent diversity of life by protection of the lands and waters they need to survive. A review of the deeds has indicated no restrictions on the properties that would impede the project.

Since all beachfrontage is owned by the Borough, the State Park, and the Nature Conservancy, it is anticipated that the 83 acres of beachfront dune and beachfill easements can be acquired easily by the local sponsor. Also, a temporary work area easement comprising of approximately 1 acre (for the site trailer) will be located on state lands, more than likely within the state park area. Further, these areas are currently open to the general public and have sufficient access for recreation and wildlife purposes.

Any project that would in involve the wetlands on both the State Park and Nature Conservancy properties would have to be evaluated in more detail to determine the real estate needs.

2.3 Environmental Resources

2.3.1 Study Area

See Section 1.2 of this report.

2.3.2 Water Quality of New Jersey Atlantic Coastal Waters

2.3.2.1 Temperature and Salinity

The Lower Cape May Meadows is primarily a brackish to freshwater system consisting of ponds of various sizes, drainage ditches, and wetlands. In general, open water areas closest to the ocean and dune system have higher salinities due to an influx of salt water during storm events, which either breach or overtop the dunes. Salinities decrease, further away from the beach as these areas are not subject to tidal inundation as frequently as the areas immediately behind the dunes. Depending on the amount of rainfall and the frequency of recent storms, salinities may range from 0 ppt to 36 ppt on any given day (Figure 2.3-1). These constant fluctuations in salinity, along with continued erosion, topography changes, and extensive ditching by the Cape May County Mosquito Commission in the late 1960's, have all contributed to the decline of water quality within The Meadows. Extensive ditching has lowered the water table, while the erosion and filling of ditches, combined with the installation of roads in south Cape May City, has altered the drainage patterns which once existed between the State Park and The Nature Conservancy properties. This, combined with the tide gate installation at Cape Island Creek, also severed the tidal connection with Cape Island Creek. As a result of these actions, during periods of low rainfall, there is very little water flow within The Meadows. This may lead to stagnation of some water, especially during warm weather. Additionally, the filtering capacity of the wetlands has been reduced due to the changes in drainage. The alteration and disturbance of water patterns in this system has also opened the door to the invasion of Phragmites australis. Currently, 93 of the 343 acres which comprise The Meadows is dominated by monotypic stands of this plant.

Offshore of The Meadows, mixing occurs in nearshore waters due to the turbulence created from wave energy contacting shallower depths. This mixing becomes less prominent in greater depths where stratification can develop during warm periods. Water temperatures generally fluctuate between seasonal changes. The average temperature range is from 3.7°C (January) to 21.4°C (October). The most pronounced temperature differences are found in the winter and summer months. Warming of coastal waters first becomes apparent near the coast in early spring, and by the end of April thermal stratification may develop. Under conditions of high solar radiation and light winds, the water column becomes more strongly stratified during the months of July to September. The mixed layer may extend to a depth of only 12 to 13 feet. As warming continues,

Figure 2.3-1

Salinity Measurements 1992 and 1993
The Nature Conservancy Property

	Stations														
Date	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
6/10/92	2	3.5	7	3.5	16	14	17	-	-	-	-	-	-	-	-
6/26/92	-	-	-	-	-	-	-	-	12	22	7	7	6.5	11	5
7/24/92	1	2	2	1	11	11	16	10	5	6	4	3	4	5	4
8/06/92	2	3.5	4	6	14.5	15.5	18	13	5	10	6	6	6	7	7

Note: All measurements are in ppt
Rain was recorded on 7/23

	Stations														
Date	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
6/28/93	1.5	X	6.5	26.5	27	28.5	26	9.5	7	26	7	6	4	6	4
7/06/93	2	X	7	33	26	29	24.5	8.5	10	31.5	9.5	7	4.5	7	1.5
7/12/93	0	X	7.5	36	24.5	33	21	6	8.5	X	8.5	6	3.5	7	X
7/23/93	2.5	3.5	8	15	21	27	20.5	X	9	16	5.5	7	4	10	X
8/01/93	0	X	14	27	26	35	24	7	9	27	8	8	4	13	4

Note: All measurements are in ppt
Rain was recorded on 6/27, 7/14, 7/19, 7/28, 8/2 and 8/6
1993 was a drought year, the area water was very low
X = area dry, no sample taken
Station locations can be found in Appendix B

Source: The Nature Conservancy, 1993

however, the thermocline may be depressed so that the upper layer of warm, mixed water extends to a depth of approximately 40 feet. Salinity concentration is chiefly affected by freshwater dilution. Salinity cycles result from the cyclic flow of streams and intrusions of continental slope water from far offshore onto the shelf. Continental shelf waters are the least affected by freshwater dilution, and have salinity concentrations varying between 30 parts per thousand (ppt) and 35 ppt. Coastal waters are more impacted by freshwater dilution, and may have salinities as low as 27 ppt. Salinity is generally at its maximum at the end of winter. The voluminous discharge of fresh water from the land in spring reduces salinity to its minimum by early summer. Surface salinity increases in autumn when intrusions from offshore more than counterbalance the inflow of river water, and when horizontal mixing becomes more active as horizontal stability is reduced.

2.3.2.2 Water Quality Parameters

Other than occasional salinity measurements taken by The Nature Conservancy, very little analysis has been conducted in regard to the water quality within The Meadows. In 1979 however, the Cape May County Health Department, Division of Environmental Health, completed a Preliminary Water Quality Survey and Assessment for the Cape May State Park. Based on water quality standards available in 1979, several of the 15 sampling sites, located within the State Park and The Nature Conservancy property, were found to be unacceptable for the parameters measured. The measured parameters included dissolved oxygen, biological oxygen demand (BOD), phosphorous, ammonia, pH, and fecal coliform. It should be noted however that at this time a portion of The Nature Conservancy's property was being used as a cow pasture, which may have had an impact on the water quality.

In order to supplement the existing water quality data for The Meadows, sediment and water quality sampling was conducted in the spring and summer of 1997. The parameters measured during these sampling efforts included; total phosphorous, ammonia, nitrate, nitrite, TKN, fecal coliform, temperature, pH, salinity and DO. Samples were collected from Lake Lily, Lighthouse Pond East and West, Shallow Pond West, and a location within The Nature Conservancy (Figure 2.3-2). Based on the data collected, the following observations were made (Versar, 1997):

<u>Sediments</u>

Nitrate and nitrite were not detected in any of the sediment samples in either the spring or summer seasons.

Substantially higher concentrations of phosphorous, ammonia, and TKN were found in the spring sediment samples at Lake Lily and Lighthouse Ponds East and West, when compared to Shallow Pond West.

Summer samples at all ponds were found to have substantially lower concentrations of phosphorous, ammonia, and TKN.

Summer nutrient concentrations were low in Shallow Pond West and The Nature Conservancy's pond, while higher concentrations were observed for Lake Lily and Lighthouse Ponds East and West.

Surface Water

Springtime surface water salinity measurements showed low salinities in all ponds, ranging from 0.3 to 0.7 ppt.

Nitrate and nitrite were not detected in any of the surface water samples in either the spring or summer sampling efforts.

Surface water salinities taken during the summer sampling effort were higher in The Nature Conservancy's pond, Shallow Pond West, and Lighthouse Pond East, ranging from 2.0 to 4.1 ppt, while Lake Lily was essentially fresh.

Low summertime DO was observed in Lighthouse Pond West and Shallow Pond East.

The nutrient concentrations of all surface water sampled during the spring were extremely low (below detection limits.)

Phosphorous concentrations at Lake Lily during summer sampling was orders of magnitude lower than all other sample locations.

A complete list of the sampling results can be found in Tables 2.3-1 and 2.3-2.

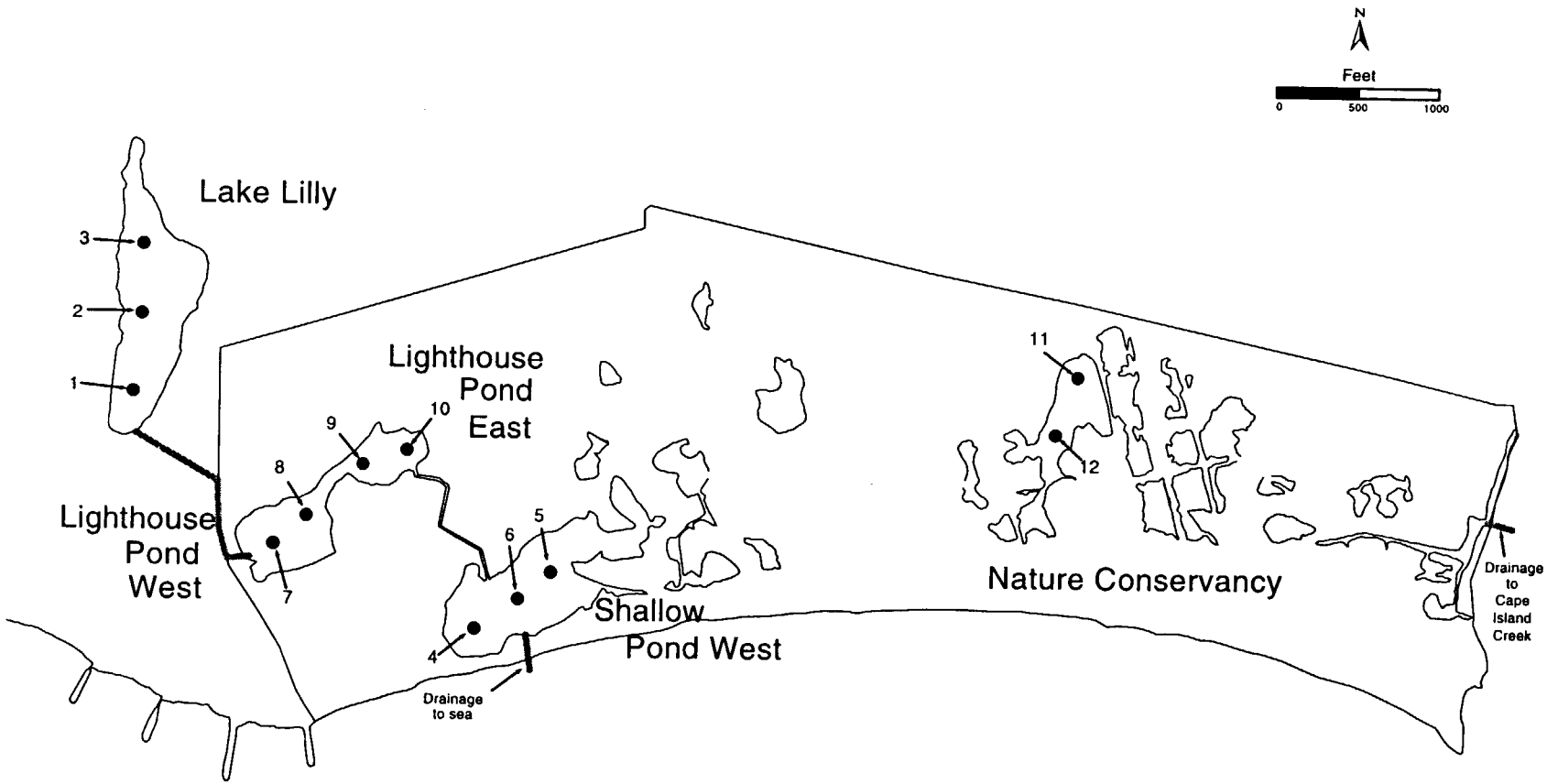


Figure 2.3-2 Station locations for sediment and surface water sampling conducted at Cape May Meadows in the spring and summer of 1997.

Table 2.3 - 1

Sediment and water quality at Lower Cape May Meadows during Spring 1997.

Parameter	Lake Lily			Lighthouse Pond West		Lighthouse Pond East		Shallow Pond West		
Station	01	02	03	07	08	09	10	04	05	06
SEDIMENT (mg/kg)										
Percent Solids (%)	8	7	7	6	5	5	6	61	50	52
Total Phosphorus	300	370	360	420	500	560	430	46	58	56
Ammonia	300	240	230	100	160	220	250	8.2	<4.0	7.7
Nitrate	<6.3	8.86	<7.1	<8.3	<10	<10	<8.3	<0.82	<1.0	<0.96
Nitrite	<0.50	<0.57	<0.57	<0.67	<0.80	<0.80	<0.67	<0.066	<0.080	<0.077
TKN	13000	14000	15000	20000	20000	20000	15000	440	820	1000
WATER QUALITY (mg/L)										
Total Phosphorus	<0.050	<0.050		<0.050		<0.050		<0.050		
Ammonia	0.3	<0.10		<0.10		<0.10		<0.10	<0.10	
Nitrate	<0.050	<0.050		<0.050		<0.050		<0.050	<0.050	
Nitrite	<0.010	<0.010		<0.010		<0.010		<0.010	<0.010	
TKN	0.9	0.9		1.2		1.9		2	1.5	
Total Coliform (cln/100 ml)	17	80		13		ND		240	34	
Fecal Coliform (cln/100 ml)	4	50		4		ND		22	11	
Temp (°C)	17.24	16.91	17.36	15.93	16.15	16.31		15.66	15.96	15.96
pH	9.64	9.58	9.62	9.67	9.68	9.53		8.41	8.20	8.19
Conductivity (mS/cm)	0.673	0.686	0.686	1.029	1.007	1.221		1.241	1.273	1.259
Salinity (ppt)	0.3	0.4	0.4	0.5	0.5	0.6		0.7	0.7	0.7
%Saturation DO	119.6	119.1	115.0	107.2	104.3	101.4		103.7	101.4	103.2
DO (mg/L)	11.47	11.50	11.00	10.56	10.22	9.90		10.27	9.97	10.15
Turbidity (NTU)	37.4	35.3	35.4	33.0	31.0	36.1		37.3	33.9	40.1

ND - Not detected

Table 2.3 - 2

Sediment and water quality at Lower Cape May Meadows during Summer 1997.

Parameter	Lake Lily		Lighthouse Pond West		Lighthouse Pond East		Shallow Pond West		Nature Conservancy	
Station	01	02	07	08	09	10	04	05	11	12
SEDIMENT (mg/kg)										
Percent Solids (%)	7	10	12	7	8	18	82	40	72	50
Total Phosphorus	<36	28	<21	76	31	32	<3.0	<6.3	<3.5	<5
Ammonia	300	220	150	230	300	83	3.7	28	15	44
Nitrate	<7.0	<5.1	<4.2	<7.3	<6.0	<2.7	<0.61	<1.3	<0.67	<0.92
Nitrite	<0.57	<0.40	<0.33	<0.57	<0.50	<0.22	<0.049	<0.1	<0.056	<0.08
TKN	2600	1500	1800	2900	4100	1300	36	640	190	770
WATER QUALITY (mg/L)										
Total Phosphorus	0.0756	0.0441		0.100		0.204	0.221	0.332		0.351
Ammonia	0.10	<0.10		0.20		0.20	0.10	0.20		0.20
Nitrate	<0.05	<0.05		<0.05		<0.05	<0.05	<0.05		<0.05
Nitrite	<0.01	<0.01		<0.01		<0.01	<0.01	<0.01		<0.01
TKN	1.7	1.4		1.6		4.0	4.3	4.7		25
Total Coliform (cln/100 ml)	30	30		8		50	1600	50		1600
Fecal Coliform (cln/100 ml)	11	8		4		50	240	50		500
Temp (°C)	25.54	24.84	24.03	23.14	22.78	22.26	21.49	21.3	26.28	26.02
pH	9.19	9.34	7.56	7.72	9.4	9.36	9.1	9.1	8.6	8.62
Conductivity (mS/cm)	0.937	0.972	2.04	2.05	3.7	3.78	7.33	3.72	3.79	4.09
Salinity (ppt)	0.5	0.5	1.1	1.1	2	2.1	4.1	2	2.1	2.2
%Saturation DO	62.8	70	10.4	40.1	41.2	47.1	0	13.7	84.5	82.4
DO (mg/L)	5.12	5.78	0.87	3.4	3.5	4.04	0	1.2	6.3	6.58
Turbidity (NTU)	4.0	1.5	5.4	3.8	--	25.7	32.8	22.4	--	24.7

ND - Not detected

Water quality in the offshore sections of the study area may be degraded by pollutants entering near-shore coastal waters by point and nonpoint sources. Point sources are typically discharges from wastewater treatment plants, industry, and combined stormwater and sewage outfalls.

Numerous nonpoint sources exist including stormwater runoff, runoff from agricultural activities, and septic tank leachate. New regulations are effectively reducing the pollution from point sources. For instance, all sewage treatment plants along the coast of New Jersey operate at the secondary treatment levels.

Nonpoint source pollution (NPS) is the primary pollution of backbay and near-shore coastal waters. NPS generally correlates directly with the intensity of land development and contains nutrients, heavy metals, oil and grease, fecal coliform, and possibly some toxic substances. By its very nature, NPS is difficult to identify and control (Rutgers University, 1988).

One indication of water quality is derived from the annual State of New Jersey Shellfish Growing Water Classification Charts. Waters are classified as approved, seasonal, special restricted or prohibited. According to the 1996 Classification Charts, the waters within the project area are classified as approved for the harvest of oysters, clams, and mussels. However the waters immediately adjacent to the study area, from the 3rd Avenue groin in Cape May to the Cape May Inlet Jetties, are classified as prohibited areas which are condemned for the harvest of oysters, clams and mussels.

The water quality of New Jersey's coastal waters is also monitored closely through the states Cooperative Coastal Monitoring Program (CCMP) which was established by the New Jersey Department of Environmental Protection (NJDEP) in 1974. The purpose of the CCMP is to assess nearshore coastal water quality and investigate sources of water pollution. The information gathered during these investigations aids in the identification and control of pollution from nonpoint sources. The program also allows local health agencies to respond quickly to public health concerns arising from contamination in coastal recreational areas (Cooperative Coastal Monitoring Program, 1993).

Under the CCMP, the county health departments are authorized by the NJDEP to monitor the coastal and backbay water quality. This is accomplished by monitoring the concentrations of fecal coliform and enterococci as indicators of fecal contamination from point and nonpoint sources.

The 1993 Annual Report for the Cooperative Coastal Monitoring Program states that in Cape May County 1024 ocean samples and 967 bay samples were collected during that year. These samples were taken at 59 and 68 stations, respectively. For ocean monitoring stations, the standard is 50 fecal coliforms per 100 milliliters (ml) while the bay stations have a standard of 200 fecal coliforms per 100 ml. In 1993, the water quality at all of the ocean monitoring stations met the standard while 2 bay stations exceeded the standard. The report states that geometric

means (GM) are one method of evaluating water quality. Other methods consist of analyzing individual sample results alone or in relation to environmental conditions at the time of sample collection. Previous coastal water quality evaluations have indicated that a chronic contamination problem may exist if approximately 20 percent of the samples collected from a station exceeds the Surface Water Quality Standards (SWQS). Based on this analysis, 2 ocean and 20 bay stations had 20 percent of the individual samples in excess of the SWQS.

Ocean Monitoring	1991	1992	1993
Total Samples	1159	1171	1024
Total Stations	59	59	59
Stations w/GM > SWQS	0	0	0
20% > SWQS	1	0	2

Bay Monitoring	1991	1992	1993
Total Samples	1023	1006	967
Total Stations	68	68	68
Stations w/GM > SWQS	1	1	2
20% > SWQS	15	18	20

2.3.3 Terrestrial Ecology of Affected Area

2.3.3.1 Vegetation

The vegetation within The Meadows is unique in its diversity and actually comprises several successional communities. According to the 1986 Cape May Point Natural Area Management Plan, Cape May Peninsula is a geographic merging point for many northern and southern plant species. An example of this is that both the northern bayberry and southern wax myrtle can be found growing within the project area. The vegetation in The Meadows is also unique in that it has experienced and adapted to various ecological, geological, and man-made changes. During large storms the "freshwater" ponds and wetlands are frequently inundated with ocean water when the dunes surrounding the area are breached or overtopped. Only plants adapted to this dynamic environment of salt air, high winds, variable soil moisture content, and varying salinity survive.

The vegetated areas in Lower Cape May Meadows span several different habitat types. Upland vegetation is primarily confined to forested and old field/scrub shrub areas. Most of the forested areas are found in the State Park section of The Meadows while the old field/scrub shrub habitat is confined to the area managed by The Nature Conservancy. Typical species inhabiting the

forested area include sassafras (Sassafras albidum), common persimmon (Diospyros virginiana), black oak (Quercus velutina), white oak (Quercus alba), and red maple (Acer rubrum). Evergreen species found in the area include American holly (Ilex opaca), eastern red cedar (Juniperus virginiana), and pitch pine (Pinus rigida).

Understory species and species located in the old field/scrub shrub habitats include sumac (Rhus sp.), poison ivy (Rhus radicans), briers (Smilax sp.), rose (Rosa sp.), marsh elder (Iva frutescens), bayberry (Myrica pensylvanica), wax-myrtle (Myrica cerifera), seaside goldenrod (Solidago sempervirens), sheep sorrel (Rumex acetosella), sweet everlasting (Gnaphalium obtusifolium), purple vetch (Vicia americana), Japanese honeysuckle (Lonicera japonica), and Polygonum sp. (Biohabitats, Inc., 1996).

2.3.3.2 Dunes

Although typical beach dunes and the habitats associated with them are almost non-existent within the Cape May Point portion of the study area, some elements of beach dune flora and fauna are still present within The Meadows. The following discussion on beach dunes mainly pertains healthy, undisturbed beach and dune areas, however, some of the dune flora and fauna discussed are still present within The Meadows, despite the recent reconstruction of portions of the dune due to storm impacts.

In typical undisturbed beach profiles along the Atlantic Coast of New Jersey, the primary dune is the first dune landward from the beach. The flora of the primary dune are adapted to the harsh conditions present such as low fertility, heat, and high energy from the ocean and wind. The dominant plant on these dunes is American beachgrass (Ammophila breviligulata), which is tolerant of salt spray, shifting sands and temperature extremes. American beachgrass is a rapid colonizer that can spread by horizontal rhizomes, and also has fibrous roots that can descend to depths of 3 feet to reach moisture. Beachgrass is instrumental in the development of dune stability, which opens up the dune to further colonization with more species like seaside goldenrod (Solidago sempervirens), sea-rocket (Cakile edentula) and beach cocklebur (Xanthium echinatum).

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

Along undeveloped portions of the New Jersey Atlantic Coastline, the primary and secondary dunes grade into a zone of shrubby vegetation. These zones are typically located on the headlands or on the barrier flats of the barrier beaches. This zone is called the scrub-thicket zone where sand movement is more diminished. Many of the flora are dwarf trees and shrubs which include: wax-myrtle (Myrica cerifera), bayberry (M. pensylvanica), dwarf sumac (Rhus copallina), poison ivy (Toxicodendron radicans), black cherry (Prunus serotina), American holly (Ilex opaca), greenbrier (Smilax spp.), groundsel bush (Baccharis halimifolia), loblolly pine (Pinus taeda), pitch pine (Pinus rigida), Virginia creeper (Parthenocissus quinquefolia), beach plum (Prunus maritima), and the non-native Japanese black pine (Pinus thunbergii).

A number of non-marine mammals, reptiles, amphibians and birds are associated with the dune habitat along the New Jersey coastline. These species include: Fowler's toad (Bufo woodhousei fowleri), eastern hognose snake (Heterodon platyrhinos), box turtle (Terrapene carolina), raccoon (Procyon lotor), eastern cottontail (Sylvilagus floridanus), red fox (Vulpes fulva), white-footed mouse (Peromyscus leucopus), meadow vole (Microtus pensylvanicus), white-tailed deer (Odocoileus virginianus), savannah sparrow (Passerculus sandwichensis), song sparrow (Melospiza melodia), mourning dove (Zenaida macroura), gray catbird (Dumetella carolinensis), northern mockingbird (Mimus polyglottos), and brown thrasher (Toxostoma rufum).

2.3.3.3 Wetlands

The Lower Cape May Meadows is a very diverse coastal freshwater wetland area, comprised of several unique and important habitats. One of the most important habitat types to many species of waterfowl and wading birds are freshwater and brackish wetlands which make up a large majority of the total acreage present within The Meadows. These freshwater wetlands are dispersed throughout The Meadows, occurring at different elevations, surrounded by different habitats, and receiving different levels of tidal inundation during storms. For this reason, wetland vegetation varies greatly throughout the site. Due to changes in elevation and drainage patterns within the site, as well as the impacts to freshwater wetland plant species associated with salt water intrusion, a majority of the wetlands have been degraded and are currently monotypic stands of Phragmites australis. Some of the more productive emergent wetlands, which are located primarily on The Nature Conservancy's property, are dominated by narrow-leaved cattail (Typha angustifolia), saltmeadow cordgrass (Spartina patens), saltgrass (Distichlis spicata), black needlerush (Juncus roemerianus), common rush (Juncus effusus), and great bulrush (Scirpus validus). On the fringes of the wetlands common vegetation consists of sea pink (Sabatia stellaris), saltwort (Salicornia sp.), marsh elder (Iva frutescens), aster (Aster sp.), water-pennywort (Hydrocotyle umbellata), boneset (Eupatorium perfoliatum), bog-hemp (Boehmeria cylindrica), and marsh goldenrod (Solidago uliginosa).

While The Meadows is considered an extremely valuable coastal habitat, as recently as 1955 the composition and productivity of the wetlands at The Meadows was dramatically different from

what exists now. In 1955, approximately 209 acres of emergent wetlands were present at The Meadows, as opposed to the 42 acres which currently exist. As stated previously, years of erosion, mosquito ditching, the loss of consistent tidal inundation through the connection with Cape Island Creek, and storm induced salt water intrusion, have all led to the transformation from productive emergent wetlands to a Phragmites australis dominated habitat. The main avenue for the expansion of the Phragmites australis has been the salt water intrusion that has occurred as a result of weakened dunes being breached and overtopped. The introduction of large quantities of salt water into the site during storms raises the salinity of the system, having a detrimental effect on the existing freshwater flora and fauna. Many plant species which currently exist within The Meadows, such as the great bulrush, common rush, water-pennywort, and aster require water with salinity no greater than 5 ppt to survive. On many occasions, as a result of storms, the salinity within The Meadows has been measured at concentrations much higher than the 5 ppt growing range of existing vegetation. When elevated salinity concentrations exist for more than a few days, sometimes several times a year, the vegetation is killed, leaving the area open to the invasion of Phragmites australis, which can tolerate higher salinities and thrives in disturbed areas. While Phragmites australis does not prefer this type of brackish environment, it survives because it is one of the few plant species capable of tolerating the varying levels of soil and water salinity associated with the tidal inundation (Biohabitats, 1996). In fact, in freshwater habitats, many other plant species will successfully out-compete the Phragmites australis (Marks, Lapin and Randall, 1994).

Another direct impact of the dune breaching and overtopping is that this situation tends to deposit large quantities of sand within The Meadows, raising the elevation of areas immediately behind the dune (overwash areas) and creating another perfect growing environment for the Phragmites australis. The frequency and magnitude of these impacts has resulted in the proliferation of Phragmites australis, at the expense of the more productive emergent wetlands.

2.3.3.4 Upper Beach

The upper beach or supralittoral zone typically lies below the primary dune and above the intertidal zone. An upper beach zone is present within the study area, however, it is subject to some disturbance from human activity. The upper beach zone is generally only covered with water during periods of extremely high tides and large storm waves. Within the project area however, continued erosion has left much of the beach in a condition where this area is regularly inundated by normal high tides. The upper beach habitat is characterized by sparse vegetation and few animals. This zone has fewer biological interactions than the dunes, and organic inputs are scarce. The most active organism in this zone is the ghost crab (Ocypode quadrata). This crab lives in semi-permanent burrows near the top of the shore, and it is known to be a scavenger, predator, and deposit sorter. The ghost crab is nocturnal in its foraging activities, and it remains in its burrow during the day. In addition to ghost crabs, species of sand fleas or amphipods (Talitridae), predatory and scavenger beetles and other transient animals may be

found in this zone.

Many species of shorebirds inhabit the beach during the spring and fall migrations, although most are even more likely to be found on more protected sand and mud flats within The Meadows, tidal marshes, or along the Delaware Bay shoreline (especially in spring when large numbers of horseshoe crab eggs are available). Shorebirds feed on small individuals of the resident infauna and other small organisms brought in with waves. Common shorebird species include sanderling (Calidris alba), dunlin (C. alpina), semipalmated sandpiper (C. pusilla), western sandpiper (C. mauri), least tern (Sterna antillarum), piping plover (Charadrius melodus), and willet (Catoptrophorus semipalmatus). Sanderling, dunlin, and western sandpiper also occur on the beach throughout the winter. Colonial nesting shorebird habitat is increasingly under pressure from development and human disturbance along New Jersey's Atlantic beaches. Nesting birds such as common tern (Sterna hirundo), least tern (Sterna antillarum), black skimmer (Rynchops niger), and American oystercatcher (Haematopus palliatus) are frequent spring and summer inhabitants on unvegetated dunes and upper beaches within the study area.

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

2.3.4 Aquatic Ecology of Study Area

2.3.4.1 Upper Marine Intertidal Zone

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

2.3.4.2 Intertidal Zone

The intertidal zone contains more intensive biological activity than the other zones. Shifting sand and pounding surf dominate a habitat which is inhabited by a specialized fauna. The beach fauna forms an extensive food-filtering system which removes detritus, dissolved materials, plankton, and larger organisms from in-rushing water. The organisms inhabiting the beach

intertidal zone have evolved special locomotory, respiratory, and morphological adaptations which enable them to survive in this extreme habitat. Organisms of this zone are agile, mobile, and capable of resisting long periods of environmental stress. Most are excellent and rapid burrowers. Frequent inundation of water provides suitable habitat for benthic infauna, however, there may be a paucity in numbers of species. Intertidal benthic organisms tend to have a high rate of reproduction, and a short (1 to 2 years) life span (Hurme and Pullen, 1988). This zone contains a mixture of herbivores, primary carnivores, and some high order carnivores such as the mole crab (Emerita sp.). A number of interstitial animals (meiofauna) are present feeding among the sand grains for bacteria and unicellular algae, which are important in the beach food chain. In 1978, extensive sampling for invertebrate infauna was performed by the U.S. Fish and Wildlife Service and Corps of Engineers on the beaches within the Delmarva Peninsula, Maryland. There were four dominant species of invertebrate infauna in this zone, which were the mole crab (Emerita talpoida), a haustorid amphipod (Haustorius canadensis), the coquina clam (Donax variabilis), and spionid worm (Scolelepis squamata). The epifaunal blue crab (Callinectes sapidus) and the lady crab (Ovalipes ocellatus) were also found in or near this zone. These species withdraw to the nearshore subtidal zone during the winter months and return to the intertidal zone when conditions are more favorable. These invertebrates are prey to various shorebirds and nearshore fishes such as the Atlantic silverside (Menidia menidia), and juveniles of spot (Leiostomus xanthurus), kingfish (Menticirrhus saxatilus), and bluefish (Pomatomus saltatrix). The horseshoe crab (Limulus polyphenus) is a common inhabitant of Atlantic Coastal areas, and utilizes the sandy beaches (particularly of Delaware Bay) to lay eggs.

Benthic macroalgae grow attached to the bottom substrate in the intertidal zone, where they are alternately exposed and submerged as the tides ebb and flow. The substrate along the Atlantic Coast of New Jersey is mainly composed of shifting sands and shell fragments, making it too unstable for large colonies of benthic algae to proliferate. Colonies do attach on hard, stable substrates provided by peat banks, shell bottoms, reefs, and man-made structures such as pilings, jetties, buoys and bridges. Various species of benthic macroalgae representing the phyla Chlorophyta and Phaeophyta are found in New Jersey's coastal waters.

2.3.4.3 Nearshore and Offshore Zones

The nearshore coastal zone generally extends seaward from the subtidal zone to well beyond the breaker zone (U.S. Army Corps of Engineers, 1984). This zone is characterized by intense wave energies that displace and transport coastal sediments. The offshore zone generally lies beyond the breakers, and is a flat zone of variable width extending to the seaward edge of the Continental Shelf. Hurme and Pullen (1988) describe the nearshore zone as an indefinite area that includes parts of the surf and offshore areas affected by nearshore currents. The boundaries of these zones may vary depending on relative depths and wave heights present.

The following paragraphs discuss planktonic, pelagic and benthic biological resources associated

with New Jersey coastal waters, which may overlap nearshore waters with offshore waters. The proposed sand borrow sites for this project will be referred to as the proposed offshore borrow sites.

2.3.4.4 Plankton

Plankton are collectively a group of interacting minute organisms adrift in the water column. Plankton are commonly broken into two main categories: phytoplankton (plant kingdom) and zooplankton (animal kingdom).

Phytoplankton play an essential role in the food web because they are the primary producers in the aquatic marine ecosystem. Phytoplankton convert light and chemical energy into organic compounds which can be assimilated by higher organisms in the food chain. Phytoplankton production is dependent on light penetration, available nutrients, temperature and wind stress. Phytoplankton production is generally highest in nearshore waters. Seasonal shifts in species dominance of phytoplankton are frequent. Dinoflagellates are generally abundant from summer through fall, and diatoms are dominant during the winter and early spring. Approximately 126 species of phytoplankton were identified in New Jersey's coastal waters representing the following phyla: Chlorophyta, Chromophyta, Pyrrophyta, Euglenophyta, and Procaryota

The most prevalent species and their season of dominance are as follows:

Nitzschia seriata - winter
Skeletonema costatum - late winter, early spring
Guinarkia flaccida - spring
Pyramimonas sp. - spring, early summer
Cryptomonas acuta - summer
Katodinium rotundatum - mid-summer
Chrysochromulina sp. - summer

Zooplankton provide an essential trophic link between primary producers and higher organisms. Zooplankton represent the animals (vertebrates and invertebrates) that are adrift in the water column, and are generally unable to move against major ocean currents. Many organisms may be zooplankton at early stages in their respective life cycles only to be able to swim against the currents (nektonic) in a later life stage, or to be a part of the benthic community. Zooplankton are generally either microscopic or barely visible to the naked eye. Zooplankton typically exhibit seasonal variances in species abundance and distribution, which may be attributed to temperature, salinity and food availability. In marine environments, seasonal peaks in abundance of zooplankton distinctly correlate with seasonal phytoplankton peaks. These peaks usually occur in the spring and fall. Sampling in the lower Delaware Bay by Watling and Maurer (1976) revealed the presence of 60 species representing the following phyla: Protozoa, Cnidaria, Ctenophora, Ectoprocta, Annelida, Mollusca, Arthropoda, Chaetognatha and Chordata.

Zooplankton species characteristic of coastal areas include: Acartia tonsa, Centropages humatus, C. furatus, Temora longicornis, Tortanus discaudatus, Eucalanus pileatus, Mysidopsis bigelowi (mysid shrimp), and Crangon septemspinosa (sand shrimp).

2.3.4.5 Macroinvertebrates

The nearshore and offshore zones of the New Jersey Coast contain a wide assemblage of invertebrate species inhabiting the benthic substrate and open water. Invertebrate phyla existing along the coast are represented by Cnidaria (corals, anemones, jellyfish), Platyhelminthes (flatworms), Nemertinea (ribbon worms), Nematoda (roundworms), Bryozoa, Mollusca (chitons, clams, mussels, etc.), Echinodermata (sea urchins, sea cucumbers, sand dollars, starfish), and the Urochordata (tunicates).

The diversity and composition of benthic communities are often reliable indicators of the overall quality of any particular habitat for supporting life (New Jersey Bureau of Fisheries, 1979). Benthic macroinvertebrates are those dwelling in the substrate (infauna) or on the substrate (epifauna). Benthic invertebrates are an important link in the aquatic food chain, and provide a food source for most fishes. Various factors such as hydrography, sediment type, depth, temperature, irregular patterns of recruitment and biotic interactions (predation and competition) may influence species dominance in benthic communities. Benthic assemblages in New Jersey coastal waters exhibit seasonal and spatial variability. Generally, coarse sandy sediments are inhabited by filter feeders, and areas of soft silt or mud are more utilized by deposit feeders.

Sampling associated with the proposed Atlantic Generating Station used clam dredges, trawls, and grab samples to survey the species composition, abundance, weight, and distribution of benthic macroinvertebrates in the vicinity of the Mullica River estuary, Great Bay, Little Egg Inlet, and the ocean from Brigantine Island to Long Beach Island and 5 miles seaward (Milstein and Thomas, 1976). Over 250 macroinvertebrate species were collected during these surveys. These species included: Aricidea jeffreyssi (paraonid polychaeta), Spiophanes bombyx (spionid polychaeta), Tellina agilis (tellinid bivalvia), Mediomastus ambiseta (capitellid polychaeta), Nephtys picta (nephtyid polychaeta), Unciola irrorata (aorid amphipoda), Paranaitis speciosa (phyllodocid polychaeta), Nucula proxima (nuculid bivalvia), and Ensis directus (solenid bivalvia).

In 1979, the NJ Bureau of Fisheries conducted a benthic study in the inlets from Great Bay to Great Egg Harbor Inlet to inventory benthic organisms and the composition of the sediments in which they lived. The resulting report discussed the relationship of the organisms to sediment composition, as well as the condition of benthic communities in specific substrates. Although some species association was found with certain sediment types, no strong correlations between species diversity and density, and sediment composition were found (Fish and Wildlife Service, 1991).

In September 1996, Versar, Inc., conducted a benthic-sediment assessment focusing on infauna species in the proposed offshore sand borrow sites located offshore of Cape May City (Borrow Area P1) and offshore of the Lower Cape May Meadows (Borrow Area P2), to establish a baseline for the benthic macroinvertebrate assemblages within the proposed borrow sites (Figure 2.3-3). Other objectives were to identify the presence of any commercial and/or recreationally important benthic macroinvertebrates, and to identify the presence of ecologically important benthic communities within the proposed sand borrow sites. The data obtained from each borrow area were compared to each other, other local borrow areas sampled under other contracts, and nearshore reference points.

For this study, 25 benthic macroinvertebrate samples were collected from the 2 proposed borrow areas discussed above. The number of stations sampled for each borrow area was proportional to the size of the proposed area (Borrow Area P1 has an area of approximately 250 acres while P2 has an area of approximately 150 acres). Based on this acreage breakdown, sixteen samples were collected from Borrow Area P1 and 9 samples were collected from Borrow Area P2. Two additional samples were collected from reference stations located near each borrow area for a total of 4 "nearshore" reference stations (See Figure 2.3-3).

According to Versar, Inc., the results of the benthic sampling identified a total of 112 distinct infauna taxa within the proposed borrow areas and the reference sites. The mean and total number of taxa identified were within expected ranges for similar euhaline environments and the taxa collected were similar to each other, the reference sites, and to the regional areas. One exception to this was the dominant presence of a bivalve and an amphipod in Borrow Area P2.

These species, Donax variabilis and Parahauystorius longimerus respectively are generally ubiquitous to this region and should not preclude the consideration of this site for dredging activities. Significant differences were detected however in the Shannon-Wiener Index, Simpson's Diversity Index, and polychaete abundance. Versar, Inc., states that these differences were attributed to the high abundance of two polychaetes (Polycirrus eximius and Polygordius spp.) in Borrow Area 1 (Table 2.3-3).

Size data recorded suggests that Borrow Area P1 supports a greater proportion of large taxa than Area P2, despite the fact that the number of taxa with larger organisms is not significantly higher. The greater proportion of large organisms present within Borrow Area P1 may suggest that this area would require a longer time frame to recover from dredging operations (Warwick 1986; Dauer 1993).

As stated above, the analysis also looked for the presence of benthic species with commercial and/or recreational value. One species of commercial or recreational value was collected during the macroinvertebrate survey, the Atlantic surf clam. Borrow Area P2 had the greater abundance of surf clams (though not significantly), but the biomass of surf clams was significantly lower than either Borrow Area P1 or the reference sites (Table 2.3-4). Thirty-nine percent of the surf

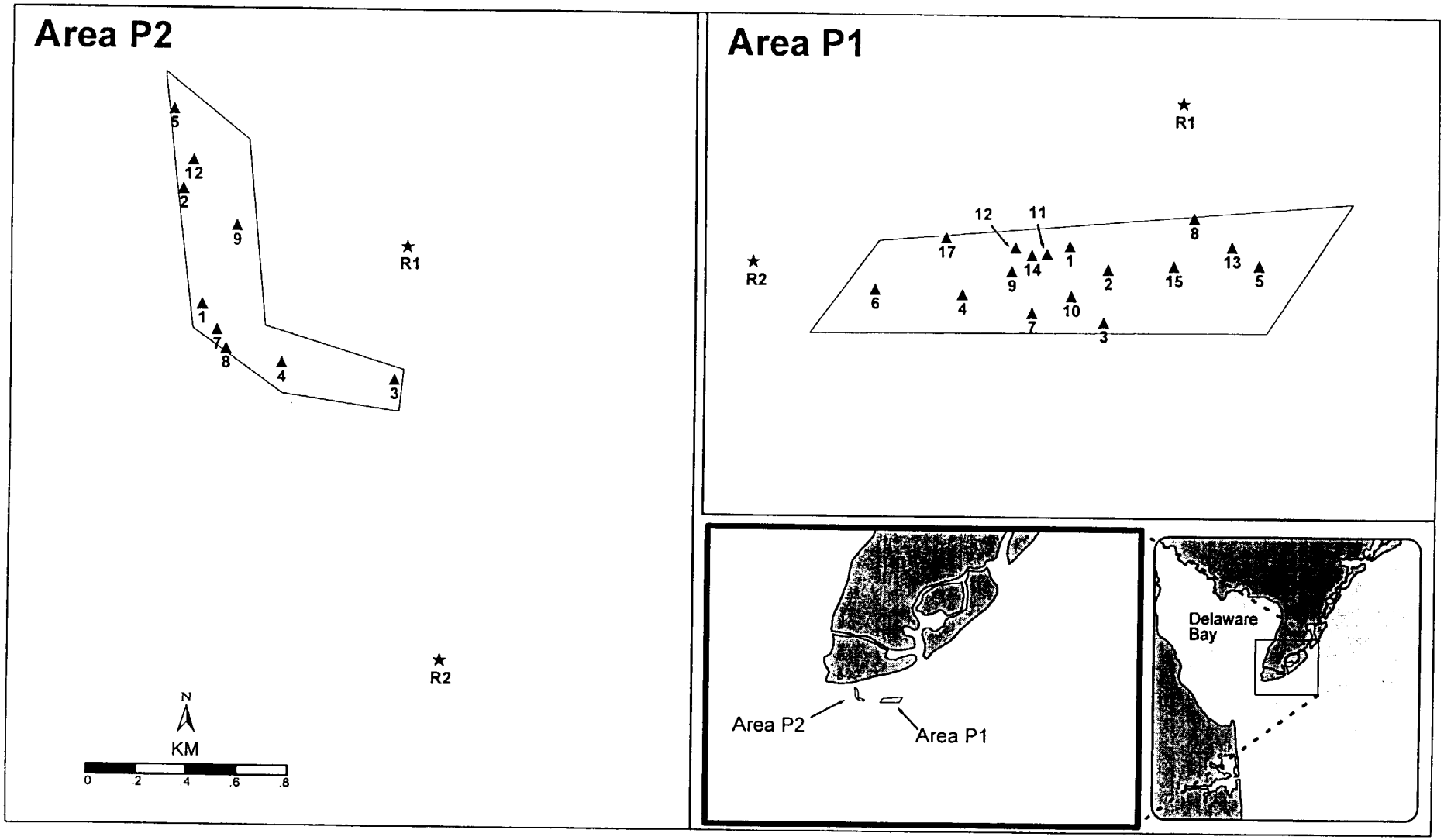


Figure 2.3-3 Station locations at the proposed borrow areas and reference sites in lower Cape May Meadows, New Jersey

clams collected in Borrow Area P1 had lengths greater than 2 cm, however, no individuals greater than 2 cm in length were collected in Borrow Area P2 (Table 2.3-4). This may suggest that while juvenile surf clams settled and are surviving in Borrow Area P2, they may not be reaching older life stages (Versar, Inc., 1997).

The complete benthic survey report can be found in Appendix B.

2.3.4.6 Fisheries

2.3.4.6.1 Shellfish/Aquatic Invertebrates

Extensive shellfish beds, which fluctuate in quality and productivity are found in the shallow ocean waters of the study area. Atlantic surf clams (Spisula solidissima) are found offshore the barrier islands along with hard clams (Mercenaria mercenaria), blue mussel (Mytilus edulis) and blue crab (Callinectes sapidus). Surf clams are the largest bivalve community found off the Atlantic coast from the Gulf of Saint Lawrence, Canada to North Carolina. The clams usually spawn twice off the coast of New Jersey, once in July and August and then again in October. The blue crab and the hard clam are two of the most important invertebrates of recreational and commercial value along the New Jersey Coast. Since many of these animals are filter feeders and tend to bioaccumulate toxins and bacteria within their systems, bivalves are often used as indicators of water quality. Indications of this can be seen when shellfish areas are closed or have restricted harvests. In areas where this occurs, there are generally water quality or pollution problems associated with the closings.

The area immediately offshore from the Lower Cape May Meadows has been classified as approved for the harvesting or shellfish according to the New Jersey Shellfish Growing Water Classification Charts. Most of the area between the 3rd Avenue Terminal Groin in Cape May City and the Cape May Inlet is classified as prohibited, most of which extends 0.25 nautical miles from shore. In prohibited areas, the waters are condemned for the harvest of oysters, clams, and mussels.

The surf clam fishery supports the largest molluscan fishery in New Jersey, accounting for, by weight, 52% of the State's total molluscan commercial landing in 1993. This catch represents over 85% of the total Mid-Atlantic area catch for 1993, with a value of over 21 million dollars. The coastal area below Absecon Inlet however, contains only 17% of the total standing stock and comprises less than 5% of the total commercial use during the 1993-1994 season. In addition, sampling conducted by the Bureau of Shellfisheries in 1993 indicates that the surf clam resource below Great Egg Harbor Inlet remains noncontributory to the overall standing stock and continues to provide no evidence of recruitment (N.J. Bureau of Shellfisheries, 1994).

Table 2.3-3 Mean abundances (#/m^2) of the 10 most abundant infaunal taxa collected during macroinvertebrate sampling at the borrow areas and reference sites

Taxa	Borrow P1	Borrow P2	Reference
Nemertinea			
Nemertinea	106.5	35.4	198.9
Annelida : Polychaeta			
Amastigos caperatus	15.6	197.0	715.9
Caulleriella sp. B (Blake)	474.4	300.5	380.7
Paraprionosyllis longicirrata	72.4	598.5	318.2
Polycirrus eximius	5843.7	1123.7	278.4
Polygordius spp.	10994.3	1214.6	3846.6
Tharyx sp. A (Morris)	7.1	356.1	62.5
Annelida : Oligochaeta			
Oligochaeta	315.3	126.3	289.8
Mollusca : Gastropoda			
Turbonilla interrupta	166.2	5.1	0
Mollusca : Bivalvia			
Donax variabilis	0	199.5	0
Mysella planulata	119.3	48.0	17.1
Petricola pholadiformis	61.1	515.2	198.9
Spisula solidissima	169.0	275.3	170.5
Tellina agilis	208.8	131.3	198.9
Arthropoda : Amphipoda			
Parahaustorius longimerus	0	166.7	0

Table 2.3-4 Mean abundance (#/m^2) and mean biomass (g/m^2) of the commercially and recreationally important species *Spisula solidissima* in the borrow areas and reference sites. Standard error in parenthesis. Means with the same letter are not significantly different as indicated by Duncan's Multiple Range Test.

Attribute	Borrow P1	Borrow P2	Reference
Abundance	169.0[a] (28.7)	275.3[a] (100.2)	170.5[a] (83.2)
Biomass	9.15[a] (2.61)	0.07[b] (0.02)	6.82[a,b] (6.8)

Percentage of organisms longer than 2 cm collected in the borrow areas and reference sites (zeros indicate species less than 2 cm were not collected; no value indicates species was not collected). Mean number of taxa with the same letter are not significantly different as indicated by Duncan's Multiple Range Test.

Taxon	Borrow P1	Borrow P2	Reference
Mollusca : Bivalvia			
Ensis directus	40.63		
Pandora gouldiana	0		25.00
Spisula solidissima	39.22	0	20.45
Arthropoda : Decapoda			
Callianassa setimanus	0	11.11	

The hard clam is the most economically important shellfish of the back bays, supporting both commercial and recreational fisheries (N.J. Bureau of Fisheries, 1979). Although data on exact locations and densities of adult hard clams within the project area is limited, they are known to be found in the intertidal and subtidal zones of bays and lower estuaries.

Invertebrates common to the New Jersey coast include sea stars (Asterias forbesi), salt marsh mosquito (Aedes cantator and (Aedes sollicitans), bay scallop (Aequipecten irradians), mosquito (Anopheles sp.), blue crab (Callinectes sapidus), common rock crab (Cancer irroratus), horsefly (Chrysops sp.), snapping shrimp (Crangon septemspinosa), oyster (Crassostrea virginica), mosquito (Culex sp.), American lobster (Homerus americanus), Atlantic longfinned squid (Loligo peali), salt marsh snail (Melampus bidentatus), hard clam (Mercenaria mercenaria), ribbed mussel (Modiolus demissus), common blue mussel (Mytilus edulis), roundworms (Nematoda), grass shrimp (Palaemonetes sp.), moon snails (Polinices duplicata), surf clams (Spisula solidissima), horsefly (Tabanus sp.), and fiddler crab (Uca sp.).

Typically, the sublittoral areas, below the low tide level to the maximum depth of plant growth, consist of variable mixtures of sand, gravel, shells, and mud. Filter feeders and deposit feeders inhabit coarse sandy sediment and soft silts and muds, respectively. Surf clams and moon snails burrow in sand bottoms from the edge of the intertidal zone into deeper water. Sessile invertebrates, such as sponges, hydroids, barnacles, and gribbles, are found on rock jetties, bulkheads, pilings and sunken debris.

2.3.4.6.2 Finfish

Many small fish species and other aquatic organisms exist in the freshwater to brackish ponds and marshes which are located throughout The Meadows in both the natural area and the migratory bird refuge. Due to weather conditions, the lack of proper drainage and coastal storms, the water levels within these ponds fluctuate greatly from season to season, and at times some of the ponds and drainage ditches are completely dry. Some deep areas do exist however which provide some refuge for fish and other aquatic organisms during these periods of low water. One of the factors which affects the health and diversity of the aquatic environment is the coastal storms, which have a tendency to transport both sand and salt water into The Meadows when the dunes surrounding them are breached. Due to the combination of these and other factors, only the most adaptable organisms, which are capable of surviving under such fluctuating conditions, would be expected to survive.

The Management Plan lists the following fresh and brackish water fish species as being present within The Meadows: mummichog (Fundulus heteroclitus), banded killifish (F. idaphanus), sheepshead minnow (Cyprinodon variegatus), rainwater killifish (Lucania parva), tidewater silversides (Menidia beryllina), mosquitofish (Gambusia affinis), American eel (Anguilla nostratra), and several kinds of sticklebacks including three-spined sticklebacks (Gaster osteus

aculeatus). It is also likely that carp (Cyprinus carpio) and yellow perch (Derca flavescens) occur in The Meadows since they inhabit Lily Lake which is located in Cape May Point.

In August, 1994 aquatic sampling was conducted within some of the ponds within The Nature Conservancy property. Sampling was done with a seining net and revealed the presence of species similar to those listed above for the State Park. The specific species collected during this effort included the mosquitofish, rainwater killifish, sheepshead minnow, mummichog, and silversides.

In the past, Cape Island Creek was primarily responsible for bringing fish into The Meadows. The creek provided a tidal connection between The Meadows and Cape May Harbor. Due to a combination of erosion, storm damage, road installation, changes in drainage patterns, the installation of a flap gate, and filling of ditches, this tidal connection has been severed, ending the constant tidal flow of water and fish into The Meadows. Currently the greatest impacts on the fish population occur in connection with coastal storms. Often, as stated above, flooding, and inundation connected with breaching and overtopping of the dunes, results in an increase in the salinity of the ponds and drainage ditches in The Meadows. This increase in salinity can have detrimental effects on the existing fish population, and fish kills have been known to occur. In addition to the impacts related to the existing fish population, the storms also serve to carry fish into The Meadows from both the ocean and surrounding ponds and drainage areas.

In regard to the fish species present in the coastal region off shore of The Meadows, a comprehensive survey of finfish was conducted from June 1973 through December 1977 in the Hereford Inlet Estuary which is slightly northeast of the study area. This survey collected a total of 105 species of finfish at various stages of life. The most frequently collected species included such year-round residents as the Atlantic silverside (Menidia menidia), mummichog (Fundulus heteroclitus), winter flounder (Pleuronectes americanus), and tidewater silversides (Menidia beryllina). Several species of spring migrants were also collected, as well as some species which are considered rare occurrences for southern New Jersey.

The finfish found along the Atlantic Coast of New Jersey are principally seasonal migrants. Winter is a time of low abundance and diversity as most species leave the area for warmer waters offshore and southward. During the spring, increasing numbers of fish are attracted to the New Jersey Coast, because of its proximity to several estuaries which are utilized by these fish for spawning and nurseries.

Species known to utilize estuaries along the Atlantic Coast of New Jersey include summer flounder (Paralichthys dentatus), sea bass (Centropristis striata), striped bass (Morone saxatilis), bluefish (Pomatomus saltatrix), winter flounder (Pleuronectes americanus), tautog (Tautoga onitis), weakfish (Cynoscion regalis), scup (Stenotomus chrysops), white perch (Morone americana), and Atlantic menhaden (Brevoortia tyrannus). In a study conducted at nearby Peck Beach, 178 species of saltwater fishes were recorded. Of these, 156 were from the nearshore

waters. Of the 124 species recorded in nearby Great Egg Harbor Inlet, 28 are found in large number in offshore waters. North of the study area, 87 species were found in the near shore ocean, bay and inlets adjacent to Peck Beach. Of these, 46 were located in the near shore waters.

Recreational fishing in southern New Jersey consists of scup (Stenotomus chrysops), black sea bass (Centropristis striata), summer flounder (Paralichthys dentatus), weakfish (Cynoscion regalis), bluefish (Pomatomus saltatrix), red hake (Urophycis chuss), white hake (Urophycis tenuis), silver hake (Merluccius bilinearis), Atlantic mackerel (Scomber scombrus), chub mackerel (S. japonicus), Atlantic cod (Gadus morhua), northern kingfish (Menticirrhus saxatilis), and tautog (Tautoga onitis). Northern puffer (Sphaeroides maculatus), spot (Leiostomus xanthurus), red drum (Sciaenops ocellatus), pollock (Pollachius virens), and Atlantic bonito (Sarda sarda) may also be taken occasionally.

Commercial species may include menhaden (Brevoortia tyrannus), winter flounder, weakfish, bluefish, scup, mackerel, silver hake, red hake, yellow flounder, black sea bass, butterfish (Perprilus triacanthus), and shad (Alosa mediocris). Harvesting is accomplished by purse seining, otter trawling, pots, and gill netting.

The Magnuson-Stevens Fishery Conservation and Management Act of 1996 (MSFCA) requires that the essential habitat of any species managed by a fishery management council be recognized and attempts should be made to avoid degrading it. Although the essential fish habitat (EFH) designation process is ongoing, the EFH designations for managed species will be complete in the near future. The following is a list of managed species for which EFH will be designated for the project area:

American lobster (Homarus americanus), American plaice (Hippoglossoids platessoides), Atlantic butterfish (Peprilus triacanthus), Atlantic cod (Gadus morhua), Atlantic halibut (Hippoglossus hippoglossus), Atlantic herring (Clupea harengus), Atlantic mackerel (Scomber scombrus), Atlantic salmon (Salmo salar), Atlantic sea scallop (Placopecten magellanicus), black sea bass (Centropristis striata), bluefish (Pomatomus saltatrix), haddock (Melanogrammus aeglefinus), long finned squid (Loligo pealei), monkfish (Lophius americanus), ocean pout (Macrozoarces americanus), ocean quahog (Artica islandica), pollock (Pollachius virens), redfish (Sebastes marinus), red hake (Urophycis chuss), scup (Stenotomus chrysops), short finned squid (Illex illecebrosus), silver hake (Merluccius bilinearis), spiny dogfish (Squalus acanthias), summer flounder (Paralichthys dentatus), surf clam (Spisula solidissima), tilefish (Lopholatilus chamaeleonticeps), white hake (Urophycis tenuis), windowpane flounder (Scophthalmus aquosus), winter flounder (Pleuronectes americanus), witch flounder (Glyptocephalus cynoglossus), yellowtial flounder (Limanda ferruginea).

2.3.5 Threatened and Endangered Species

A number of Federally listed endangered or threatened mammals, birds, reptiles and fish may be found within the vicinity of the project area, although most are transients. There are six species of endangered whales that are known to migrate north and south along the Atlantic Coast. These are the blue whale (Balaenoptera musculus), finback whale (Balaenoptera physalus), humpback whale (Megaptera novaeangliae), right whale (Balaena glacialis), sei whale (Balaenoptera borealis) and sperm whale (Physeter catodon). Five species of endangered or threatened sea turtles may also be found in Atlantic coastal waters off of New Jersey. These are the endangered hawksbill turtle (Eretmochelys imbricata), leatherback turtle (Dermochelys coriacea), Atlantic ridley turtle (Lepidochelys kempii), and loggerhead turtle (Caretta caretta), and the threatened green turtle (Chelonia mydas). All but the loggerhead turtle breed further south from Florida through the Caribbean, and the Gulf of Mexico. There are no known loggerhead nesting sites within the project area.

Three Federally protected bird species are known to occur within the project area. These are the peregrine falcon (Falco peregrinus) which is endangered and the bald eagle (Haliaeetus leucocephalus), and piping plover (Charadrius melodus), which are threatened. Surveys conducted by the Cape May Bird Observatory have demonstrated a significant increase in sightings of both the bald eagle and peregrine falcon over the past several years (Cape May Bird Observatory/New Jersey Audubon Society, 1993). Over the past ten years, peregrine sightings have increased five-fold and bald eagle sightings have doubled. There are no known nesting sites for either species within the project area. The piping plover is a migratory shorebird that nests on sandy beaches along the Atlantic Coast of New Jersey between April and mid-August. During the 1993 breeding season, three pairs of piping plovers nested on the beach at The Nature Conservancy property. Despite protective measures taken, the chicks from one pair did not survive, but four chicks fledged from the other two nests (The Nature Conservancy, 1993). During the 1994 breeding season, four pairs of piping plovers nested in The Meadows, producing six fledged chicks (Elizabeth Johnson, 1994). Since this time, the number of piping plover nests within The Meadows has increased and in 1996, 10 pairs of piping plovers were present while in 1997, 9 pairs of piping plovers nested on The Meadows' beaches (NJDEP, 1997).

In addition to these Federally protected species, numerous state threatened and endangered species are also known to occur within the project area. These species include the endangered pied-billed grebe (Podilymbus podiceps), Cooper's hawk (Accipiter cooperii), northern harrier (Circus cyaneus), upland sandpiper (Bartramia longicauda), roseate tern (Sterna dougallii), least tern (Sterna albifrons), black skimmer (Rynchops nigra), short- eared owl (Asio flammous), short-billed marsh wren (Cistothorus platensis), and cliff swallow (Petrochelidon pyrrhonota). State threatened bird species include great blue heron (Ardea herodias), yellow-crowned night heron (Nyctanassa violacea), red-shouldered hawk (Buteo lineatus), osprey (Pandion haliaetus), merlin (Falco columbarius), barred owl (Strix varia), red-headed woodpecker (Melanerpas erythrcephalus), bobolink (Dolichonyx oryzivorus), savannah sparrow (Passerculus

sandwichensis), and grasshopper sparrow (Ammodramus savannarum). In addition to the piping plovers nesting success, for the first time in several years, a minimum of 15 least tern chicks fledged from The Nature Conservancy property (The Nature Conservancy, 1993). Since this time, terns have continued to nest in this area.

In addition to these bird species, the Cape May Point Natural Area Management Plan of 1986 lists several plant species as endangered or rare. The endangered plant species found in The Meadows in 1986 included the awl-leaved rush (Juncaceae coriaceus) and butterfly pea (Clitoria mariana). The rare species included swamp pine (Pinaceae serotina), long's rush (Juncaceae longii), narrow-leaved wild crab apple (Pyrus angustifolia), whorled marsh-pennywort (Hydrocotyle verticillata), and blue boneset (Eupatorium coelestinum).

In 1995 and 1996, a Rare, Threatened and Endangered Plant Survey was conducted in order to develop a current list of rare, threatened, and endangered plant species within The Meadows, and to pinpoint their exact location and general health. The results of this survey, which was conducted in October of 1995, and June of 1996 by Biohabitats, Inc., indicates that there are currently 4 species of protected plants within the meadows. These species are the narrow-leaved wild crab apple (imperiled), blue boneset (rare), whorled marsh-pennywort (imperiled), and dodder (Cuscuta indecora) (endangered). The blue boneset and whorled marsh-pennywort were the most common, being found in several locations within the State Park and Nature Conservancy properties. The populations of blue boneset were generally in good to excellent health and were primarily located in areas that had been cleared or mowed and received full to partial sunlight. The whorled marsh-pennywort was generally found in moist soil conditions in areas receiving full or partial sunlight. The dodder populations were limited to two previously unmapped areas within The Nature Conservancy property. The plants were found in moist soils near a pond edge.

The butterfly pea, which was previously identified within The Meadows, was not found during the 1995-1996 field investigations. Historic records and personnel communication reveal that this species had not been observed in The Meadows for the past five years. According to Biohabitats, Inc., the increase in soil salinity and soil saturation is most likely the cause of the disappearance of this species. Other species historically found in the study area, such as the awl-leaved rush and Pinus serotina, were also not observed during the current study. Most of the locations where these populations were previously identified are now overgrown with Phragmites australis. A full summary of the Rare, Threatened and Endangered Plant Survey can be found in Appendix B. Additionally, The Nature Conservancy has stated that Joncus coriaceus and Diodia virginiana can be found in the study area.

2.3.6 Wildlife Resources

Areas of Cape May County, especially the Lower Cape May Meadows, play a critical role within the Atlantic Flyway. Habitat in The Meadows and the surrounding County provide crucial seasonal, migratory, overwintering, and year-round habitat for a variety of waterfowl, shorebirds, songbirds and raptors. Over 360 species of birds can be observed in Cape May County over the course of the year, many of which utilize the unique habitat available within The Meadows.

A variety of shorebirds use coastal habitat at The Meadows over the course of the year. Many species even nest in the area during the spring and summer months. Common nesting species include the common tern (Sterna hirundo), least tern (Sterna albifrons), herring gull (Larus argentatus), laughing gull (Larus atricilla) and black skimmer (Rynchops nigra). The area also provides habitat for a large number of wading birds. Common species include the snowy egret (Leucophoyx thula), glossy ibis (Plegadis falcinellus), little blue heron (Florida caerulea), black-crowned night heron (Nycticorax), great egret (Casmerodius albus), and yellow-crowned night heron (Nyctanassa violacea).

Wading birds typically arrive in mid-March and remain to mid-fall when they migrate south. Nesting is underway by early May and completed by mid-July. Other migratory species of shorebirds use the area for resting and feeding during the spring migration from South and Central America to breeding grounds in the Arctic. Over 20 species, primarily the red knot (Calidris canutus), ruddy turnstone (Arenaria interpres), sanderling (Calidris alba) and semipalmated sandpiper (Calidris pusilla), coincide their arrival with the horseshoe crab spawning season. Horseshoe crab eggs provide a valuable food source for these migrating birds. Other important migratory species observed in the area include dunlin (Calidris alpina), least sandpiper (Calidris minutilla), willet (Catoptrophorus semipalmatus), short-billed dowitcher (Limnodromus griseus), semipalmated plover (Charadrius semipalmatus), piping plover (Charadrius melodus) and black-bellied plover (Pluvialis squatarola).

The coastal wetland habitats are also valuable to overwintering waterfowl. An estimated 34 percent of the entire Atlantic Flyway black duck (Anas rubripes) population overwinters along the coast of New Jersey. These marshes also provide important breeding habitat for the black duck and support large numbers of migrating waterfowl. Important species include the wood duck (Aix sponsa), blue-winged teal (Anas discors), green-winged teal (Anas crerra), American wigeon (Anas americana), mallard (Anas platyrhynchos), gadwall (Anas strepera), northern shoveler (Anas clypeata), northern pintail (Anas acuta), canvasback (Aythya valisineria), greater scaup (Aythya marila), lesser scaup (Aythya affinis), Canada geese (Branta canadensis) and snow geese (Chen caerulescens). Many individuals of these species remain in the area throughout the winter.

Over a dozen raptor species are known to migrate through the Cape May area on an annual basis. An average of 60,000 hawks a year have been recorded by the Cape May Bird Observatory since

1976 (Cape May Bird Observatory/New Jersey Audubon Society, 1993). These birds typically use the eastern shore of Delaware Bay as a migratory corridor. Important species include the sharp-shinned hawk (Accipiter striatus), Cooper's hawk (Accipiter cooperii), red-tailed hawk (Buteo jamaicensis), broad-winged hawk (Buteo platypterus), red-shouldered hawk (Buteo lineatus), northern harrier (Circus cyaneus), American kestrel (Falco sparverius) and merlin (Falco columbarius).

Many owls also migrate through the Cape May area on an annual basis. Typical species include the common barn-owl (Tyto alba), northern saw-whet owl (Aegolius acadicus) and long-eared owl (Asio otus). During their migration through The Meadows, owls generally utilize the cedar groves which are along the border of the State Park and The Nature Conservancy.

In addition to the above, Cape May has one of the largest concentrations of songbirds of any area on the Atlantic Coast during the fall migration period. Nearly 100 species pass through the area, utilizing a variety of habitat types. Common species include the American robin (Turdus migratorius), eastern bluebird (Sialia sialis), tree swallow (Iridoprocne bicolor), common flicker (Colaptes auratus), indigo bunting (Passerina cyanea), eastern meadowlark (Sturnella magna), marsh wren (Cistothorus palustris), blue grosbeak (Guiraca caeruiea), and eastern kingbird (Tyrannus tyrannus).

Mammals utilizing the tidal wetlands adjacent to the project area include the eastern cottontail (Sylvilagus floridanus), muskrat (Ondatra zibethicus), river otter (Lutra canadensis), meadow vole (Microtus pennsylvanicus), and rice rat (Oryzomys spp.). The northern diamondback terrapin (Maladlemys terrapin) is the only reptile in the tidal wetlands habitat. The brackish marshes and other habitat support the white-tailed deer (Odocoileus viiginiamus), opossum (Didelphia marsupialis), raccoon (Procyon lotor), longtail weasel (Mustela frenata), striped skunk (Mephitis mephitis), red fox (Vulpes vulpes), gray fox (Urocyon cinereoargenteus), eastern mole (Scalopus aquaticus), eastern pipistrel (Pipistrellus subflavus), red bat (Lasiurus cinereus), and big brown bat (Eptescius fuscus).

Several species of turtles and snakes may occur within the study area including the snapping turtle (Chelydra serpentina), eastern mud turtle (Kinosternon subrubrum), stinkpot (Sternotherus sp.), painted turtle (Chrysemys picta), northern watersnake (Natrix sipedon), northern black racer (Coluber constrictor), northern red-bellied snake (Storeria occipitomaculata), and eastern garter snake (Thamnophis sirtalis). Amphibians, such as the southern leopard frog (Rana utricularia), northern spring peeper (Hyla crucifer), New Jersey chorus frog (Pseudacris triseriata), Fowler's toad (Bufo woodhousei fowleri), four-toed salamander (Hemidactylium scutatum), and red-backed salamander (Plethodon cinereus) may also be present.

2.4 Fish and Wildlife Habitat Degradation

2.4.1 Introduction

The Meadows area is composed of two sections. The eastern section, which has an area of approximately 190 acres, was designated as a migratory bird refuge when The Nature Conservancy acquired the property in 1981. This area consists of six different habitat types which, when combined with its location in the Atlantic Flyway, make this site a unique area which is vital to the survival of thousands of migrating birds that pass through the area each year. The habitat, managed by The Nature Conservancy, includes 12 acres of mixed forest, 24 acres of field/scrub-shrub, 42 acres of emergent wetlands, 40 acres of beaches and dunes, 45 acres of wetlands dominated by monotypic stands of Phragmites australis, and 27 acres of open water ponds and ditches. The western section of The Meadows is the Cape May Point State Park. This 153-acre site has been designated as a Natural Area by the Office of Natural Lands Management (ONLM), within the New Jersey Department of Environmental Protection, Division of Parks and Forestry. The Natural Area System Act of 1976 (N.J.S.A. 13:1B-15.12a et seq.) defines a Natural Area as "an area of land or water which has retained its natural character, although not necessarily completely undisturbed, or having rare or vanishing species of plant and animal life or having similar features of interest which are worthy of preservation for the use of present and future residents of the State." This Natural Area is also located within the Atlantic Flyway and consists of four different habitat types. The habitat types within the State Park include 63 acres of mixed forest, 48 acres of wetlands dominated by monotypic stands of Phragmites australis, 22 acres of open water ponds and ditches, and 20 acres of beach and dunes. This area also offers a unique resting stop for migrating birds which frequent Cape May. The combination of the State Park's forest area and The Nature Conservancy's field/scrub-shrub area is considered especially vital to migrating raptors.

2.4.2 Migratory Habitat

Cape May has been identified as one of the most important migratory stopovers in North America. The southern tip of the peninsula supports one of the largest concentrations of migrating birds of prey in the United States, giving it the reputation as one of the top birding areas in the world (The Nature Conservancy, 1982). Documentation of Cape May as an area supporting a large concentration of migrating raptors began with the various works of Stone (1937). Since that time much more analysis has been done, including the yearly autumn hawk counts which were started in 1976 by the Cape May Bird Observatory/New Jersey Audubon Society. In the past 18 years these counts have shown an average migration of almost 60,000 birds of prey a year. The highest count was recorded in 1981 when 88,532 hawks were identified within The Meadows. Over the past several years however, the number of raptors identified within The Meadows has been steadily declining. A record low of 22,808 hawks were recorded

Table 2.4-1

Summary of totals of Cape May Point, NJ, fall hawk counts, 1976-1993.

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	AVG
DAYS	88	71	80	95	103	107	99	95	107	96	93	103	102	100	108	106	106	102	97.8
HOURS	722.5	558	706.2	718.5	921.2	936.5	867.3	772.1	1022.7	1073.5	889	855	810	788.5	988	856.5	852	814	841.8
SPECIES																			
BV	0	0	0	4	0	0	0	3	5	1	0	0	13	11	9	45	66	76	12.9
TV	959	453	549	700	560	716	371	580	724	632	599	473	853	884	603	758	674	1540	701.5
OS	1270	1172	793	1303	1302	1491	2206	1081	1838	2943	3437	5402	2823	3358	1843	1367	1488	1613	2040.5
MK	0	0	0	0	2	1	2	2	1	0	0	0	0	0	0	0	0	0	.4
BE	12	19	10	8	8	23	18	25	22	26	55	47	37	29	61	39	86	57	32.3
NH	957	1183	761	1115	3105	2161	1298	1118	2179	2354	2355	3036	2542	1221	1035	883	785	1742	1657.2
SS	28258	47790	32610	48444	52274	43040	43976	34072	61167	40122	28987	19838	20911	10611	12477	14408	8207	13219	31133.9
CH	878	864	668	1873	1612	2082	1207	744	1814	2672	1867	2944	2517	2008	1592	2124	1106	2467	1724.4
NG	17	21	19	16	25	34	35	40	25	75	24	20	13	9	34	55	30	80	31.8
RS	700	390	372	512	599	399	268	190	395	705	549	612	453	139	180	155	152	350	395.5
BW	1462	12402	845	1025	3283	13917	1425	808	1147	2027	6497	4608	1485	822	1079	374	2343	625	3120.8
SW	2	2	1	0	1	7	4	1	3	2	5	3	3	1	1	1	2	1	2.2
RT	1955	1597	1406	1522	2277	1427	941	853	2032	1965	3371	1701	2297	1158	855	610	624	1180	1542.8
RL	4	6	7	4	10	7	5	6	4	4	4	3	4	2	3	3	1	2	4.4
GE	13	9	5	16	14	9	6	3	4	4	16	11	19	9	21	8	7	12	10.3
AK	11467	14862	9440	19719	12595	21821	8764	6673	9259	11756	12390	16532	7337	7185	7345	6200	5872	6662	10882.2
ML	562	766	717	1179	1085	1225	1675	888	2375	2875	2450	2447	1965	1504	1421	1196	936	931	1455.4
PG	105	61	149	230	198	171	363	295	518	396	615	685	339	703	818	731	429	416	401.2
OO			3	1		1					2		1						
TOTALS	48621	81597	48355	77671	78950	88532	62564	47382	83512	68559	63223	58362	43612	29654	29377	28957	22808	30973	55149.7

SOURCE: NEW JERSEY AUDUBON SOCIETY AND CAPE MAY BIRD OBSERVATORY

in 1992, illustrating an alarming drop in the numbers of many species, including the northern harrier, sharp-shinned hawk, American kestrel, and red-tailed hawk (Table 2.4-1) (Cape May Bird Observatory/New Jersey Audubon Society, 1994). In 1995 however, a total of over 60,000 raptors were identified during the annual Cape May Bird Observatory Hawk Watch. While some species were observed less frequently than in the past, other species, such as the golden eagle, peregrine falcon, Cooper's hawk, black vulture and turkey vulture, were observed in record high numbers (Table 2.4-2). The reasons for the decline of some species and increase in numbers of other species are not fully understood. Some of the declines are thought to be linked to the loss of acreage and degradation of habitat, which have been caused by severe storms and dune breaching and overtopping. While the meaning is unclear, it should also be noted that the increase in species such as the black vulture and turkey vulture may indicate a change in land use or in the migrating raptor population as a whole.

2.4.3 Coastal Erosion and Storms

Shoreline erosion has led to the loss of over 124 acres of valuable habitat within The Meadows since 1955. It is estimated that an additional 138 acres of habitat will be lost between 1997 and 2050 if existing conditions prevail. Another problem associated with the increased erosion is the fact that the loss of the beach leaves the dunes vulnerable to high tides and high waves associated with severe coastal storms. These dunes are vital to the protection of the wetlands and other valuable habitat which exist beyond the dune. When the dunes are breached or overtopped during a storm, saltwater flows into the "freshwater" system raising the salinity of the system and impacting the organisms living there. Over the past several years the frequency of storm related dune breaching and overtopping in The Meadows has been uncharacteristically high. In October of 1991 an unusually large storm was responsible for the destruction of approximately 2,000 linear feet of dune, as well as severe flooding and dune breaching. January, October, and December of 1992 were also marked by severe storms which caused extensive erosion, flooding, saltwater intrusion, and dune breaching. More flooding, erosion, and dune damage also took place in March of 1993 and 1994. These events, occurring within a relatively brief period of each other, severely impacted the freshwater wetlands, birds, mammals, and vegetation existing within The Meadows. Prior to the 1991 storm, the last occurrence of saltwater intrusion on the site was during Hurricane Gloria in September of 1985. Based on this information, it appears that the area has been subject to some unusually severe storms over the past several years. If this high storm frequency and intensity continues, irreparable damage may be done to the wetland community.

2.4.4 Saltwater Intrusion

As stated above, saltwater frequently enters The Meadows during storms and periods of high water. This saltwater raises the salinity of the system and has detrimental effects on both

Table 2.4-2

Cape May Bird Observatory Hawk Watch, Autumn 1995

Andre Robinson, Official Hawk Watcher

SPECIES	SEASON'S TOTAL	SEASON'S PEAK FLIGHT & DATE(S)	
Black vulture	195 *	21	9/15 *
Turkey vulture	3,242 *	311	11/5
Osprey	5,378	431	10/13
Bald eagle	135	11	10/29 *
Northern harrier	2,374	182	10/30
Sharp-shinned hawk	26,397	1,788	9/24
Cooper's hawk	5,010 *	347	10/1
Northern goshawk	54	4	(4 dates)
Red-shouldered hawk	450	49	10/26
Broad-winged hawk	1,385	369	10/17
Swainson's hawk	3	1	(3 dates)
Red-tailed hawk	3,825	562	11/5
Rough-legged hawk	1	1	10/12
Golden eagle	26 *	5	10/30, 11/9
American kestrel	8,488	1,375	10/8
Merlin	2,064	213	10/8
Peregrine	1,101 *	103	9/28
TOTAL	**60,128**	**3,062**	**9/28**

*record high counts

Source: Cape May Nature Watch News, Spring 1996

vegetation and wildlife. Many plant species which exist in The Meadows such as the great bulrush (Scirpus validus), common rush (Juncus effussus), water-pennywort (Hydrocotyle umbellata), and aster (Aster sp.) require water with salinity no greater than 5 ppt to survive. Other resident species such as Polygonum sp. and red maple (Acer rubrum) can only survive if the salinity is less than 0.5 ppt. Phragmites australis, on the other hand, can thrive in salinities ranging from 0.0 to 20 ppt. On many occasions, especially during 1993, storm water intrusion has elevated the salinity within The Meadows considerably higher than 5 ppt (Figure 2.4-1). When this happens often enough, or lasts for a long period of time, vegetation is killed. This leaves the area open to the invasion of Phragmites australis, which can tolerate much higher salinities. This has happened in a majority of The Meadows, and Phragmites australis now dominates more than two-thirds of the wetlands on the site. During severe storm events, saltwater is carried into the forested areas at the back end of The Meadows. As the dune system and beach continue to retreat due to erosion and dune breaches, the frequency of this inundation will increase. Saltwater intrusion is likely to negatively impact forest habitat over time. Some species which reside there, such as the pitch pine and white oak can tolerate some infrequent flooding with small amounts of saltwater but are unlikely to survive repeated assaults of this nature. To illustrate how much the salinity in The Meadows fluctuates from day to day and from the front of the site to the back of the site, The Nature Conservancy has taken periodic salinity measurements in 1982, 1988, 1992, 1993, and 1994. While not a common occurrence, these measurements do show that during a single day, the salinities within The Meadows can range from 0 ppt to 36 ppt, depending on sample location (Figure 2.4-1). These measurements also identified days where the salinity ranged only from 0 ppt to 6 or 8 ppt. Sampling conducted in a few areas in 1997 by Versar, Inc., show a salinity high of 4.1 ppt of the sites sampled. Many factors, such as the duration and intensity of a storm, the time of year, the amount of recent rainfall, and the frequency of storms play a role in determining the salinity at any given time. An example of this can be seen in the 1993 data where the salinities ranged from 0 to 36 ppt (Figure 2.4-1). In 1992 and 1993, a total of 4 large storms had hit The Meadows, causing saltwater intrusion and dune breaching, which increased salinities on the site. Adding to this condition was the fact that the summer of 1993 was a drought year and many of the sample sites were dry on several occasions. This lack of rain served to keep the salinities on the site high, as there was little fresh water brought into the system to dilute the ponds. Since very few plant or animal species can survive such a large fluctuation or range of salinities, it is obvious that if saltwater intrusion continues, it could completely devastate the unique habitat which currently exists. Examples of the impacts occurring in The Meadows can be seen in the amphibian population which includes many species which require completely fresh water to survive. One noticeable impact is the disappearance of the spring peeper within The Meadows. Spring peepers used to be very common within both the State Park and The Nature Conservancy property. In the past several years however, no spring peepers have been observed within either properties. Saltwater intrusion is believed to be the cause of their disappearance.

Figure 2.4-1

Salinity Measurements 1992 and 1993
The Nature Conservancy Property

	Stations														
Date	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
6/10/92	2	3.5	7	3.5	16	14	17	-	-	-	-	-	-	-	-
6/26/92	-	-	-	-	-	-	-	-	12	22	7	7	6.5	11	5
7/24/92	1	2	2	1	11	11	16	10	5	6	4	3	4	5	4
8/06/92	2	3.5	4	6	14.5	15.5	18	13	5	10	6	6	6	7	7

Note: All measurements are in ppt
Rain was recorded on 7/23

	Stations														
Date	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
6/28/93	1.5	X	6.5	26.5	27	28.5	26	9.5	7	26	7	6	4	6	4
7/06/93	2	X	7	33	26	29	24.5	8.5	10	31.5	9.5	7	4.5	7	1.5
7/12/93	0	X	7.5	36	24.5	33	21	6	8.5	X	8.5	6	3.5	7	X
7/23/93	2.5	3.5	8	15	21	27	20.5	X	9	16	5.5	7	4	10	X
8/01/93	0	X	14	27	26	35	24	7	9	27	8	8	4	13	4

Note: All measurements are in ppt
Rain was recorded on 6/27, 7/14, 7/19, 7/28, 8/2 and 8/6
1993 was a drought year, the area water was very low
X = area dry, no sample taken
Station locations can be found in Appendix B

Source: The Nature Conservancy, 1993

2.5 Cultural Resources

In preparing the Draft Feasibility Report and Environmental Impact Statement, the Corps has consulted with the New Jersey State Historic Preservation Office (NJSHPO) and other interested parties to identify and evaluate historic properties in the project area in order to fulfill its cultural resources responsibilities under the National Historic Preservation Act of 1966, as amended, and its implementing regulations, 36 CFR Part 800. As part of this work, cultural resources investigations were conducted along the project shoreline and within the project's offshore borrow areas (Dolan Research, Inc. and Hunter Research, Inc., 1997). Structures associated with World War II era fortifications and surface debris associated with the second Cape May Lighthouse site were identified and are considered potentially eligible for listing in the National Register of Historic Places. No significant remote sensing targets were identified in the offshore borrow or near-shore areas. No significant prehistoric cultural resources were identified along the shoreline. NJSHPO Section 106 consultation is ongoing and will be finalized prior to the implementation of any project actions.

2.5.1 Cultural Resources Investigations

The Philadelphia District has conducted numerous cultural resources studies within the project area and its vicinity. A Phase 1A investigation that included the present study area was completed in 1978 (Gilbert Commonwealth, 1979). Researchers identified numerous significant cultural resources within the communities of Cape May and Cape May Point. A Phase 2 underwater investigation of offshore borrow area M1 was conducted for the Philadelphia District by Kardas and Larrabee in 1982. This investigation, associated with beach replenishment activities in Cape May, documented known shipwreck locations off the south New Jersey coastline and noted a high shipwreck concentration centered around Cape May Inlet. Several remote sensing targets exhibiting shipwreck characteristics were identified within borrow area M1 and were subsequently avoided during sand borrowing activities.

A Phase 1 investigation was completed for the potential project area (Dolan Research, Inc. and Hunter Research, Inc., 1997). This investigation included: background and documentary research; pedestrian and magnetic survey of the shoreline at low tide; remote sensing survey of the offshore borrow and near shore sand placement areas; and analysis and evaluation of assembled research and field data. Structures associated with World War II era fortifications and surface debris associated with the second Cape May Lighthouse site were identified. Researchers consider these cultural resources potentially eligible for listing in the National Register of Historic Places. The Philadelphia District concurs with this evaluation. The following discussion has been summarized from the above referenced reports. A more detailed historical overview is provided in Appendix G.

2.5.2 Prehistoric and Historic Resources

Prehistoric sites, such as cemeteries and shell "middens", and various place names and locations of Lenape Indian groups, are noted on numerous historical maps of southern New Jersey. In 1648, early European settlers noted indigenous native populations called the "Tirans", "Tiascons" and the "Kechemeches" living near Cape May. Their campsites were recorded on or near Dias Creek, Fishing Creek and at Cold Spring, Maryville and Cape May Courthouse. The archaeological sites associated with these prehistoric groups have been poorly documented. What few sites are known appear to be the locations of Woodland period (ca. 1000 BC to contact) camps. Although no prehistoric archaeological sites have been previously documented within the study area, there are several upland agricultural locations within the study are that may have a high potential for archaeological deposits.

The first Europeans to reach Cape May were early 17th century explorers sailing for the Dutch. The Swedes successfully controlled the region's fur trade between the 1630 and 1655, when the Dutch regained the region, only to surrender the colony to the British in 1664. English settlement of the Cape May region was initially established to promote ship building and whaling. Whalers came to Cape May from England and New England during the 1690's and established the community of Town Bank. By 1723 the county's population warranted the creation of three townships with Lower Township comprising the southern portion of the Cape. The residents of Lower Township were primarily farmers during the 1700's, although they occasionally fished, whaled, and provided other boating services as ferrymen and pilots.

Cape May assumed new importance as a seaside resort in 1800. Residents began to take in vacationers and by 1801 a dormitory style hotel was constructed to accommodate an increasing number of tourists. One traveler in 1830 noted that "Cape May is a much frequented watering place... There are six boarding houses, three of which are very large; the sea bathing is convenient and excellent, the beach affords pleasant drives, and there is excellent fishing in adjacent waters". Cape May City was incorporated in 1848. Despite a series of disastrous fires and the rivalry of Atlantic City, Cape May City grew to a population of more than 2000 by 1890 and was considered one of the premiere seaside resorts in the country. The last political subdivision in the area occurred in 1894 when the Borough of South Cape May was created.

The site of South Cape May, a community once comprising the low lands south of Sunset Boulevard between Cape May Point and Cape May City, is located in the study area. It was reclaimed by Lower Township in 1945 after the majority of its seaside residences were destroyed by storms and shoreline erosion.

In addition to serving as one of the nation's oldest resort centers, Cape May also played an important role in maritime commerce. Colonial period sea traffic was heavy, and many vessels from England, Spain, Africa and the West Indies took on pilots at Cape May to negotiate the dangerous shoals as they rounded the Point and headed for Philadelphia. The British recognized

these coastal hazards and constructed the first lighthouse at Cape May Point in 1744. The third and present Cape May Lighthouse was constructed of brick in 1859 and is one of the oldest lighthouses still in use by the Coast Guard. Cape May Harbor was created in 1905 when Cape May Island Sound was dredged and Cold Springs, now Cape May Inlet, was constructed. Additional navigation improvements were made when Cape May Canal was constructed during World War II. Despite these aids to navigation, Cape May has always been a dangerous area for shipping. More than 500 vessels have been lost off Cape May's coastline. At least fifteen shipwreck sites have been documented off Cape May. Remote sensing targets exhibiting shipwreck characteristics were identified in a previous study within Borrow Area M1. The potential for unknown shipwrecks sites to be present within borrow areas P1 and P2 is considered high.

Life saving stations have been maintained on the Cape since 1848 and the United States Coast Guard Training Center continues to man patrol boats for search and rescue missions. The training center and other areas along the Cape May shoreline were developed for defensive purposes by the Navy and Coast Guard during World War II. These facilities were also used as a communication center for the Navy's Atlantic Fleet during the Korean War. An associated concrete bunker and related features are present within the study area. The United States Government transferred approximately 133 acres of the installation to the State of New Jersey for public use. This area was established as Cape May Point State Park in 1974.

2.5.3 Properties Listed on the National Register of Historic Places

Numerous historic properties, historic sites and one historic district are within, or adjacent to, the study area. Cape May City was listed in the National Register of Historic Places in 1970 and designated a National Historic Landmark in 1976. Other historic properties in the general vicinity include St. Mary's Convent and the National Register listed Cape May Lighthouse and St. Peter's by the Sea Episcopal Church.

2.6 Geotechnical Analysis

2.6.1 Physiography. The project area lies along the southern coast of New Jersey within the Coastal Plain physiographic province of eastern North America. In New Jersey, the province extends from a line through Trenton and Perth Amboy southeastward for about 150 miles to the edge of the continental shelf. The land portion of the province is bounded on the northeast by Raritan Bay and on the west by the Delaware River. The submerged portion of the plain slopes gently southeastward at 5 or 6 feet per mile for nearly 100 miles to the edge of the continental shelf. The surface of the shelf consists of broad swells and shallow depressions with evidence of former shore line sand extensions of river drainage systems. The most prominent of these valleys is the Wilmington Canyon, which is an extension of the Delaware River drainage system off the southern portion of the New Jersey coast. The Atlantic coastal shelf is essentially a sandy structure with occasional silty or gravelly deposits. It extends from Georges Bank off Cape Cod to Florida, and it is by far the world's largest sandy continental shelf.

About 85 percent of the shorefront of New Jersey consists of a chain of narrow barrier beaches with elevations generally less than 20 feet above sea level. These beaches, average approximately 7 miles in length, are separated by ten inlets. The remaining shorefront from Long Branch to Bay Head and that at Cape May Point, is mainland of much earlier origin than the barrier islands. Between the barrier beach and the mainland there is an expanse of tidal marshland and water areas which is typically two miles wide. The water areas include tidal lagoons or sounds, and a network of winding thorofares draining the marshland.

The stream drainage system of the New Jersey coastal plain was developed at a time when sea level was lower than at present. The subsequent rise in sea level has drowned the mouths of coastal streams where tidal action takes place. The formation of the barrier beaches removed all direct stream connection with the ocean between Barnegat Bay and Cape May. These streams now flow into the lagoons formed behind the barrier beach and their waters reach the Atlantic Ocean by way of the inlets between the barrier islands. The significance of these features of the drainage system to the problem area is that the coastal plain streams, which carry little sediment in their upper courses, lose that little sediment in the estuaries and in the lagoons, and supply virtually no beach nourishment to the ocean front.

2.6.2 Surficial Deposits. The entire portion of the coastal plain draining to the study area is a sedimentary feature that developed under essentially the same set of conditions for a considerable period of geologic time. The area is capped with almost entirely unconsolidated sediments of Tertiary or more recent deposition. During Quaternary time, changes in sea level caused the streams alternately to spread deposits of sand and gravel along drainage outlets and later to remove, rework, and redeposit the material over considerable areas, concealing earlier marine formations. One of these, the Cape May formation, consisting largely of sand and gravel, was deposited during the last interglacial stage when sea level stood 30 to 40 feet higher than at present. The material was deposited along valley bottoms, blending into the estuarine and

marine deposits of the former shore line. The estuarine and marine deposits in the project area are a product of the tidal deposits and marshlands. These deposits typically contain brown peat to organic clay, and now stand as terraces along portions of the coast and form the mainland bluff at Cape May. The erosion of the recent deposits (barrier beaches) is exposing the peat and clay layers along the coast in the project area. The barrier beaches being of relatively recent origin are composed of the same material as the offshore bottom.

2.6.3 Subsurface Geology. The Atlantic coastal plain consists of sedimentary formations overlying a crystalline rock mass known as the "basement". From well drilling logs it is known that the basement surface slopes at about 75 feet per mile from the Fall Line to a depth of more than 6,000 feet near the coast. Geophysical investigations have corroborated well-log findings and have permitted determination of the profile seaward to the continental slope. A short distance offshore, the basement surface drops abruptly but rises again gradually as the continental slope is approached. Overlying the basement are semi-consolidated beds of lower Cretaceous sediments. These beds vary greatly in thickness, increasing seaward to a maximum thickness of 13,300 feet then decreasing to 8,900 feet near the edge of the continental shelf. On top of the semi-consolidated material lie unconsolidated sediments of Upper Cretaceous and Tertiary formations. These materials, in relatively thin beds on the land portion of the coastal plain, increase in thickness to maximum of 4,800 feet near the edge of the continental shelf.

2.6.4 Beach Sampling. Two sets of beach samples were obtained along 10 survey lines. The survey lines that were sampled are designated as follows: AA, C, D, E, F, G, CMP-2, CMP-4, CMP-5 and CMP-6. Both winter and summer beach samples were collected by USACOE, Philadelphia District personnel during September of 1995 and March 1996 to emulate the extremes of beach conditions due to erosion and accretion. Grain size and sorting data were determined to provide a general characterization of average beach textures according to the Unified Soils Classification System. Beach samples for both sets of sampling were collected at the following locations along each survey line: dune base, mid-berm, MHW, mid-tide, -6 MLW, -12 MLW, -18 MLW, -24 MLW, and -30 MLW.

2.6.5 Borrow Area Investigation and Identification

2.6.5.1 Vibrocore Borings

The vibrocores were collected by Alpine Ocean Seismic Survey, Inc. in the Atlantic Ocean off of the coast of New Jersey. The samples were collected in May-June 1996. The desired depth of penetration for the vibrocores was 20 feet. The field work included positioning of the vessel using a DGPS navigational system, obtaining continuous core samples and obtaining penetrometer records. The field work was conducted aboard the "Atlantic Twin", a 90 foot offshore research vessel. The vibrocores were retrieved using a model 271B Alpine pneumatic vibrocorer, with an air-driven vibratory hammer. Sieve analyses of the sediment retrieved in the

vibrocores was conducted by the Army Corps of Engineers South Atlantic Division Laboratory (SAD Lab). Using information from previous investigations dating back to 1978, the majority of the vibrocore borings for borrow area identification were focused in two locations. These locations showed the highest potential for suitable sand. The first location was adjacent to the current Cape May City borrow area M1. This potential borrow area has been labeled Area P1. The second location is just offshore of Lower Cape May Meadows near the abandoned military bunker. The boundaries of the second area, named P2, were selected to avoid any potential ordnance and explosive waste (OEW) from the former guns of the bunker (see Figure 2.6-1). The remaining vibrocores were taken in areas in which shoaling had occurred. National Oceanic and Atmospheric Administration (NOAA) ocean bottom contour lines were used to determine areas of shoaling. In the reconnaissance study, borrow area M2 was established as a potential borrow area for a separate project in the vicinity. The close proximity and good compatibility to the beach material made borrow area M2 a good candidate for borrow material. However, borrow area M2 was excluded from further consideration because it is located within a defined area of OEW created by the former guns of the defense bunker.

2.6.5.2 Borrow Area Suitability Analysis. Ideally, borrow material should be the same size, or slightly coarser than the native material on the beach to be nourished. If the borrow material has a significantly smaller grain size, the profile will be out of equilibrium with the local wave and current environment, and will therefore be quickly eroded either offshore or alongshore. This analysis compares the native sediment characteristics to the borrow material characteristics. The analysis was completed using the methodology in the Shore Protection Manual. Overfill factors (Ra) and renourishment factors (Rj) were calculated for each potential borrow area. The overfill factor estimates the volume of fill material needed to produce one cubic yard of stable beach material after equilibrium (when the beach and native materials are compatible) is reached. Consequently, overfill factors are greater than or equal to one. For example, an overfill ratio of 1.2 would indicate that 1.2 cubic yards of borrow material would be required to produce 1.0 cubic yards of stable beach material. This technique assumes that both the native and composite borrow material distributions are nearly log-normal. The renourishment factor is a measure of the stability of the placed borrow material relative to the native beach sand. Desirable values of the renourishment factor are those less than or equal to one. For example, a renourishment factor of 0.33 would mean that renourishment using the borrow material would be required one third as often as renourishment using the same type of material that is currently on the beach. The borrow material is expected to be coarser than the native beach material, thus, creating favorable overfill and renourishment factors. Vibrocores taken in a shoal area south of the ordnance site revealed materials such as gravels and silts, which are very incompatible with the native beach sands. Only Areas P1 and P2 have compatible material for the project area. The results of the comparison of the beach material to the potential borrow material from Areas P1 and P2 can be seen in Table 2.6.1. Other potential areas which could have been considered as potential sources of beach fill material were eliminated due to their incompatibility with the native beach material or their distance to the project area.

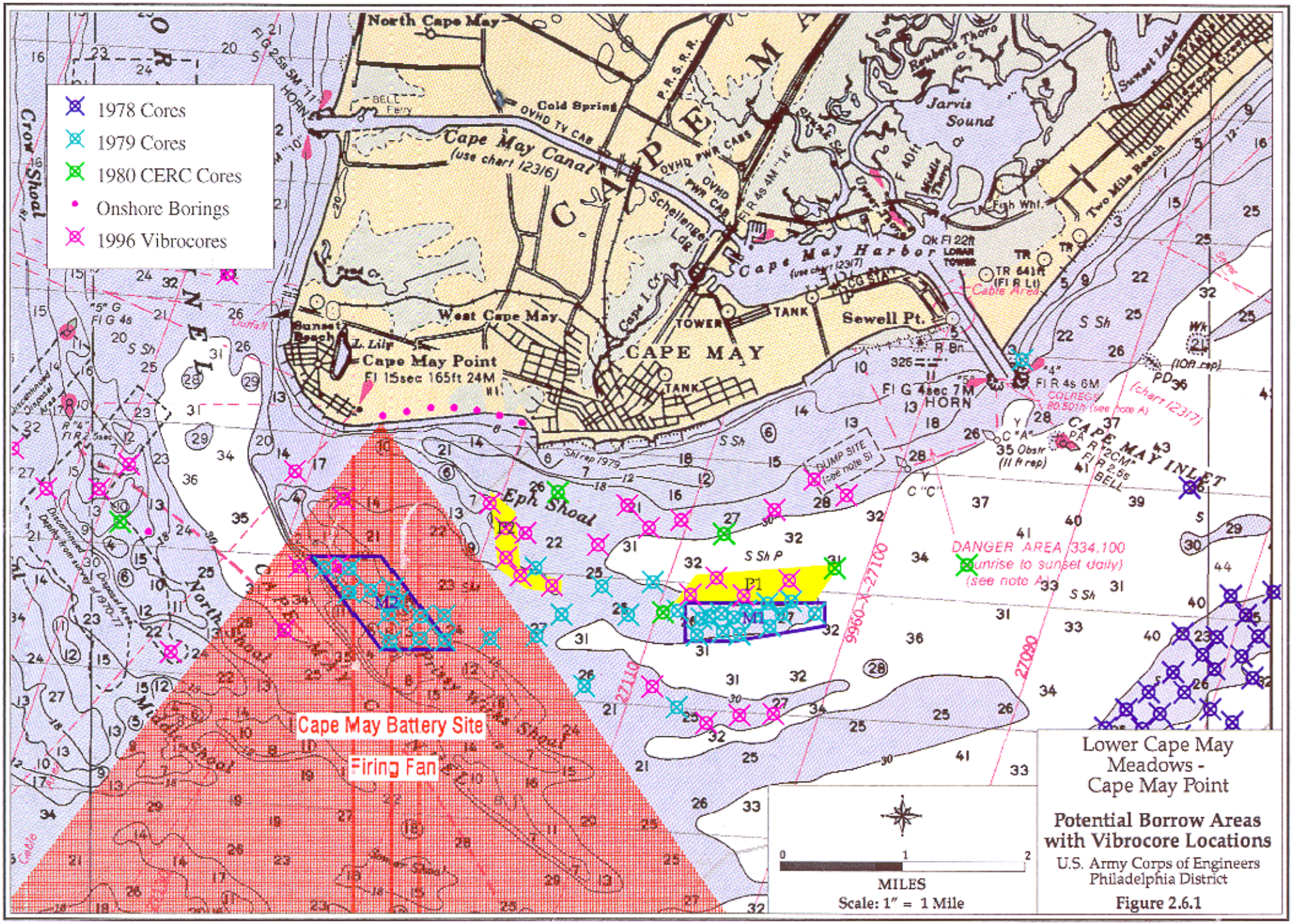
2.6.5.3 Native Beach Characteristics. A composite beach grain size curve was developed for Lower Cape May Meadows and also for Cape May Point. The beach sand in the Cape May Meadows area is finer than that of Cape May Point. The grain size tests performed indicate a median diameter of 0.21 mm in the Meadows and 0.42 mm in the Point.

Table 2.6 -1
Borrow Area Suitability Analysis

Borrow Area	Fill Location	Estimated Quantity cu. yds.x 10^6	Mean Borrow Diameter (mm)	Overfill Factor R_a	Renourishment Ratio R_j
Area P1	Meadows	4.7	1.38	1.0	0.04
Area P2	Meadows	1.8	0.75	1.0	0.06
Area P1	Point	4.7	1.38	1.0	0.36
Area P2	Point	1.8	0.75	1.0	0.61

2.6.6 Subsurface Beach Investigation. In March of 1996, the Army Corps of Engineers Philadelphia District contracted with Uni-tech Drilling of Malaga, New Jersey to drill and sample three soil borings located along the Lower Cape May Meadows. The seven borings were continuously sampled to a depth of approximately 50 feet, with undisturbed soil samples being taken in layers of fine-grained soil. The purpose of these borings was to ascertain the foundation conditions in this area and determine whether these conditions would permit a structural solution (groins..etc) to the erosion problem at the Meadows.

The borings indicate that a layer of medium dense fine sand extends to a minimum depth of 35 feet and a maximum depth of 48 feet below the ground surface. Lying immediately below the



Lower Cape May Meadows - Cape May Point

Potential Borrow Areas with Vibrocore Locations

U.S. Army Corps of Engineers
Philadelphia District

Figure 2.6.1

layer of fine sand is a layer of medium stiff to stiff light brown to gray silt/clay ranging in thickness from 5 feet to 10 feet. The softer fine grained sediment layer was encountered at depths ranging from 36 feet to 48 feet below the surface (see Appendix D for the boring logs).

Only four undisturbed samples were taken from the seven borings, due to the lack of soft fine grained sediments. These samples were shipped to the South Atlantic Division Laboratory for shear strength and consolidation testing. It does not appear that the foundation conditions will prevent a structural solution or require special measures to build a storm protection structure.

Previous storm events have caused severe erosion of the dune in The Meadows which also caused areas of sand accretion on the interior of the dune. In May 1997, the washout areas in the interior of the dune were investigated with a hand auger. The depth of sand and depth to groundwater were measured to determine the quantity of material that can be reused for the proposed dune improvement. A maximum of four feet of sand was deposited in the washout area. The depth of sand deposited decreased with distance from the dune to zero. The groundwater for the majority of the washout area was approximately 2.5 feet below ground surface. Logs of the augered holes were not provided in this report.

2.7 Hazardous, Toxic, and Radioactive Waste Search

Federal and state databases were referenced to perform an HTRW Preliminary Assessment of the project area. The search encompassed the coastal area from Cape May Inlet to Cape May Canal. The results of the preliminary assessment point out seven potentially contaminated sites. The possible sites and their descriptions are as follows: In 1941, the United States Department of Defense acquired a 133 acre site near Cape May Point, along the coast. The Department of the Army built a concrete bunker and gun emplacements on this site. This former Cape May Point Coastal Defense Bunker has a potential for contamination of ordnance and explosive waste (OEW), due to the past firing of 155mm artillery from the bunker into the ocean. There is this same potential for OEW contamination in borrow area M2 because of the artillery fire from the defense bunker (Figure 2.6-1). For this reason, borrow area M2 was dropped from the list of potential borrow areas. There is evidence of one underground storage tank at the former defense bunker site, which is a potential for contamination to the site. The Cape May Lewes Ferry docking site has a potential for contamination from an oil leak. The Northwest Magnesite Plant and the Harbison Walker Refractories facility on Sunset Boulevard, are listed as USEPA CERCLIS sites which have a potential for HTRW contamination. The Sunset Shell Gas Station has a potential for contamination due to an underground tank leak. Cape May Harbor is suspected of contamination due to fuel spills.

The potential for contamination at these six sites is considered minor. Borrow Area M2 will not be encountered; and therefore, will not pose a threat of contamination to the proposed project. The potential borrow areas and the Cape May Meadows/Point areas are considered to be free of any contaminants, therefore, any potential project is considered environmentally safe.

2.8 Shore Protection Structural Inventory

Lower Cape May Meadows

(Note: Elevations are referenced to NGVD 29, as were original mapping and surveys. To convert NGVD 29 elevation to NAVD 88, subtract 1.27 to elevations.)

Refer to Figure 2.8-3 for plan of existing conditions.

Dunes. Reinforced dunes extend from the groin at Lighthouse Avenue to the eastern study limit of the Meadows at the terminal groin in Cape May City (Photos 2-1 & 2-2). Dune design includes a compacted core consisting of NJDOT I-5 select fill with a top elevation varying between +6.35 and +8.35 NGVD and side slopes of 2 horizontal to 1 vertical (Figure 2.8-1). Top width of the dunes vary between 15 to 30 feet, and side slopes are 1V:3H. Average top elevation of the dunes is +16.5 NGVD. Existing dune grass is well established in those areas of dune not recently damaged by erosion. Sand fencing on the seaward side of the dunes is in a straight line configuration. Most recent repairs to the dunes were made in 1996. The profile in Figure 2.8.1 was developed from 1996 surveys.

Armor Mattress. A portion of the seaward face of the reinforced dunes in Cape May Meadows is stabilized by an armor mattress (Photo 2-3). The mattress is constructed from a geogrid basket filled with 3 to 4 inch stone and extends for a distance of 450 feet east of the Lighthouse Ave. groin. The mattress is supported by a base of broken concrete rubble which is beneath a layer of graded core stone. The toe of the mattress is covered by 2 to 4 ton stone. The mattress was constructed in 1995 by the NJDEP. Condition of the mattress is good. This mattress was extended towards the bunker in 1998.

Outfall. One 24" diameter ductile iron stormwater outfall pipe is located approximately 1500 feet east of the Lighthouse Ave. groin, extending through the existing dune (Photos 2-4 and 2-5). Outfall pipe length is 300 feet. The invert elevation at the seaward end is +1.90 NGVD and flow is regulated with a backflow preventer. A concrete inlet drop structure exists at the landward end, with an inlet elevation at +3.50 NGVD. The pipe is supported on piles and timber cribbing, and was constructed in 1993.

Cape May Point

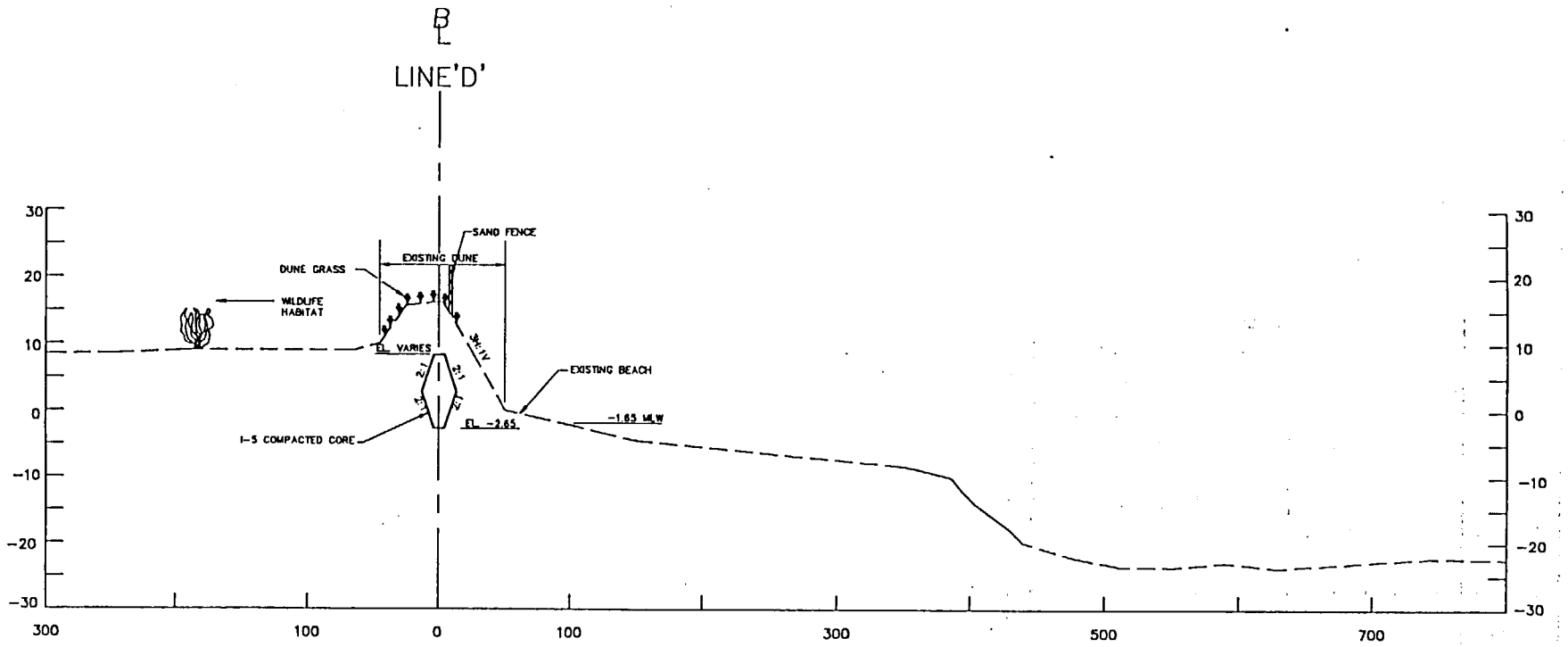
Groins. There are nine groins in Cape May Point (Photos 2-6 through 2-9, Figure 2.8-2). Eight of the nine groins were originally constructed of timber, except for the groin at Lehigh Avenue, which is composed entirely of stone. Top elevation of the original timber groins is approximately +9.35 NGVD. All eight groins originally constructed of timber were extended with stone. The final stone extensions were constructed between 1966-68 and all have a 14 foot wide crest. Crest elevations vary between +7.35 NGVD at the landward end to +3.35 NGVD at

the seaward end, maintaining a low profile step design that follows the existing ground (Figure 2.8-2). Lengths of the groins vary from 340' to 520'. All are in good condition except for the Lighthouse Ave. and Lehigh Ave. groins. The structural integrity of these two groins is in question due to the presence of a scour hole located at the seaward ends of these structures. The possible effect of the scour hole on these groins is uncertain at this time.

Revetment. A revetment constructed of approximately 3 to 5 ton quarrystone and recycled concrete is located between the Lighthouse Ave. and Lehigh Ave. groins and extends approximately halfway to the next groin at Whilldin Ave (Photo 2-10). Condition is fair; however, the majority of the recycled concrete pieces are not large enough to remain stable when subjected to wave attack.

Ruins. The remains of three concrete foundation pads exist on the beach in Cape May Meadows located approximately 450 feet east of the Lighthouse Ave. groin. Each pad is about 10 feet square at the bottom. There are also the remains of steel rails from an old railroad track located on the beach approximately 1,300 feet east of the Lighthouse Ave. groin .

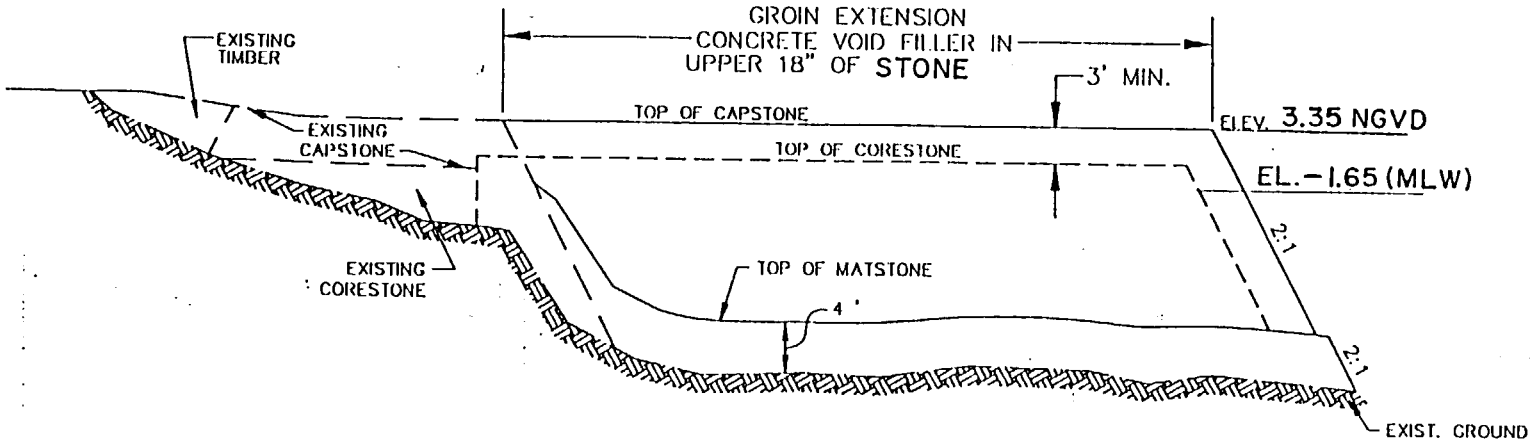
Also on the Cape May Meadows beach are the ruins of a concrete structure which was historically used as a military bunker (Photo 2-11). The footprint of this structure is approximately 200 feet by 100 feet and is supported on timber piles. The structure is located approximately 1,400 feet east of the Lighthouse Ave. groin.



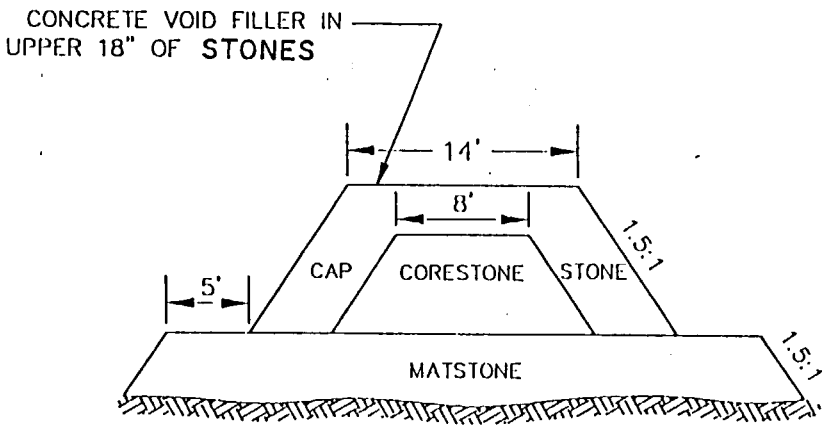
TYPICAL SURVEY PROFILE
AND EXISTING REINFORCED DUNE
CAPE MAY MEADOWS

NOT TO SCALE

FIGURE 2.8.1



TYPICAL PROFILE OF GROIN
N.T.S.

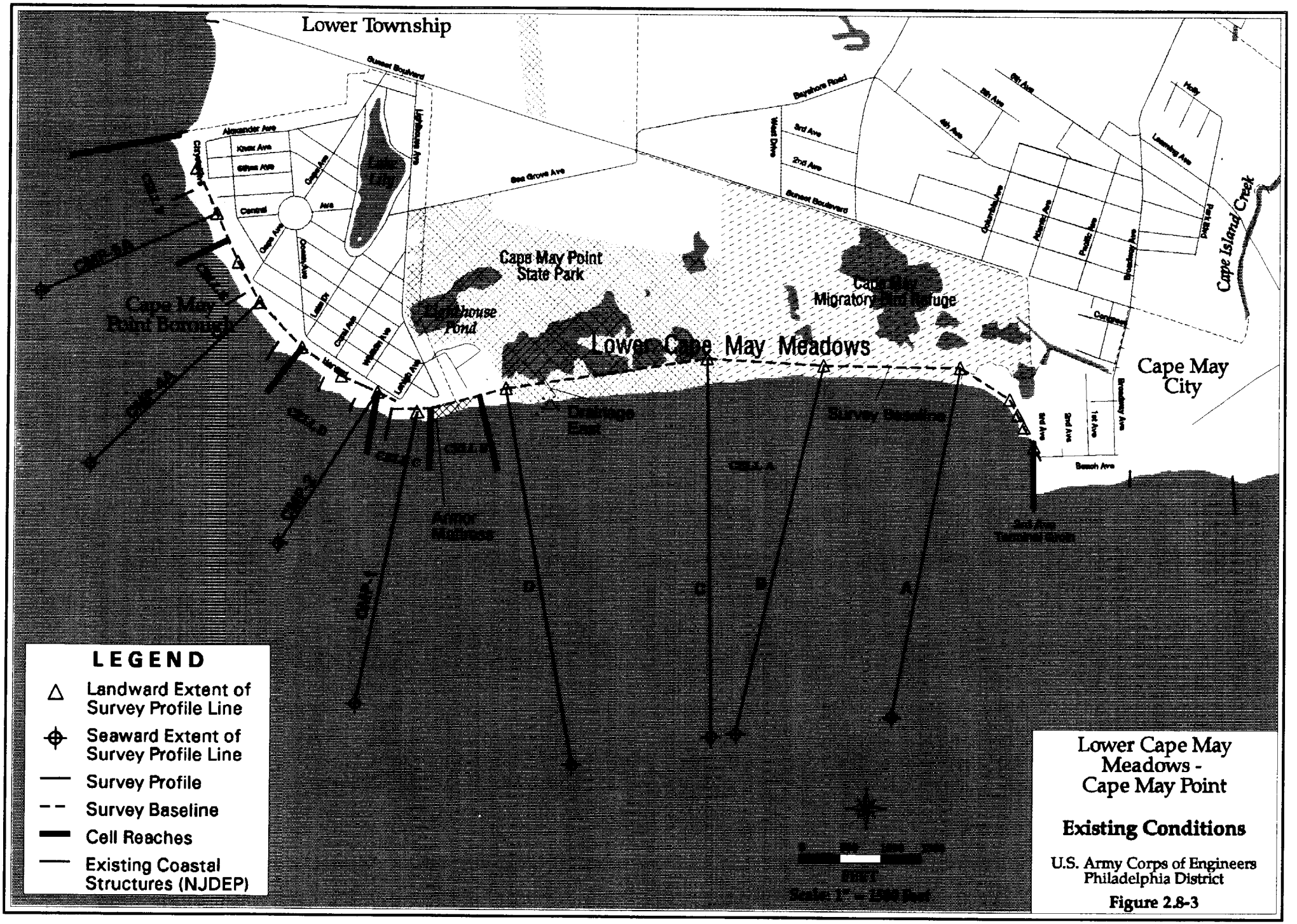


TYPICAL SECTION
GROIN EXTENSION CONSTRUCTION
N.T.S.

TYPICAL PROFILE EXISTING GROINS

CAPE MAY POINT

FIGURE 2.8.2



Lower Cape May Meadows - Cape May Point

Existing Conditions

U.S. Army Corps of Engineers
Philadelphia District

Figure 2.8-3

Photo 2.8-1 Seaward side of existing dune fronting Cape May Point State Park, facing west. Note exposed NJ I-5 compacted core exposed by erosion (1997).

Photo 2.8-2 Landward side of dune in Cape May Meadows in State Park. (1997)

Photo 2.8-3 Armor mattress on seaward side of dune in Cape May Meadows, looking west, existing concrete ruins in background (1997).

Photo 2.8-4 24" diameter D.I. Outfall pipe looking into Cape May Point State Park (1993).

Photo 2.8-5 24" diameter D.I. outfall pipe looking east (1997).

Photo 2.8-6 Groins at Lehigh and Whillden Aves., Cape May Point (1993).

Photo 2.8-7 Groin at Coral Ave., Cape May Point (1993).

Photo 2.8-8 Groins at Lake Ave., Cape May Point (1993).

Photo 2.8-9 Groin at Central Ave., Cape May Point (1993).

Photo 2.8-10 Stone and concrete rubble revetment in Cape May Point.

Photo 2.8-11 Cape May Meadows looking east. Remains of concrete bunker in surf zone (1997).

2.9 Coastal Processes

2.9.1 Introduction

A number of coastal hydraulic processes which affect The Meadows and Cape May Point study area were investigated. The following paragraphs summarize these critical elements which include historic and existing wind, wave, water level and sediment conditions for the study area.

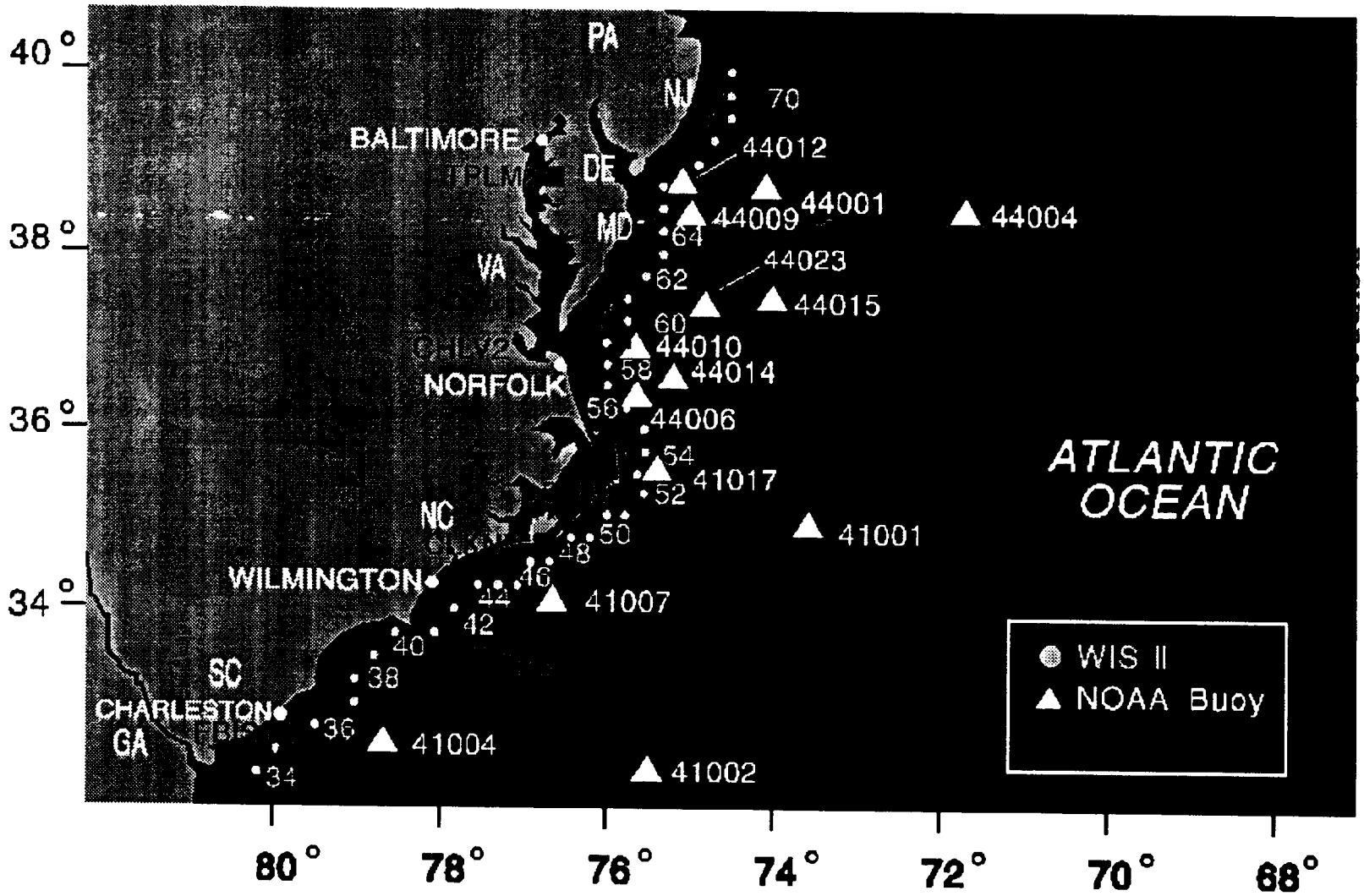
2.9.2 Waves

The most recent analysis of general wave statistics for the study area shoreline is presented in a report entitled "Hindcast Wave Information for the U. S. Atlantic Coast" (Wave Information Study (WIS) Report 30) prepared by Hubertz, et al., 1993. The WIS data is also available digitally through the Coastal Engineering Data Retrieval System (CEDRS) developed by the U.S. Army Engineer Coastal Engineering Research Center. WIS Report 30 and information in CEDRS provides wave data for 108 locations along the U. S. Atlantic coast, and supersedes WIS Report 2 (Corson, et al. 1981), WIS Report 6 (Corson, et al. 1982) and WIS Report 9 (Jensen 1983). The wave information for each location is derived from wind fields developed in a previous hindcast covering the period 1956 through 1975 and the present version of the WIS wave model, WISWAVE 2.0 (Hubertz 1992). Wave heights are universally higher for the current hindcast than for the original hindcast since the values more closely correspond to maximum measured (buoy) values.

Hindcast results are available as time series every 3-hr for the 20-yr period and as tabular summary statistics. WIS Report 30 contains tables presenting the distribution of spectral wave height, peak period and peak mean direction by month for the 20-yr period; the number of occurrences by 1-m height and 2-sec period categories for eight different direction bands and a final table for all directions; the distribution of wind in 2.5-m/sec and 45-deg speed and direction categories on a monthly basis; and finally summary tables of mean and maximum wave heights by month for each of the 20 years hindcast. These tables also include the peak period and peak mean wave direction associated with the maximum wave height occurrence.

The WIS output results are a verified source of information for wind and wave climate along the U.S. Atlantic Coast and have been used to gain a basic understanding of the wind and wave climate at the study area. The wave statistics pertinent to the study area are those derived for Station 67 of WIS Report 30 (Figure 2.9.1). The location of Station 67 is Latitude 39.00 N, Longitude 74.50 W, in a water depth of approximately 60 ft. Monthly mean wave heights at Station 67 for the entire 20-yr hindcast range from 2.3 ft in August to 4.2 ft in December and January. The maximum wave height (H_{mo}) at Station 67 for the 20-yr period is reported as 23.6 ft, with an associated peak period of 14 sec and a peak direction of 97 deg on 7 March 1962.

WIS Phase II - Mid Atlantic Region



Atlantic WIS

U.S. ARMY ENGINEER DISTRICT, PHILADELPHIA
CORPS OF ENGINEERS
PHILADELPHIA, PENNSYLVANIA

LOWER CAPE MAY MEADOWS-CAPE MAY POINT
FEASIBILITY STUDY

WIS Station Map

FIGURE 2.9.1

The maximum wind speed for Station 67 for the 20-yr hindcast is reported as 89 ft/sec at 20 deg on 7 March 1962. The actual wave spectrum experienced at any particular time along the project shoreline may show considerable local variation. This variability is largely due to the interaction of incident waves with: tidal currents at the entrance to Delaware Bay, shoal morphology, local shoreline alignment, nearshore bathymetry, and presence of shoreline stabilization structures. Therefore, the hindcast wave statistics should be viewed as a very general representation of the wave climate of the study area offshore. Inshore of the 60 ft depth, the effects enumerated above will modify the incident waves such that significant alongshore differences may exist with respect to breaking wave height and angle relative to the shoreline. Computer programs which transform offshore waves over varying bathymetry must be used to further investigate wave conditions closer to the shoreline.

2.9.3 Wind and Climate

The site closest to the study area for which long-term systematic wind and climatic data are available is Atlantic City. Weather data were recorded at the Absecon Lighthouse from about 1902 to 1958. In 1943, systematic weather observations were initiated at the U. S. Naval Air Station located about 10 miles northwest of the Absecon Light. Records have been made continuously at the Air Station site (presently, National Aviation Facilities Experimental Center, Pomona) to the present. In 1958, the weather observation site in Atlantic City proper was relocated from Absecon Light about 1.1 miles northwest to the Atlantic City State Marina. The station was then moved several hundred yards to the Atlantic City Coast Guard Facility. The following paragraphs are quoted from the 1992 Annual Summary of Local Climatological Data, and are considered to be fully representative of conditions along the study area.

"Atlantic City is located on Absecon Island on the southeast coast of New Jersey. Surrounding terrain, composed of tidal marshes and beach sand, is flat and lies slightly above sea level. The climate is principally continental in character. However, the moderating influence of the Atlantic Ocean is apparent throughout the year, being more marked in the city than at the airport. As a result, summers are relatively cooler and winters milder than elsewhere at the same latitude."

"Land and sea breezes, local circulations resulting from the differential heating and cooling of the land and sea, often prevail. These winds occur when moderate or intense storms are not present in the area, thus enabling the local circulation to overcome the general wind pattern. During the warm season sea breezes in the late morning and afternoon hours prevent excessive heating. Frequently, the temperature at Atlantic City during the afternoon hours in the summer averages several degrees lower than at the airport and the airport averages several degrees lower than the localities farther inland. On occasions, sea breezes have lowered the temperature as much as 15 to 20 degrees within a half hour. However, the major effect of the sea breeze at the airport is preventing the temperature from rising above the 80's. Because the change in ocean temperature lags behind the air temperature from season to season, the weather tends to remain comparatively mild late into the fall, but on the other hand, warming is retarded in the spring. Normal ocean temperatures range from an average near 37 degrees in January to near 72 degrees in August."

"Precipitation is moderate and well distributed throughout the year, with June the driest month and August the wettest. Tropical storms or hurricanes occasionally bring excessive rainfall to the area. The bulk of winter precipitation results from storms which move northeastward along, or in close proximity to, the east coast of the United States. Snowfall is considerably less than elsewhere at the same latitude and does not remain long on the ground. Precipitation, often beginning as snow, will frequently become mixed with or change to rain while continuing as snow over more interior sections. In addition, ice storms and resultant glaze are relatively infrequent."

As referenced in the 1992 Annual Summary from the US Coast Guard Facility, the prevailing winds are from the south and of moderate velocity (14 to 28 miles per hour), and winds from the northeast have the greatest average velocity (between 19 and 20 miles per hour). The wind data from this period also show that winds in excess of 28 miles per hour occur from the northeast more than twice as frequently as from any other direction.

The maximum five-minute average velocity at Atlantic City was recorded during the hurricane of September 1944, with a value of 82 miles per hour from the north. This storm also caused the largest recorded storm surge along the Atlantic coast of New Jersey. The fastest mile windspeed recorded at the Atlantic City Marina site over the 1960 to 1992 period was recorded during Hurricane Doria in August 1971. The fastest mile wind speed was 63 miles per hour from the southeast. The wind records generally reflect the fact that the most extreme, but infrequent, winds accompany hurricanes during the August to October period. Less extreme but more frequent high winds occur during the November to March period accompanying northeasters.

2.9.4 Tides

The tides affecting the study area are classified as semi-diurnal with two nearly equal high tides and two nearly equal low tides per day. The average tidal period is actually 12 hours and 25 minutes, such that two full tidal periods require 24 hours and 50 minutes. Thus, tide height extremes (highs and lows) appear to occur almost one hour (average is 50 minutes) later each day. The mean tide range at the Cape May Municipal pier is reported as 4.3 feet in the Tide Tables published annually by the National Oceanic and Atmospheric Administration (NOAA). The spring tide range is reported as 5.2 feet.

The NOS (National Ocean Service) tide gage nearest to the study area shoreline is Breakwater Harbor, Delaware. The mean and spring tide ranges for the gage are 4.2 and 4.9 feet respectively.

2.9.5 Storms

Storms of two basic types present a significant threat to New Jersey's coastal zone. Hurricanes are the most severe storms affecting the Atlantic Coast. Extratropical storms with winds from easterly quadrants, particularly the northeast, also cause extensive damage to beaches and

structures along the coast.

Tropical storms and hurricanes, spawned over the warm low latitude waters of the Atlantic Ocean, are probably the best known and most feared storms. Hurricanes, characterized by winds of seventy-five miles per hour or greater and heavy rain, plague the Gulf and Atlantic seaboards in the late summer and autumn. Historically, the Hurricane of 1944 and Hurricane Gloria are ranked first and fifth, respectively, in terms of maximum stage at the Atlantic City gage.

Extratropical storms, often called "northeasters", present a particular problem to the Atlantic seaboard. Such storms may develop as strong, low pressure areas over land and move slowly offshore. The winds, though not of hurricane force, blow onshore from a northeasterly or easterly direction for sustained periods of time and over very long fetches. The damage by these storms may ultimately exceed the destruction from a hurricane. The March 1962 Northeaster ranks second only to the 1944 hurricane in terms of maximum stage. The northeasters which occurred in November 1950 and December 1992 rank third and fourth in the stage frequency analysis for the Atlantic City gage.

The intensity and damage-producing potential of coastal storms are related to certain meteorological factors such as winds, storm track, and amount and duration of precipitation. However, the major causes of coastal damage tend to be related to storm surge, storm duration, and wave action. Storm surge and wave setup will be discussed in the storm erosion and inundation analysis included in a later section.

2.9.6 Sea Level Rise

Sea level rise is a contributing factor to long term coastal erosion and increased potential for coastal inundation. Because of the variability and uncertainty of the climatic factors that affect sea level rise, predicting future trends with any certainty is difficult. There exists many varying scenarios of future sea level rise. Corps of Engineers guidance ER-1105-2-100 section 5-25 recommends that The National Research Council (NRC) study on sea level rise, Responding to Changes in Sea Level: Engineering Implications, 1987 be used until more definitive data become available. Corps of Engineer's policy calls for consideration of designs which are most appropriate for a range of possible future rates of rise. Strategies, such as beach fills which can be augmented in the future as more definitive information becomes available, should receive preference over those that would be optimal for a particular rate of rise but unsuccessful for other possible outcomes. Potential sea level rise should be considered in every coastal study, with the degree of consideration dependent on the quality of the historical record for the study site. Based on historical tide gage records between 1912 and 1986 at Atlantic City and Ventnor, New Jersey, sea level has been rising at an approximate average rate of 0.013 feet per year (Hicks and Hickman 1988). In consideration of the length and quality of the tide record at Atlantic City, the ocean stage frequency analysis incorporates the effects of the local sea level rise. Over the proposed fifty year project life, it is assumed that mean sea level will rise by 0.65 feet.

2.9.7 Storm Criteria

Under contract to the Philadelphia District, Offshore & Coastal Technologies Inc- East Coast (OCTI-E) developed storm water level, wave height, period and direction criteria for the project area for the 2-, 5-, 10-, 20-, 50-, 100-, 200-, and 500-year events.

Storm wind, wave and water level data to be used for erosion and inundation modeling were generated using historic data and hindcasting techniques. This section describes the techniques used and the results for the Cape May Meadows study area.

Historic storm data were generated using a series of numerical models, applied to the two storm populations: hurricanes and northeasters. First, the wind fields were specified during each storm at a high temporal (hourly for tropical storms, six-hourly for northeasters) and spatial resolution. The wave field over the northern and mid-Atlantic Ocean area and the eastern Delaware Bay was simulated to provide data for the coastal areas of southern New Jersey and Delaware. Fully discrete directional spectra were modeled using a numerical spectral model that has had considerable prior validation in deep and shallow areas around the world. The present study includes the effects of swell propagation from the Atlantic Ocean by appropriate nesting of wave model grids which included a large portion of the Atlantic Ocean and significant detail in Delaware Bay and the adjacent oceanfront shorelines of southern New Jersey and Delaware.

The specification of water levels and currents for the area of interest was performed using a two-dimensional storm surge and current model. The model included the effect of shallow water and land boundaries, the effects of surface wind stresses, Coriolis forcing, and the important contribution of astronomical tide.

2.9.7.1 Historic Storm Selection

A total of 30 of the most severe storms to have impacted the Delaware Bay and the New Jersey coast were selected for the hindcasting study from a 102-year period of record; including 15 hurricanes and 15 northeasters. Storm selection was based on the potential for wind, wave and storm surge-generation by the events. Coastal erosion and inundation are primarily a function of water level; however, waves are a significant consideration. For this study, the population of storms was considered applicable to the New Jersey Atlantic Coast area due to the large size of northeasters that govern the majority of historic extreme storms in the area and due to the sparsity of hurricanes in the historic storm population.

Screening of historic hurricanes was performed using the NOAA database to determine the most severe events based upon track and intensity. This screening, which yielded a list of storms that passed within 100 miles of the study area, was refined by assessing documented or reported storm severity (storm damages along the Delaware Bay and Atlantic Ocean coastlines and measured oceanographic data). A set of 15 storms was finalized as shown in Table 2.9.1.

Table 2.9.1
Hurricanes Used In Hindcast

Oct 1891	Aug 1954 (Carol)
Aug 1899	Sep 1954 (Edna)
Sep 1903	Sep 1958 (Daisy)
Aug 1924	Sep 1960 (Donna)
Sep 1933	Sep 1967 (Doria)
Sep 1936	Aug 1976 (Belle)
Sep 1944	Sep 1985 (Gloria)
Aug 1953	

Northeasters were selected based upon a review of historic weather maps, reputed storm damages and tide records. Several types of extra tropical storms have historically affected the New Jersey and Delaware area, originating in the Bahamas, southern Florida, or arriving from the Appalachia. The storm selection process resulted in the storm list provided in Table 2.9.2.

Table 2.9.2
Northeasters Used
In Hindcast

Nov 1950	Oct 1977
Oct 1953	Feb 1978
Mar 1962	Oct 1980
Jan 1964	Mar 1984
Jan 1966	Oct 1991
Dec 1973	Jan 1992
Nov 1974	Dec 1992
Mar 1977	

2.9.7.2 Storm Wind Fields

Historic wind fields were simulated using three numerical wind field models: a parametric hurricane wind model, a geostrophic wind field model and a planetary boundary layer (PBL) model. For hurricanes and tropical storms, a parametric wind model was used. The model was a relatively detailed model that allowed the generation of wind fields based upon temporally-varying storm parameters. The method used to derive wind fields in northeasters was similar to that used for tropical storms except for the application of the parametric tropical storm model. The standard approach to specification of wind fields in non-tropical regimes relies on

direct analysis of surface observations in a process called kinematic analysis to develop the most accurate wind fields possible. Isobars on historic surface weather charts were digitized at the best available resolution (generally 4 mb), with maps mostly available at 6-hourly time increments. Digital information was gridded on a one-degree increment. After application of the geostrophic and PBL wind models, ship observations and buoy data, as available, were blended into the resulting surface wind fields along with smaller-scale weather systems affecting the New Jersey and Delaware coastal and offshore areas. Wind fields were validated against all available marine buoy and C-MAN station data.

2.9.7.3 Storm Wave Fields

Hindcasted storm wave conditions for this study were simulated using a second generation discrete directional spectral wave model that is applicable in all water depths. The model was developed by Dr. D.T. Resio and includes a nonlinear wave-wave interaction source term and shallow water wave transformations. The model is a FORTRAN code which simulates wave growth, dissipation and propagation in deep or shallow water. Spectra are represented as fully two-dimensional spectra in discretized frequency and direction bands. Propagation effects and source/sink mechanisms are computed in terms of variations of energy levels in each of these frequency-direction elements. All wave parameters such as significant wave height, frequency of the spectral peak, mean wave direction, etc. are computed from these discrete elements.

The New Jersey coast application of the model includes the propagation of energy toward shore from the deep water of the Atlantic Ocean to the shallow shelf waters and into the Delaware Bay. The model includes source terms describing wave shoaling, refraction, wind effects, wave-wave interactions and bottom interaction effects. The wave model was implemented to simulate waves on three nested grids. The series of grids assures that distant swell as well as locally-generated wind waves are included in the results. The final (finest resolution) grid spacing used a one nautical mile resolution so that conditions very near to the coast could be produced to the best accuracy possible.

The extreme wave heights estimated using hindcast results were compared to Wave Information Study (WIS) wave hindcast results produced by CERC at Station 67, the offshore hindcast reporting location that is closest to the study area. The WIS data are generally higher than the recently-hindcast results up until the 50-year event. The difference in the results reflects basic differences in the studies:

--The recent hindcast includes storm of all types (tropical and extra tropical) from a longer period of record, i.e. hurricanes since 1890 and northeasters since 1950, whereas WIS includes storms from a 20-year period between 1956 and 1975.

--The recent hindcast accounts for detailed local bathymetric conditions whereas WIS bathymetry used a simplified shelf configuration (straight and parallel contours).

--The recent hindcast includes near shore storm winds whereas WIS data was propagated

from a WIS phase II station without near shore wave generation by winds.

2.9.7.4 Storm Surges

Water level and current hindcasting were performed using a depth-integrated finite difference model. This model included the effect of shallow water and land boundaries on the flow field. The results of the storm simulations reflect the astronomical tidal and storm wind-and pressure-induced water level changes and currents during each event. These components of water level and current must be added to other sources of ambient currents, wave setup, coastal currents, etc. to determine total conditions at a given location. The model used in this study solves momentum and continuity equations using an explicit differencing scheme. The momentum equations contain advection, surface slope, Coriolis, wind stress, bottom stress and inverse barometer terms. The effects of sea level rise are included in the calculation of water levels and effects on waves by applying the storm driving forces over recently collected bathymetry and beach profile surveys. This data is referenced to NGVD 1929 vertical datum.

The computational grid for the hindcast was a 1-minute grid covering the Atlantic Ocean and Delaware Bay area extending from 73 to 75.5 degrees West Longitude and from 37.0 to 40.0 degrees North Latitude. Only results within the wave model grid three were recorded as output from the model for further archiving and post-processing.

2.9.7.5 Frequency Design Criteria

Peak waves and water level information were produced for the Cape May Meadows study area offshore of The Meadows at coordinates 38 degrees 55 minutes North Latitude/74 degrees 55 minutes West Longitude. The location, outside the major influences of near shore tidal shoals, had a water depth of approximately 26 feet MLLW.

An analysis of storm peak waves and water levels was performed in order to formulate extreme design criteria for the project. A best-fit Gumbel distribution was developed using all of the data. Extremes were calculated for return periods of 2, 5, 10, 20, 50, 100, 200 and 500 years.

The approach for formulating a distribution of the most extreme events was performed using the hindcast results, which include a large percentage of the most severe water level and wave events that historically have occurred at the study area. This method utilized the actual historical record, supplemented by numerically-modeled details, to generate the extreme value distribution. A curve was fitted to the hindcasted sample distribution of actual storms and then this curve was extrapolated to longer time intervals than that covered by the sample. The wave height and water level frequency data are provided as Table 2.9.3.

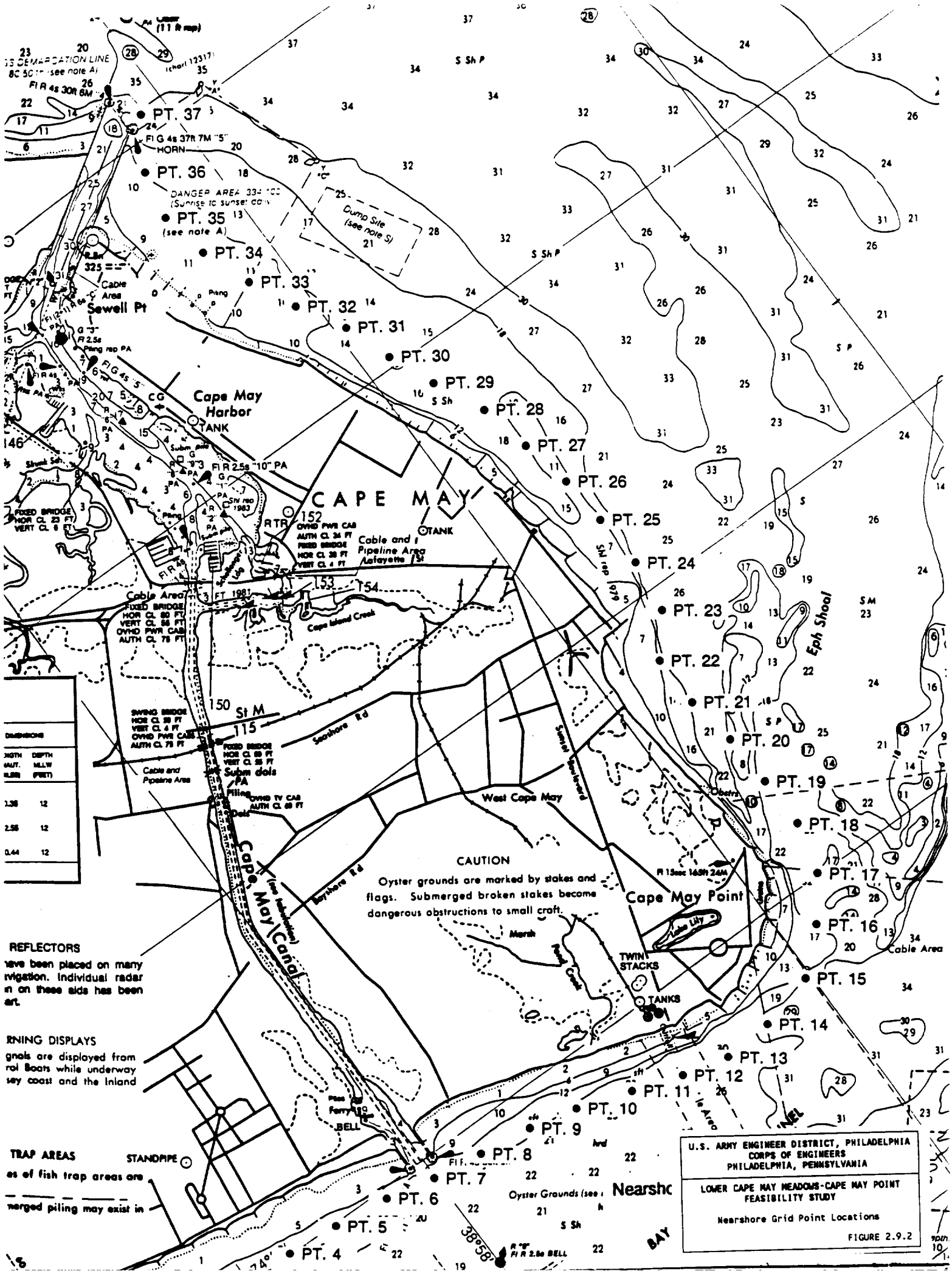
Table 2.9.3
Frequency Wave and Water Level (at 38-55N, 74-55W)

Event(Year)	Probability of Exceedance	Water Surface Elevation (ft-NGVD)	Sig Wave Height (feet)
2	0.500	4.9	13.1
5	0.200	6.6	14.4
10	0.100	6.9	16.7
20	0.050	7.4	19.4
50	0.020	8.1	22.6
100	0.010	9.1	24.9
200	0.005	10.0	27.2
500	0.002	11.3	30.5

Note: Elevations referenced to NAVD88 datum are obtained by subtracting 1.27 feet from the NGVD29 elevations

2.9.8 Longshore Sediment Transport

Andrews, Miller & Assoc., Inc. under contract to the Philadelphia District prepared an assessment of the longshore transport potential in the vicinity of Cape May Meadows and Cape May Point. The analysis was based on a near shore wave and current hindcast for the period 1987-1992 prepared by OCTI-E acting as a subcontractor for Andrew Miller Inc. The meteorological and oceanographic numerical modeling approaches used are the same as that described in the section above, except for the use of a fine scale grid model (0.25 nautical miles) nested inside the larger grid. The limits of the finer grid for the Atlantic Ocean and Delaware Bay area extended from 74 to 75 degrees West Longitude and from 38.0 to 39.0 degrees North Latitude. The transport grid provides the necessary definition of nearshore waves and currents for use in a sediment assessment. The location of the 37 grid points nearest to shore are shown on Figure 2.9.2.


PT. 37
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(see note A)
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PT. 4
Dump Site (see note S)
Sewell Pt
Cape May Harbor
CAPE MAY
Cape May Point
West Cape May
Cape May Canal
Eph Shoal
Cable and Pipeline Area
Cable Area
Seashore Rd
Sunset Boulevard
Cape Island Creek
Pond Creek
Lake Lily
TWIN STACKS
TANKS
STANDPIPE
BELL
Oyster Grounds (see
Nearshore
BAY
38°58'
74°
CAUTION
Oyster grounds are marked by stakes and flags. Submerged broken stakes become dangerous obstructions to small craft.
REFLECTORS
TRAP AREAS
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CORPS OF ENGINEERS
PHILADELPHIA, PENNSYLVANIA
LOWER CAPE MAY MEADOWS-CAPE MAY POINT
FEASIBILITY STUDY
Nearshore Grid Point Locations
FIGURE 2.9.2

2.9.8.1 Wave-induced Nearshore Longshore Transport

The wave data generated at each of the 37 near shore locations was analyzed to determine long shore transport potential due to waves. Wave-driven transport potential was calculated using the CERC energy flux method- with long shore energy flux and transport rate expressions taken from the Shore Protection Manual (SPM Equations 4-39 and 4-49). This procedure calculates the breaking wave height and angle with respect to the local shoreline orientation as scaled off the bathymetric chart at each of the 37 locations. Snell's Law was used with the assumption of straight and parallel bottom contours and conservation of wave energy flux directed onshore. The rates were calculated for each onshore wave condition and cumulated for each year of the 6-year normal condition hindcast.

Based on the methodology discussed above, the near shore long shore sediment transport potential was calculated for each of the thirty-seven (37) nearshore grid points which are spaced 0.25 nmi along the study area from Cape May Canal to Cape May Inlet. The results of the calculations consist of potential long shore sediment transport to the left (-) and to the right (+) (conventional reference with observer standing onshore and looking offshore), net transport and gross transport for each of the thirty-seven (37) near shore grid points for the years 1987-1992. The six (6) year average of the net potential long shore transport for each point is presented as Table 2.9.4.

As shown in Table 2.9.4, the calculated value of the potential net long shore sediment transport averaged over the study area from Cape May Inlet to Cape May Point is 242,848 cubic yards per year (east to west), which compares very closely to the value of 250,000 cubic yards per year net transport to the east computed by Caldwell (Corps, 1980). Variations in the wave-induced potential net long shore transport rate along the study area shoreline are shown in Figure 2.9.3.

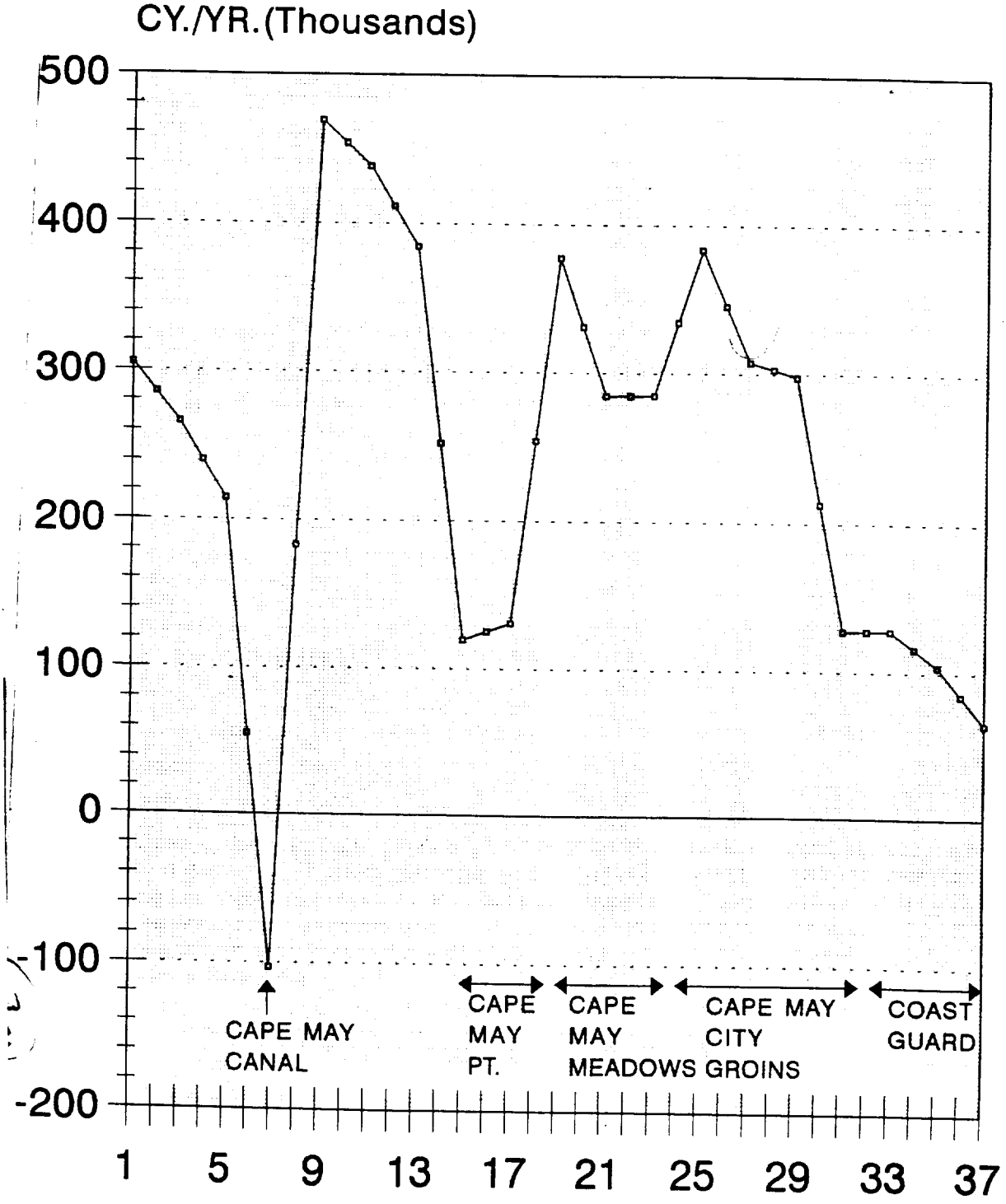
Proceeding west from the Cape May Inlet jetties, the net long shore transport rate averages about 104,000 cubic yards per year (to the west) along the Coast Guard shoreline and then increases to an average of about 289,000 cubic yards per year (to the west) along the Cape May City shoreline. The lower net transport rate along the Coast Guard shoreline is probably attributable to sheltering by the jetties and shoreline orientation differences with the Cape May shoreline. Along the Cape May Meadows shoreline, the average net transport rate is about 313,000 cubic yards per year (to the west) and then decreases to an average of about 158,000 cubic yards per year along the Cape May Point groin field. This decrease in transport is a result of the shoreline orientation change along the Point which would reduce the transport potential of waves from the east to southeast directions. From the west groin at Cape May, the transport rate increases to an average of about 370,000 cubic yards per year due to shoreline orientation changes which would increase the transport potential of waves from the south to southwest.

At Cape May Canal, there is a reversal in the net transport direction to 100,000 cubic yards per year to the south. From north of the entrance to the canal, the net transport is to the north at an average of about 228,000 cubic yards per year.

Table 2.9.4
Potential Wave-Induced Net
Longshore Sediment Transport

Nearshore Grid Point	Qnet (Cy/Yr)	Nearshore Grid Point	Qnet (Cy/Yr)
1	304850	20	331000
2	285306	21	284500
3	265762	22	284667
4	240000	23	284833
5	214238	24	334250
6	55611	25	383667
7	-103107	26	345667
8	182852	27	307667
9	468720	28	302750
10	453317	29	297833
11	437913	30	212750
12	411240	31	127667
13	384567	32	127750
14	252283	33	127833
15	120000	34	116167
16	125500	35	104500
17	131000	36	84833
18	254250	37	65167
19	377500		
Average	242848		
Min Value	-103017		
Max Value	468720		
Standard Dev	127530		

CAPE MAY, NEW JERSEY
WAVE-INDUCED LONGSHORE SEDIMENT TRANSPORT



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Potential Wave-Induced
Longshore Sediment Transport

FIGURE 2.9.3

2.9.8.2 Current-induced Longshore Transport

The hindcast tidal current data for each near shore grid point was analyzed to determine long shore transport potential due to currents. Bed load sediment transport potential due to storm and tidal driven current was calculated using a relationship developed by Dixon and Westfall (Morris and Wiggert, 1972) which is based upon a large range of laboratory and field conditions. The relationship is a function of median grain size (here, assumed to be 0.2 mm) and the flow velocity.

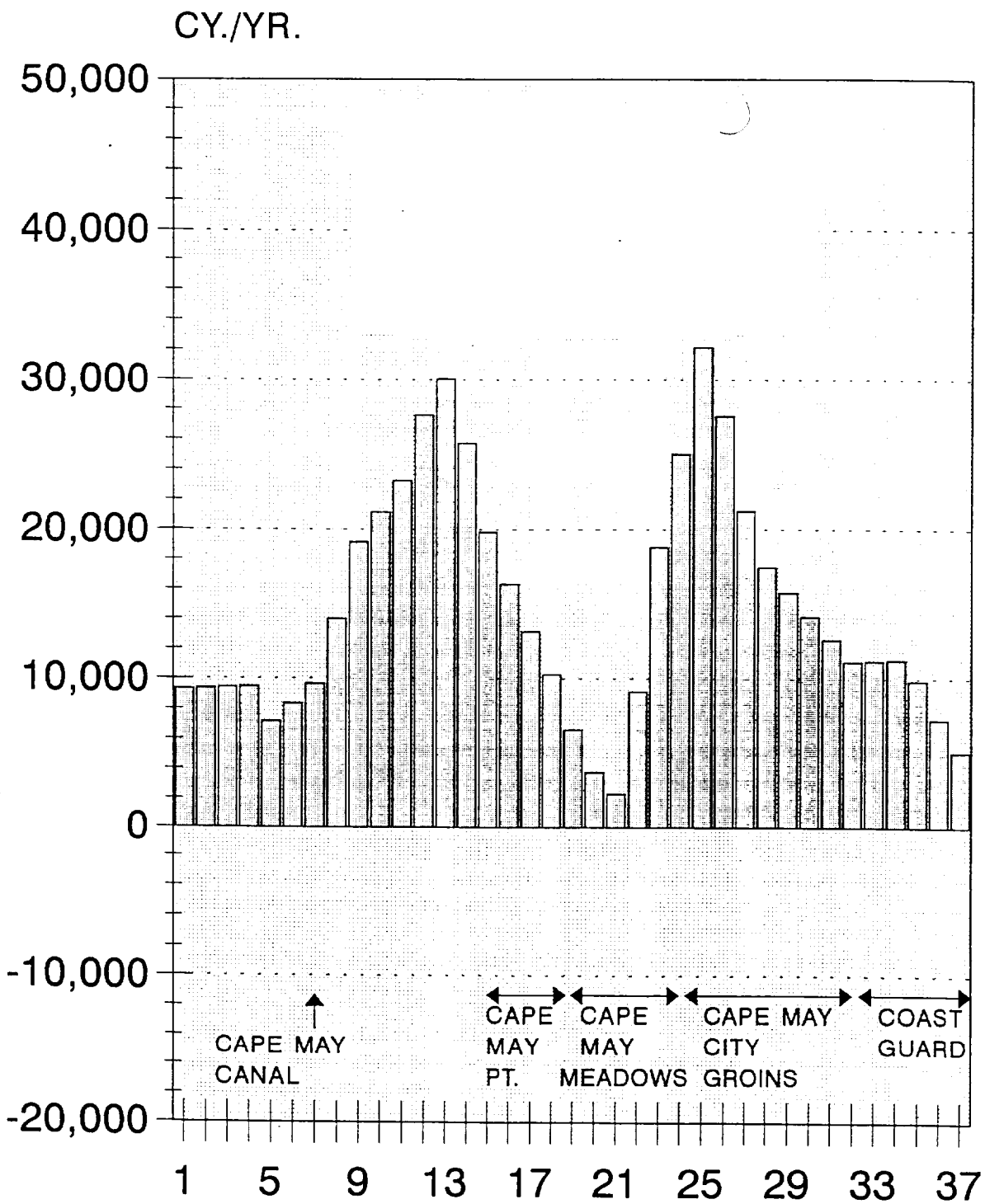
The results of the calculations consist of potential current induced long shore sediment transport to the left (-) and to the right (+) (conventional reference with observer standing onshore and looking offshore), net transport and gross transport for each of the thirty-seven (37) near shore grid points for the years 1987-1992. The six (6) year average of the net potential long shore transport for each point is presented as Table 2.9.5.

As shown in Table 2.9.5, the calculated potential current-induced long shore sediment transport averaged over the study area is 14,747 cubic yards per year. Variations in the current-induced long shore transport along the shoreline are shown in figure 2.9.4. Analysis of Figure 2.9.4 indicates that there are peaks in the current-induced transport offshore of the 3rd Avenue terminal groin and in the vicinity of the west groin at Cape May Point. Figure 2.9.4 also indicates a minimum current-induced transport offshore of The Meadows area.

Table 2.9.5
Potential Current-Induced Net
Longshore Sediment Transport

Nearshore Grid Point	QNet (Cy/Yr)	Nearshore Grid Point	QNet (Cy/Yr)
1	9329	20	3745
2	9383	21	2279
3	9437	22	9166
4	9492	23	18813
5	7171	24	25022
6	8365	25	32157
7	9658	26	27556
8	13987	27	21217
9	19148	28	17466
10	21136	29	15765
11	23234	30	14141
12	27609	31	12597
13	30033	32	11134
14	25737	33	11197
15	19818	34	11260
16	16316	35	9864
17	13137	36	7288
18	10286	37	5089
19	6621		
Average	14747		
Minimum Value	2279		
Maximum Value	32157		
Median	12597		
Standard Deviation	7658		

CAPE MAY, NEW JERSEY
CURRENT-INDUCED LONGSHORE SEDIMENT TRANSPORT



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Potential Current-Induced
Longshore Sediment Transport

FIGURE 2.9.4

2.9.8.3 Tidal Current Data Collection

A field effort was undertaken to obtain tidal current data consisting of velocity, direction, and depth across four (4) profiles perpendicular to the shoreline. Data collection at locations across each profile and at various depths defines the horizontal and vertical tidal current distribution. Current measurements were taken at three stations along each of the four profiles, as shown in Figure 2.9.5, and at a minimum of three depths. Each station was referenced to the New Jersey State Plane Coordinate System. The first location along each profile was as close to shore as possible without entering the surf zone. Successive measurements were then taken at greater distances from shore as determined by changes in bathymetry. The tidal measurements were obtained during the optimum conditions of spring tide with minimum wind and wave interference over the period 26-28 July 1994.

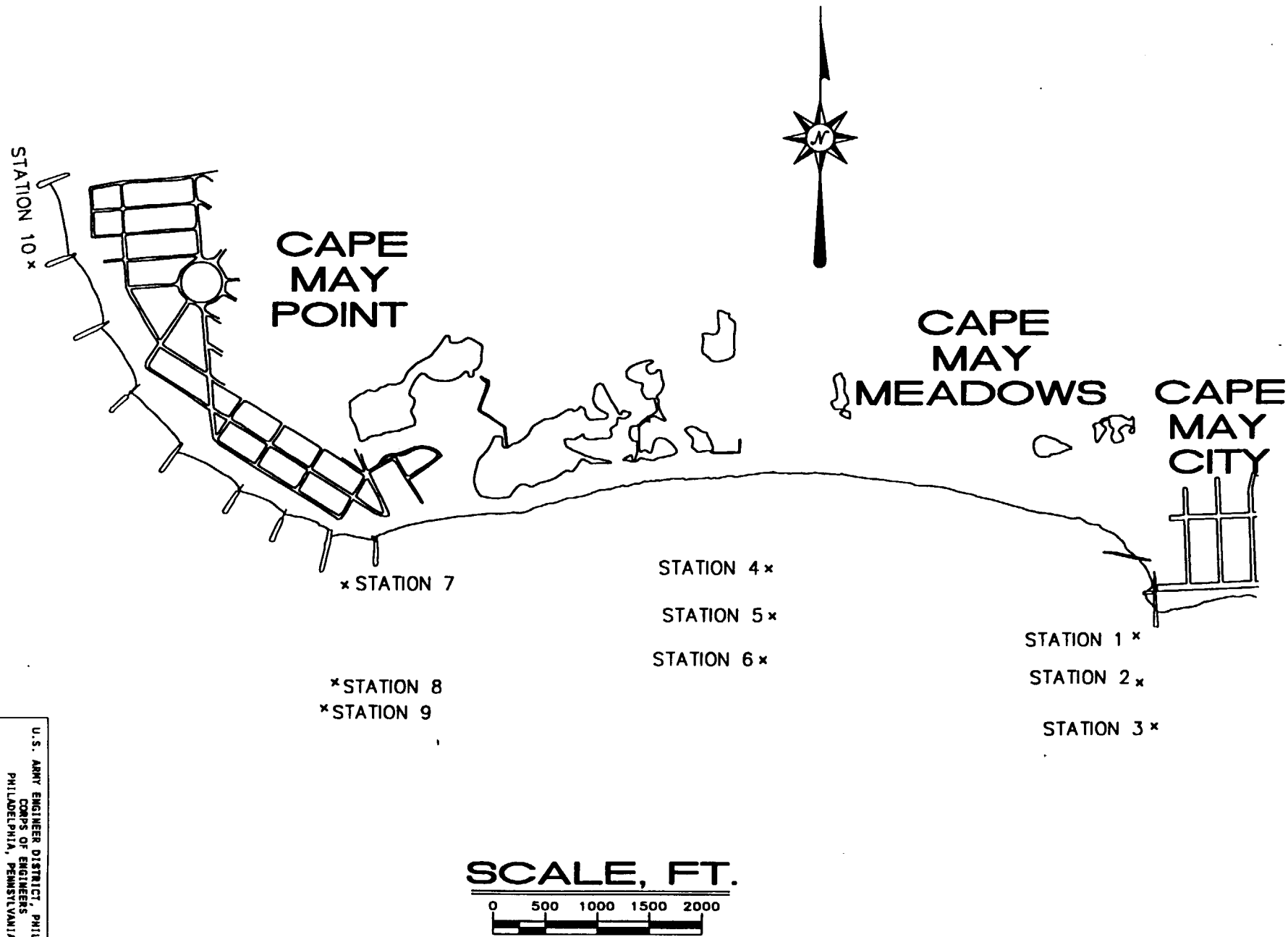
2.9.8.4 Tidal Current Data Evaluation

Analysis of the current velocity data indicates that the maximum current velocities occur about 2.5 hours prior to the maximum high tide or low tide elevation. In general, the slack current occurred about 40 minutes after the high tide elevation occurs. Tidal current measurements were made at three depths at each of the 12 stations. These depths were generally -2 feet, -6 feet, and -13 feet relative to the water surface. Analysis of the data shows the typical vertical distribution of current velocity with the higher velocities at the surface (-2 feet) and decreasing velocity with depth. Evaluation of the data indicates that the vertical distribution of the current velocity is generally distributed in accordance with the one-seventh-power law which gives the tidal current velocity at any depth (UTz) as:

$$Utz = UTz\ (z/d)^{**}(1/7)$$

where:

Utz = surface current
z = distance above the bottom measured positive upward
d = water depth



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Tidal Current Measurement Stations

FIGURE 2.9.5

Since one of the primary objectives of the study was an evaluation of the impacts of the tidal currents on sediment transport, the near bottom current velocity was calculated for each measurement at each of the 12 stations. This data is most useful in evaluating sediment transport potential. The data indicate that the maximum flood current velocities exceed the maximum ebb current velocities at Stations 1-7. Station 7 which is located just offshore of the second groin compartment at Cape May Point, showed a significant flood current dominance. A near shore tidal channel has been identified previously in this location. For Stations 8-12, the data indicates that in general the maximum ebb current velocities exceed the maximum flood current velocities.

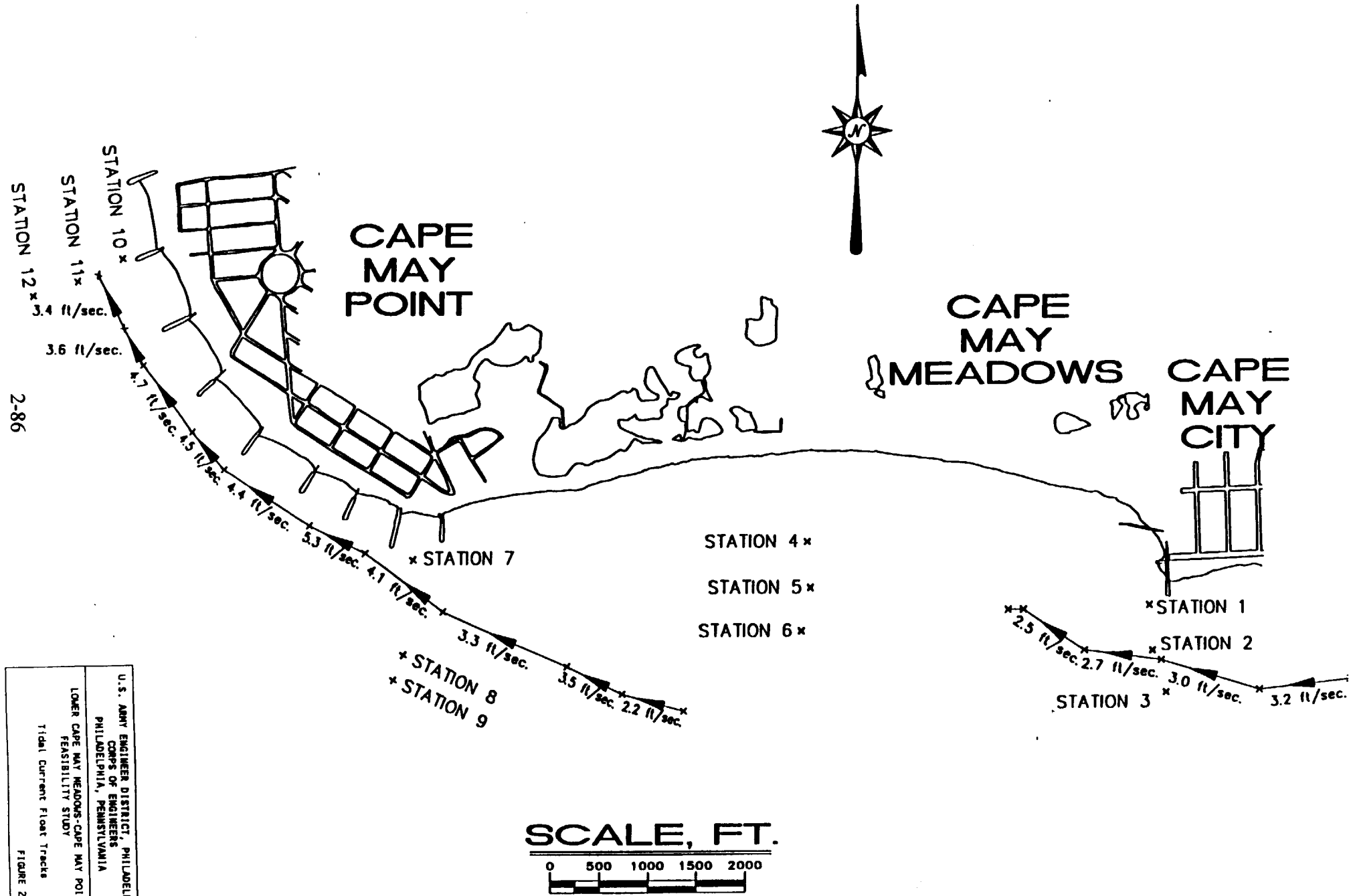
Analysis of the data does not show a general trend in the horizontal distribution of current velocities at each of the profile locations. However, the data does indicate a significant increase in the flood current velocity from offshore to inshore between Stations 7-9 at Cape May Point and a decrease in ebb current velocities from offshore to inshore at the same stations.

2.9.8.5 Tidal Current Float Deployment

In order to observe the pattern of the flow field, tidal current floats were deployed on 29 July 1994. The floats were of the drag type and consisted of 2x2' plywood sheets painted fluorescent red with a cable and umbrella suspended under the float for drag. This type of float is not subject to winds and generally provides a reasonable simulation of the current movement.

Floats were deployed in the 3rd Avenue terminal groin and Cape May Point areas during flood tide. The results of the float tracking are presented in Figure 2.9.6. In the 3rd Street area, the floats moved in a general shore parallel direction from east of the terminal groin to the terminal groin and then moved shoreward somewhat. The average velocity of the floats was about 3 feet per sec which is comparable to the surface current velocities measured at stations 1-3.

In the Cape May Point area, the floats moved in a shore ward direction from the release point at a velocity of about 3 feet per second and accelerated to over 4 feet per second when they were located just offshore of the first and second groin compartments. This accelerated velocity compares very closely to the surface current velocities measured at Station 7. From this point, the float velocity increased to an average of greater than 4.5 feet per second and the floats maintained a general shore parallel direction throughout the rest of the Cape May Point area. Offshore of the westernmost groin compartments, the float velocity decreased to about 3.5 feet per second. The results of the float tracking, like the tidal current measurements, indicate the presence of a flood current channel along the Cape May Point area.



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Tidal Current Float Tracks

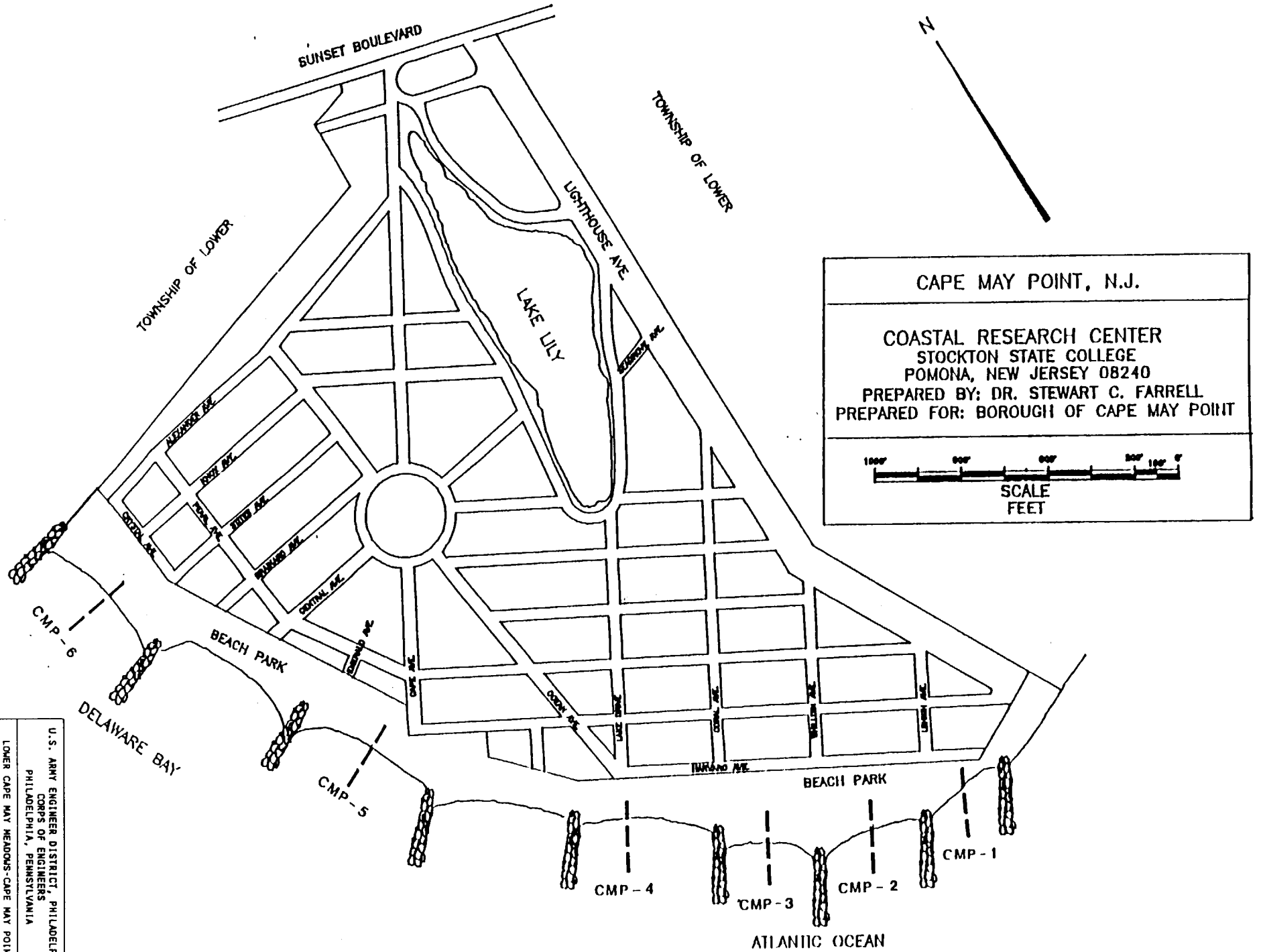
FIGURE 2.9.6

2.9.8.6 Previous Investigations

Based on an analysis of shoreline change data between 1949-1978, the U.S. Army Coastal Engineering Research Center (CERC) concluded that all the beaches in the study area suffer from a lack of sand due to the Cape May Inlet jetties which act as a littoral barrier to sand moving down coast. This deficit of sand has resulted in significant erosion of up to 20 feet per year at the Coast Guard Training Center. Erosion of this beach has been a principal source of littoral drift for the Cape May City area between Windsor and Third Avenues. Further west, the terminal groin at 3rd Avenue in Cape May City also acts as a littoral barrier to the shoreline to the west where shoreline erosion rates have averaged 20 to 30 feet per year. Previous analyses of profiles along the study area shoreline by the Corps of Engineers indicated a definite steepening of the profile slopes both above and below mean low water in the Cape May Point area. These steeper profiles were attributed to the erosive tide-induced currents in the deep channelized area offshore between Cape May Point and Prissy Wicks Shoal. It was concluded that the continuous effects of the tidal forces in producing these currents keep the beach and offshore slopes in this reach comparatively steep.

Previous investigations of tidal currents from Wildwood to Cape May Point were conducted by the Corps of Engineers using drift floats during the period of November 1947 to December 1948. These observations indicated a definite reversal of currents in the area of observation with the change of tide in Delaware Bay. Typical current velocities measured during this time period averaged on the order of 3 feet per second maximum for both flood and ebb currents. During Delaware Bay's ebb tide, a pattern of currents was believed to be set up that opposes the wave direction. Since currents attain velocities of over 3 feet per second under normal tide conditions, it is possible that the net transport of sediment to the west is reduced as the incoming waves and ebb currents meet. However, during flood flows these same currents combine with the normal wave action to possibly increase the sediment transport to the west. No conclusions were reached based on this data regarding the significance of the tidal currents in the sediment transport process.

At Cape May Point, Stockton College identified the location of a major tidal channel about 450 feet offshore of the instrument location at Profile CMP-1 located in the eastern most groin cell as shown in Figure 2.9.7. This channel runs offshore through Profile CMP-4. Flood and ebb tidal currents were reported to move swiftly through this channel and acted to transport sand at its margin into shoals located east and west of Cape May Point in the mouth of Delaware Bay. Stockton College's monitoring efforts indicated that storm events produce intense wave turbulence along the shoreline of the groin compartment and this turbulence acts to move sand in suspension out of the groin cell. At Profile CMP-2, where the majority of a beach fill was placed between May-July, 1991, Stockton College reported that the October 1991 storm removed essentially all of the sand placed in the berm and dune. Little if any of the lost sand was observed to have accumulated in the shallow sub-tidal zone between the groins; the normal onshore migration of sand after the storm did not occur. The probable reason for this situation was identified to be near shore tidal currents which removed the sand from the system. Stockton



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Cape May Point Profile Locations

FIGURE 2.9.7

College concluded that wave turbulence and tidal eddies carry larger quantities of sand away from the Borough than should leave by wave transport alone along the shoreline.

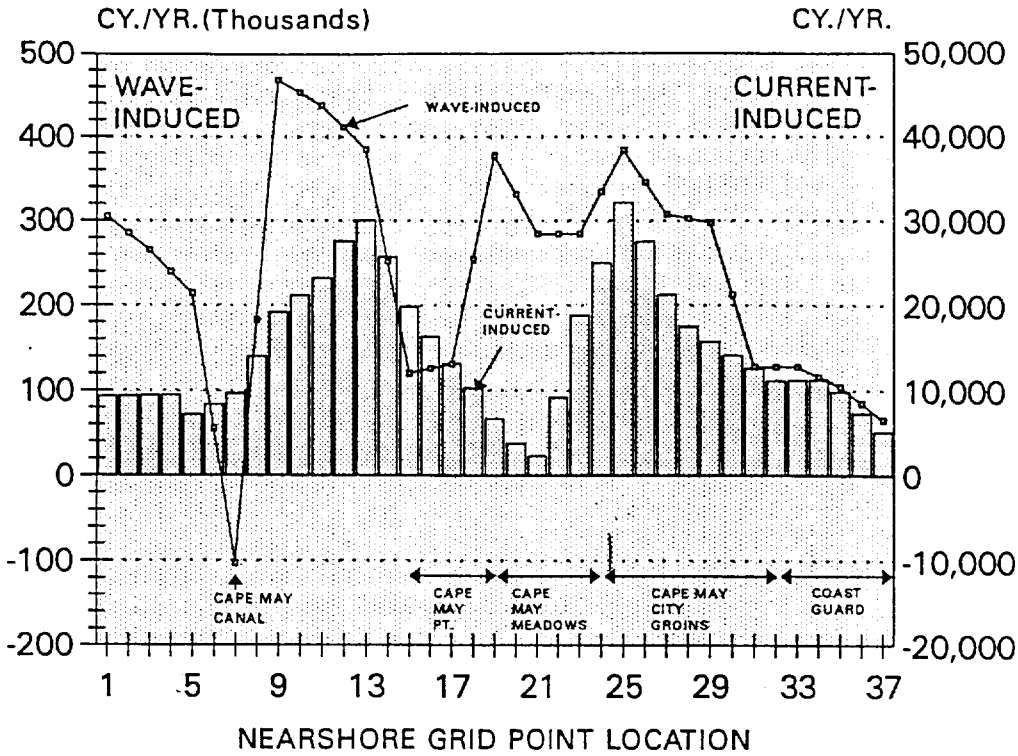
2.9.8.7 Relative Importance of the Various Sediment Transport Processes

In order to gain insight into the relative importance of each of the potential sediment transport processes, the potential wave-induced and potential current-induced bed load net transport rates (averaged between 1987-1992) along the study area were plotted together in Figure 2.9.8a and the available historical shoreline changes were plotted in Figure 2.9.8b. Analysis of Figure 2.9.8a indicates that the potential wave-induced longshore sediment transport exceeds the potential current-induced bed load sediment transport at the near shore grid points (0.25 nmi offshore and at 0.25 nmi alongshore) throughout the study area by a factor of 10 to 20.

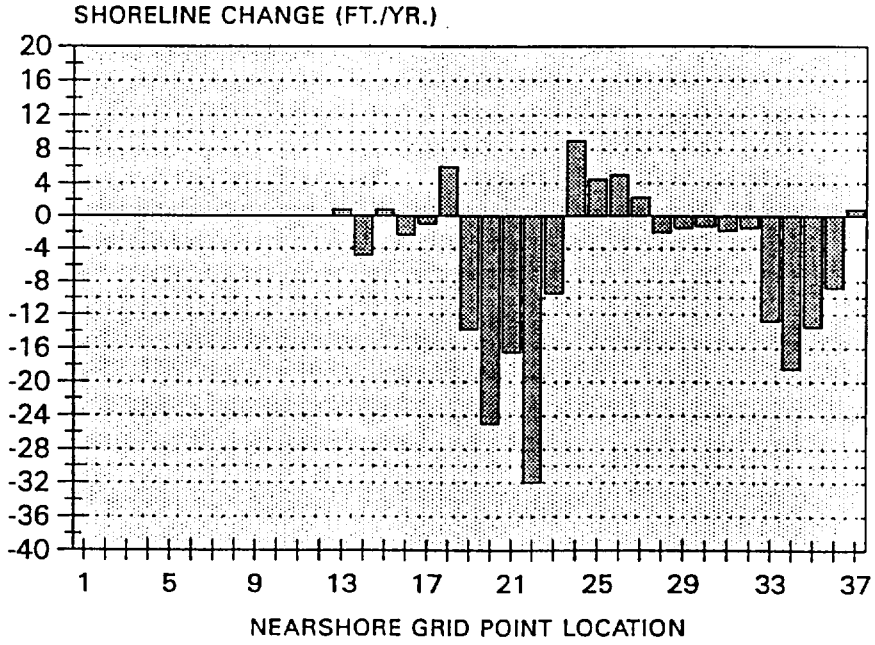
Considered independently, the data indicates that the potential wave-induced sediment transport is dominant throughout the study area since without wave-induced suspension of sediment, tidal currents would have to entrain sediment from the bottom and transport it as bed load. Under these circumstances, current-induced transport is clearly not dominant. However, in areas where longshore sediment transport is induced by wave breaking and turbulence in the vicinity of relatively strong tidal currents, the currents could augment the transport of this sediment out of the near shore littoral system and thus play a more significant role.

The computed potential current-induced transport and previous investigations identified two potential areas where tidal currents may be more important. They are in the vicinity of the 3rd Avenue terminal groin in Cape May City and along the groin field at Cape May Point. Peaks in the potential current-induced sediment transport are generally located in both of these areas as shown in Figure 2.9.8a. Tidal current measurements made on 27-28 July 1994 also showed peak flood current velocities at these general locations (Stations 1 and 7). In addition, results of the float tracking on 29 July 1994 indicated a relatively strong flood current offshore of the 3rd Avenue terminal groin and indicated a significant acceleration of flood current velocities in the vicinity of the Cape May Point groins. At the 3rd Avenue groin, net westerly moving longshore sediment transport that bypasses the groin could be subject to transportation by the tidal currents in that area. Flood currents would tend to transport this material either offshore or towards Cape May Point and essentially past the eroding Cape May Meadows shoreline which is located significantly land ward.

Along the shoreline at Cape May Point, primarily between the first two (2) groin compartments, Stockton College reported that a tidal channel offshore of this location is transporting sediment suspended by wave turbulence out of this area. Tidal current measurements at Station 7 on 28 July 1994 and the float tracking confirm the presence of a flood channel in this area.



Potential Wave-Induced vs. Current-Induced Sediment Transport



Historical Shoreline Change Rates: 1949-1978

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Potential Wave vs Current Induced
Sediment Transport and Historic
Shoreline Change Rates: 1949-1978

FIGURES 2.9.8a/b

As further analysis, the computed sediment transport rates are compared with the historical changes along the study area shoreline for the period 1949-1978 shown in Figure 2.9.8b. Although the potential longshore sediment transport rates shown in Figure 2.9.8a are based on the 1987-1992 period, they should provide representative rates for qualitative comparison with the historical erosion rates. Comparison of Figure 2.9.8a and 2.9.8b indicates a reduced net wave-induced and current-induced longshore transport rate along the Coast Guard shoreline in an area that experienced high erosion rates between 1949-1978. The reduced wave-induced sediment transport in this area is probably due to the sheltering provided by the Cape May Inlet jetties and the shoreline orientation of this area as compared to the shoreline to the west. Although both the wave-induced and current-induced longshore transport rates are lower than the average in this reach, the total lack of sand supply from up drift resulted in the high erosion rates between 1949-1978.

From the east end to the west end of the Cape May City groin field the wave-induced and current-induced longshore transport rates increase to an average of about 289,000 cubic yards per year and 20,000 cubic yards per year, respectively. However, this area showed net accretion during the 1949-1978 period as shown in Figure 2.9.8b. This accretion is attributed to the sand eroded from the Coast Guard shoreline and the eastern action of the Cape May groin field.

Along the Cape May Meadows shoreline, wave-induced transport rates remain high averaging about 313,000 cubic yards per year as compared to a decrease in the current-induced transport rate to about 5,000 cubic yards per year. The lack of sand supply due to the 3rd Avenue terminal groin combined with the high rate of potential wave-induced sediment transport are assumed responsible for the high erosion rates in this area during 1949-1978.

Along Cape May Point, the wave-induced longshore transport rates decrease to an average of about 158,000 cubic yards per year as compared to an increase in current-induced transport to an average of about 13,000 cubic yards per year. The wave-induced transport reduction is attributed to the shoreline orientation shift from East to West to Southeast to Northwest. However, the general stability of this reach between 1949-1978 is attributed to the groins along the point.

West of Cape May Point, both the wave-induced and current-induced transport rates increased to an average of about 370,000 cubic yards per year and 20,000 cubic yards per year, respectively. However, shoreline change data was not available for comparison.

2.9.8.8 Conclusions

Based on the computed potential transport rates and the preceding evaluations, it is concluded that wave-induced longshore sediment transport is generally dominant in the Cape May area with the net direction of transport from the east to the west at an average rate of about 245,000 cubic yards per year. This conclusion reflects an assessment of sediment transport by tidal currents as bed load transport. In this mode, the tidal currents would have to scour the near shore bottom and entrain and transport sediment. The analyses conducted during this study indicate that this mode of current-induced sediment transport is not significant. However, it is probable that tidal

currents also play a role by transporting sediment set in suspension by wave breaking and turbulence. Increases in longshore sediment transport due to this process are probable in the area and are considered to be potentially more important in at least two locations: 1) offshore of the 3rd Avenue terminal groin and offshore of this groin field at Cape May Point.

2.10 Historic Shoreline Change Analysis

2.10.1 Summary Of Historic Shoreline Conditions

A historic shoreline analysis was conducted for the ocean shorelines of Lower Township Cape May (Meadows) and Cape May Point. This analysis documents past behavior and "background" conditions of the shoreline and determines long-term erosion rates where applicable in the study area.

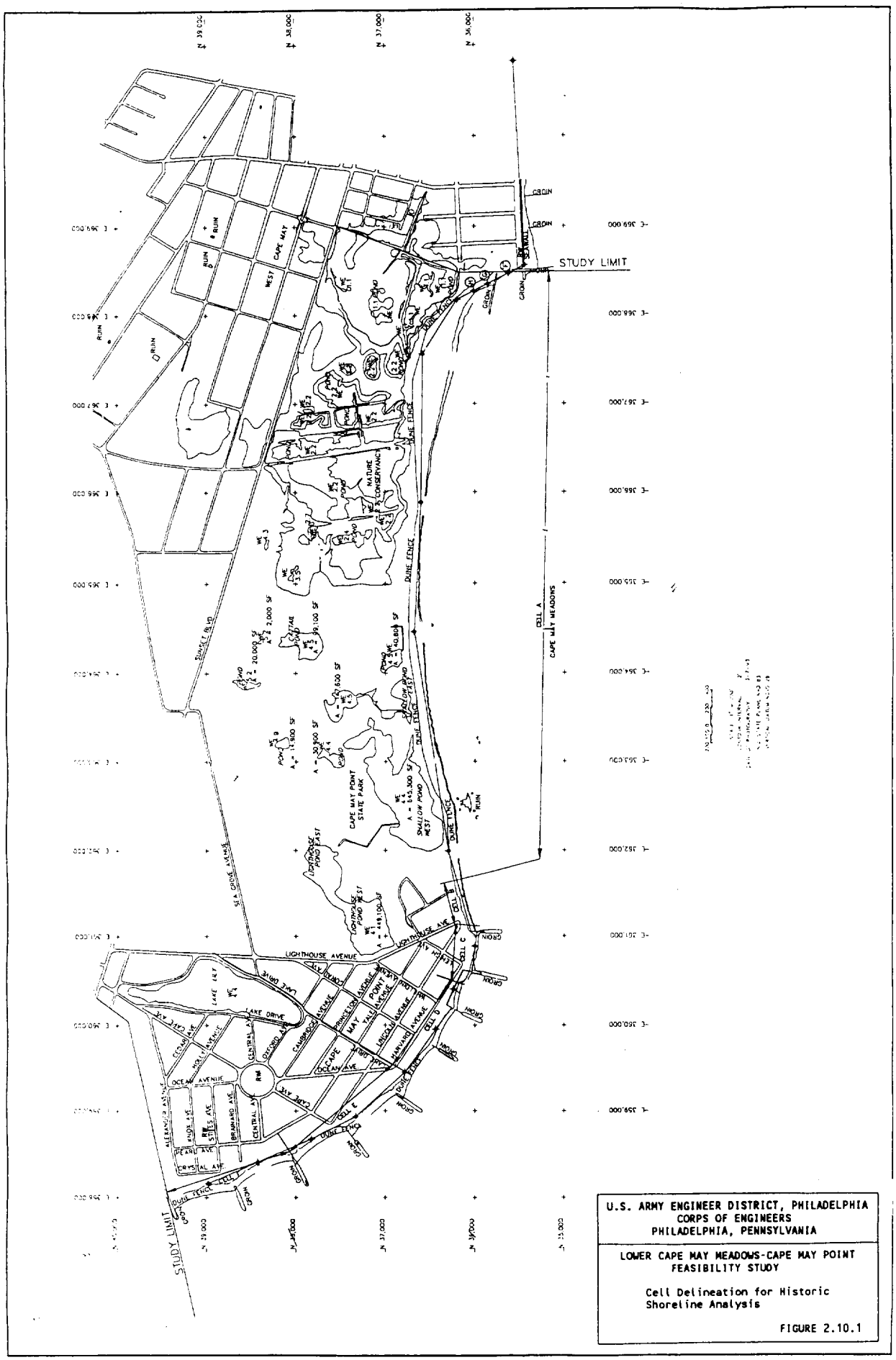
2.10.2 Cell Delineations

In order to adequately quantify and analyze the erosion potential for the study area, the spatial variability along the ocean shoreline must be considered. Consequently, the ocean shoreline of the study area was subdivided into a number of "cells" based on general similarity of shoreline alignment, beach width, historic shoreline behavior, location of significant shoreline structures (revetments, groins, bulkheads, etc.), and development category of land and structures landward of the shoreline. The ocean shoreline cells and their respective limits are presented in Table 2.10.1 and Figure 2.10.1.

Table 2.10.1
Cell Delineation for
Long Term Erosion

Cell ID	Length (Ft)	Limits
A*	7450	Third Ave groin in Cape May City to Lighthouse Ave groin in Cape May Point
C	470	First groin cell in Cape May Point (i.e. Lighthouse Ave groin to Lehigh Ave groin)
D	1660	Lehigh Ave groin to Lake Drive
E	1420	Lake Drive to Central Avenue
F	1490	Central Ave to Alexander Ave

*Determination of inundation profiles required cell A be subdivided into cell A and cell B.



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Cell Delineation for Historic
Shoreline Analysis

FIGURE 2.10.1

2.10.3 Data Sources

The historic shoreline analysis relied on four principal types of information: aerial photography, onshore/offshore beach profiles, digital shoreline change maps, and previous reports. In the period of 1953 through 1955 a groin was constructed at Third Avenue, the boundary between Cape May City and Lower Township. For the purposes of this analysis only the information for the period after 1955 was considered because it incorporates into the erosion assessment the combined effects of wave climate and the inevitable deficit of sand attributable to the jetties.

The aerial photography used for the study area was from two periods, 1949-1978 and 1953-1993. The period of 1949-1978 was compiled by the Coastal Engineering Research Center (CERC) in 1980. The period of 1953-1993 was compiled specifically for this study. Most of the aerial photography is vertical black-and-white at a contact scale of 1 inch equals 400 feet.

A total of six beach profile lines in Lower Township Cape May and Cape May Point have been monitored by the Corps of Engineers periodically since 1965. Because the lines established in 1965 could not be recovered new lines were set to better document existing conditions. In 1993 five (5) new monitoring lines where added to Cell A. The new lines were in close proximity to the 1965 lines and they gave a better indication of current conditions. In Cells C through F the beach profile lines used for the analysis were those established by the Coastal Research Center of Stockton State College. The profile lines typically extend from the landward side of the existing dune or revetment seaward out to a depth of 30 feet below mean low water.

Historic shorelines of the study area were digitally mapped as part of the New Jersey Historical Shoreline Map Series (Farrell and Leatherman, 1989). These maps include shorelines from 1879-85, 1899, 1932-36, 1955, 1971, 1977, and 1986. A digital shoreline from 1993 was subsequently added. These eight shorelines are plotted together on Figure 2.10.2. The shoreline maps provide a beneficial overview of shoreline conditions through time. However, it can be difficult to evaluate and differentiate natural shoreline evolution from the effects of development and coastal protection projects (such as beach fills and coastal structures). A list of known beach fill nourishment projects for the years 1940 to 1993 is provided in Table 2.10.2.

The reports and documents pertinent to the study area shoreline, which were reviewed for this analysis, included the following:

- Historical Shorelines of New Jersey, 1835-1986, NJDEP-Division of Coastal Resources.

- Cape May Inlet to Lower Township, Phase I - General Design Memorandum.

- Cape May Inlet to Lower Township, New Jersey, Shoreline Changes Drawing, Dated June 1972.

All of the above listed sources of information pertinent to the study area were compiled and reviewed in order to develop a qualitative, and where possible, a quantitative understanding of

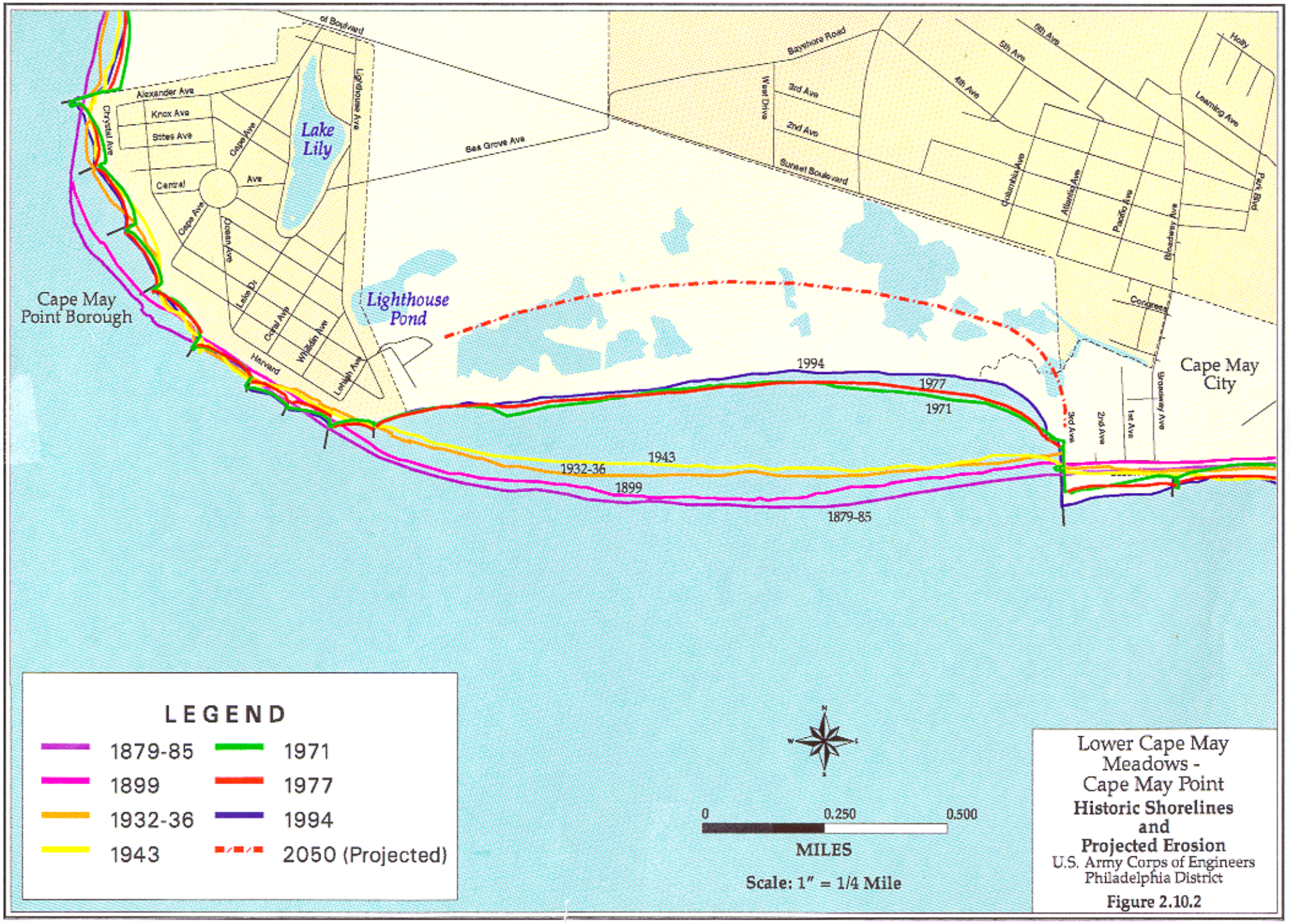

Cape May Point Borough
Cape May City
Lake Lily
Lighthouse Pond
Alexander Ave
Knox Ave
Stites Ave
Central
Cape Ave
Ocean Ave
Lake Dr
Harvard
Sea Grove Ave
Bayshore Road
West Drive
3rd Ave
2nd Ave
Sunset Boulevard
4th Ave
5th Ave
6th Ave
Columbia Ave
Atlantic Ave
Pacific Ave
Broadway Ave
Congress
Holly
Learning Ave
1st Ave
1994
1977
1971
1943
1932-36
1899
1879-85
LEGEND
1879-85
1899
1932-36
1943
1971
1977
1994
2050 (Projected)
0
0.250
0.500
MILES
Scale: 1" = 1/4 Mile
Lower Cape May Meadows - Cape May Point
Historic Shorelines and Projected Erosion
U.S. Army Corps of Engineers
Philadelphia District
Figure 2.10.2

Table 2.10.2
History of Beachfills

Location	Volume Placed (cu yd)	Date Completed	Responsible Agency
Cape May Point	156,700	1962	ACOE
Cape May Point State Park to Lighthouse Ave	15,000	9 Mar 1967	NJDEP
Cape May Point	2,500	1967	ACOE
Lighthouse Ave to Alexander Ave	253,900	12 May 1969	NJDEP
Cape May Point State Park	87,000	1986	NJDEP
Cape May Point	50,000	1991	NJDEP
Cape May Point State Park and Cape May Point	98,000	1992-3	NJDEP
Cape May Point (Lehigh Ave groin)	22,000	1993	NJDEP

historic behavior of the ocean shoreline. In order to adequately quantify and analyze the erosion hazard for the study area, the spatial variability along the ocean shoreline must be considered. Since the shoreline of Cape May Meadows is fairly short and the various methods of analysis did not show any one area being significantly different from the others, a single erosion rate was chosen to represent the behavior of the shoreline.

After reviewing all the information available for the study area the data selected for further analysis were the aerial photography from 1953-1993. This was chosen because the period coincides with the post-construction period of the Third Avenue groin. This best represents the current and likely future conditions of the shoreline in the study area. The 3rd Ave groin was constructed in response to the accelerated erosion caused by the Cape May Inlet jetties.

The long-term erosion rate for Cell A is approximately 15 feet per year. Cells C through F consist of a series of 8 groin compartments. Because of these groins, the shorelines in Cells C through F have shown variability over the last 40 years that range from 3 feet of erosion per year to 3 feet of accretion per year. Therefore it was concluded that Cells C through F do not have any significant long-term erosion.

2.11 Historical Bathymetry Analysis

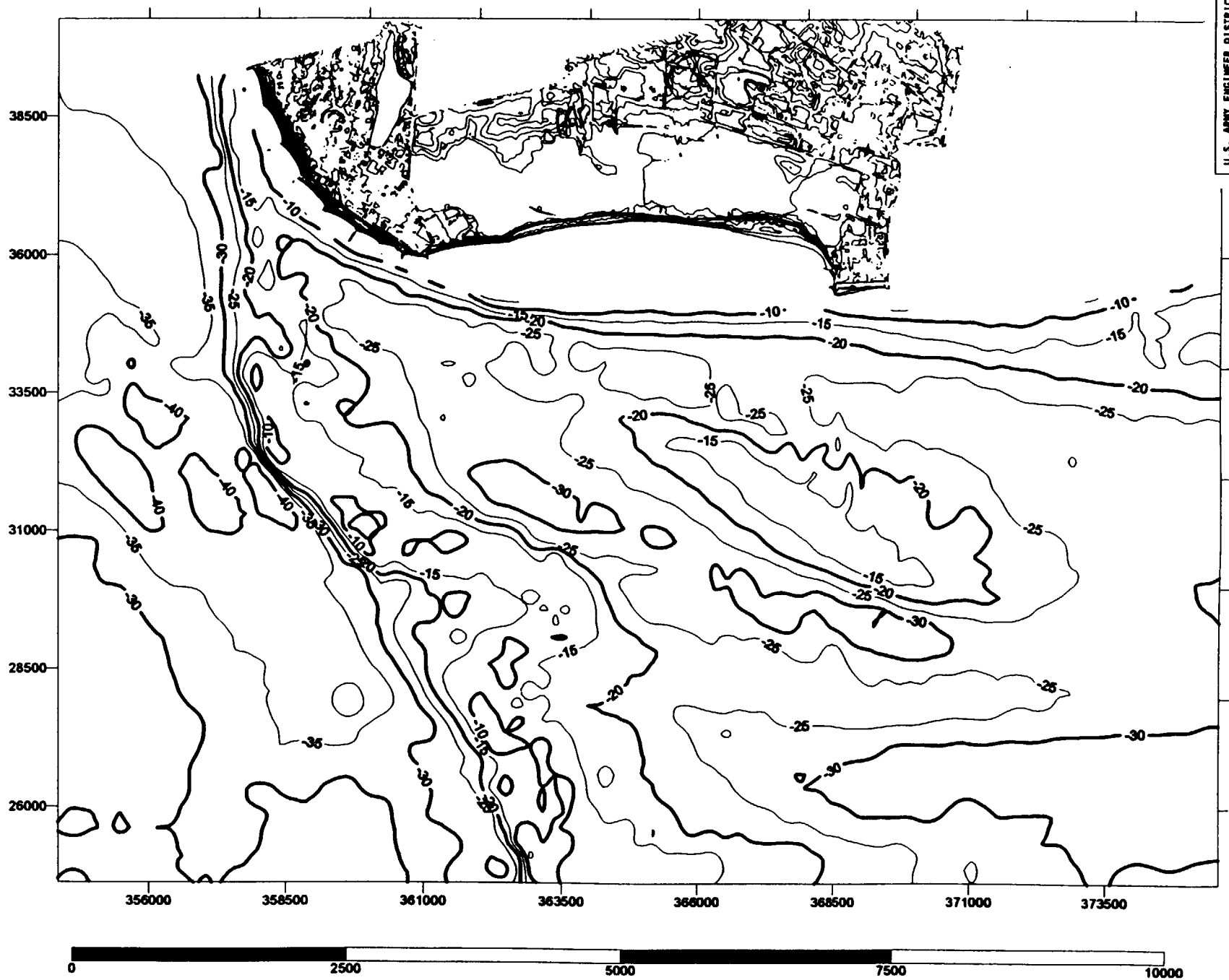
An analysis of historic offshore bathymetric data was conducted in addition to the analysis of shoreline change described in Section 2.10. The bathymetry analysis was considered necessary in view of the large recession which has occurred along The Meadows shoreline. This recession has created a situation in which the formerly low-elevation upland of Cape May Meadows has been progressively converted into nearshore open-ocean bottom as the shoreline retreated. Additionally, hydrographic surveys obtained by the Philadelphia District since 1993 in the vicinity of The Meadows and Point have revealed significant scour "holes" adjacent to the easternmost groins at Cape May Point.

The principal sources of data for this analysis consist of hydrographic surveys obtained by the National Ocean Service, and its predecessor, the US Coast and Geodetic Survey, in 1937 and 1972. The bathymetric data were available as digital files of soundings (depth below MLW) at specific points (latitude, longitude pairs) in the Atlantic Ocean and Delaware Bay offshore of the Cape May Meadows/Point study area. The data from each survey date were manipulated within AutoCAD to create a "tin" (triangulated irregular network), which is an imaginary surface mathematically fitted to the irregularly spaced points in each survey data file. Contour plots of depth for the 1937 and 1972 surveys are shown on Figures 2.11.1. and 2.11.2, respectively.

To evaluate the depth changes between the two survey dates, the 1937 and 1972 "tins" were superimposed within AutoCAD, and the difference in depth between the tins was calculated. The result of this comparison is a plot which displays areas of "cut" (equivalent to "scour") and "fill" (equivalent to "shoaling"). A plot of the 1937 to 1972 depth changes offshore of the study area is shown in Figure 2.11.3, with a 5-foot contour interval. The most significant feature revealed by the depth change plot is the shoaling which has occurred at location "A". This location corresponds to the bottom feature historically known as "Eph Shoal" which has migrated northwestward approximately 3,000 feet in the 35 year interval between the two surveys. In addition to this specific location, the figure also displays the spatial extent of "scour and shoal" changes in the zone which extends approximately 2 miles in the offshore direction along approximately 4 miles of shoreline.

Section 2.9 of this report previously documented the modeled and observed tidal current regime in the nearshore zone immediately offshore of the Cape May Meadows and Point study area. Both efforts clearly demonstrate that normal and storm condition "tidal" currents regularly exceed 1 meter per second, and that the predominant direction of sediment transport driven by these currents is westward, toward the entrance of Delaware Bay. These findings are entirely consistent with the historic bathymetric changes revealed by the comparison of the 1937 and 1972 NOS surveys. It is inferred that the "scour and shoaling" changes in the area offshore of Cape May Meadows and Point are largely, if not entirely, the product of the tidal circulation between the Atlantic Ocean and Delaware Bay, and not related to man-made changes at the shoreline of the study area.

Cape May Meadows and Point
Contour Map of 1937 Bathymetric Data



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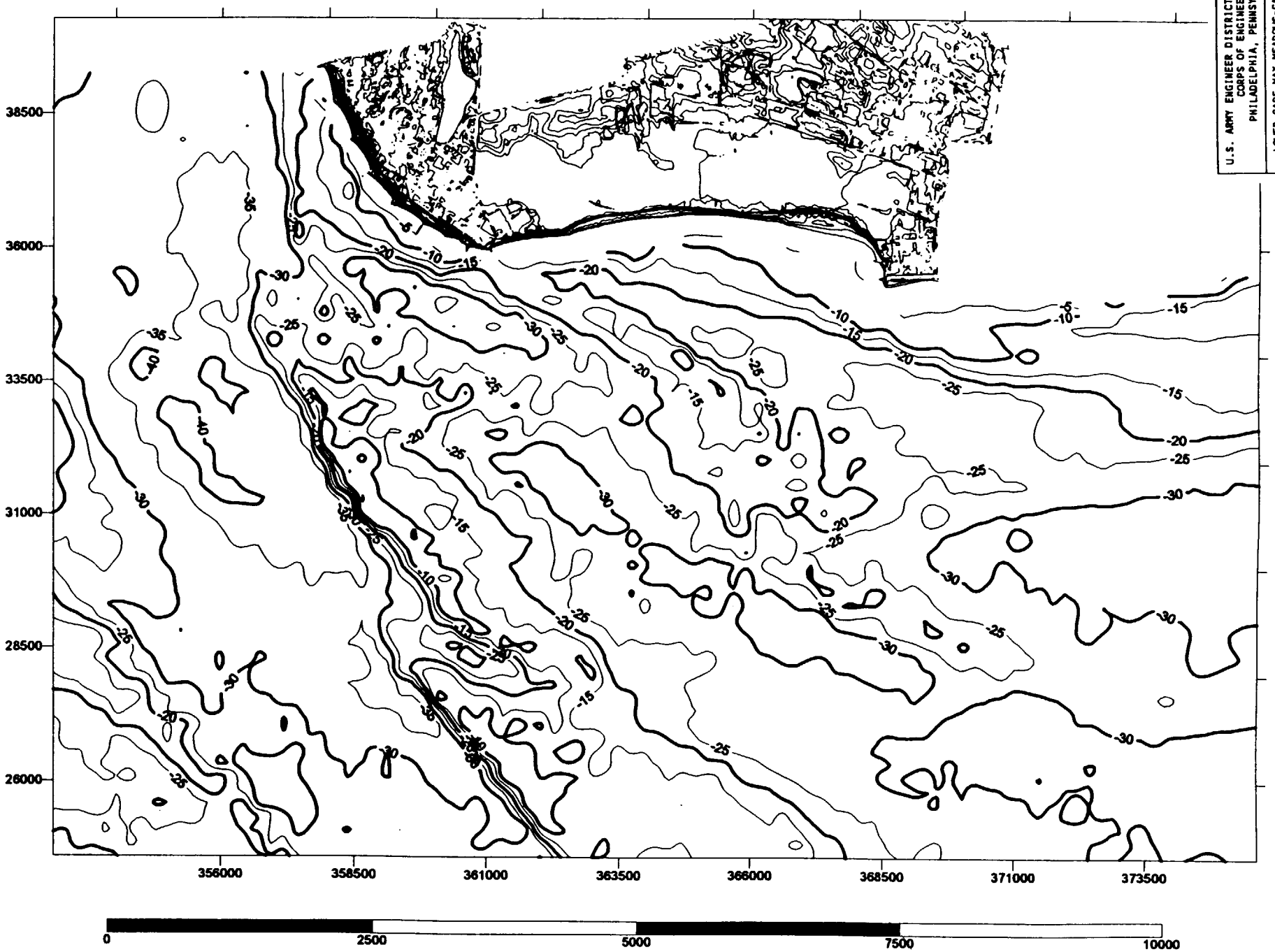
1937 Bathymetric Contours

FIGURE 2.11.1

Cape May Meadows and Point
Contour Map of 1972 Bathymetric Data



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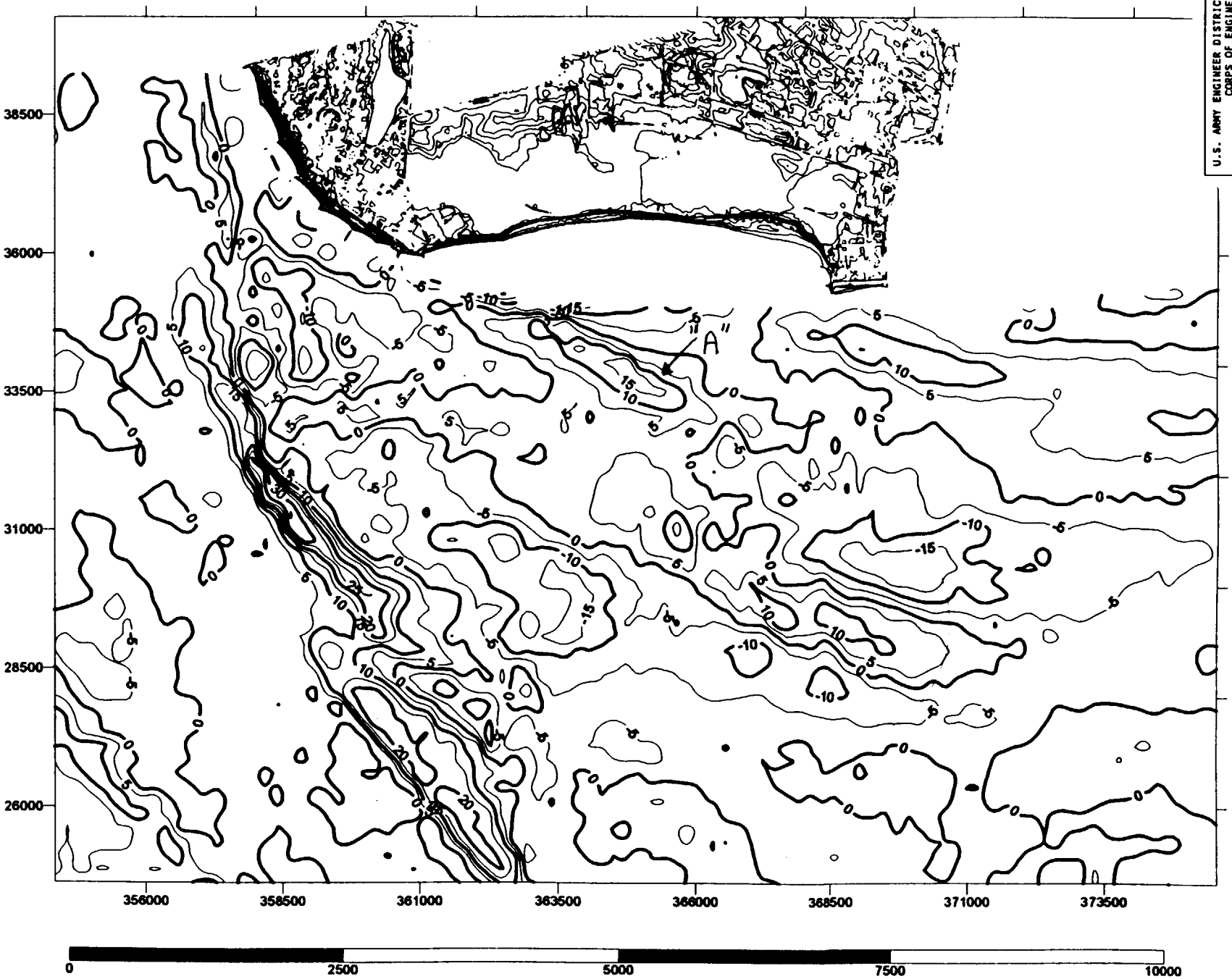
1972 Bathymetric Contours

FIGURE 2.11.2

Cape May Meadows and Point
Contour Map of Depth Changes Between 1937 and 1972



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1937 to 1972 Depth Changes

FIGURE 2.11.3

As a result of the initial findings from the comparison of 1937 and 1972 surveys, a more detailed set of hydrographic surveys was obtained on several dates in 1995 and 1996 in the zone extending approximately one-half mile from the study area shoreline. These surveys revealed that localized scour at the eastern end of the Cape May Point groin field has attained depths in excess of 60 feet at the easternmost groin (groin # 1), and approaching 50 feet at the adjacent groin # 2. The depth of scour at these locations, coupled with the hindcast and observed current velocities documented in the sediment transport analysis, suggests that at least the eastern end of the Cape May Point groin field is at risk in terms of structural integrity and ability to maintain the Cape May Point shoreline stability.

2.12 Fluvial Hydrology of Study Area

2.12.1 Precipitation

The viability of The Meadows ecosystem is ultimately dependent upon the amount and distribution of rain throughout the year. Accurate information of the area's precipitation is provided by a NOAA climatological and hourly precipitation station located at Cape May at coordinates 38-57N, 74-56W. The station has been in continuous operation since 1949. Data from this station was used to prepare the following summary tables.

Average annual rainfall is 40.7 inches per year, but the annual rainfall is highly variable ranging from a low of 29.2 inches in 1968 to a high of 54.9 inches in 1958. Annual rain totals for the period of record are provided in Table 2.12.1.

Table 2.12.1
Cape May Meadows
Annual Rainfall

Year	Total Annual Rainfall(in)	Year	Total Annual Rainfall(in)
1949	35.7	1971	44.2
1950	34.8	1972	52.7
1951	30.5*	1973	43.6
1952	40.7**	1974	33.7
1953	47.7	1975	46.2
1954	40.3	1976	37.5
1955	36.7	1977	37.2
1956	48.1	1978	41.6
1957	34.1	1979	52.5
1958	54.9	1980	36.2
1959	40.4	1981	35.0
1960	38.4	1982	37.3
1961	45.3	1983	47.5
1962	38.5	1984	43.8
1963	35.6	1985	44.3
1964	36.1	1986	32.1
1965	30.4	1987	33.0
1966	40.5	1988	37.3
1967	46.4	1989	52.0
1968	29.2	1990	40.9
1969	40.3	1991	40.2
1970	37.0	1992	38.7
		1993	41.3

* Data for December is missing.
** Data for January and February are missing.

The average monthly precipitation is fairly uniform over the year ranging from a low of 3.0 inches for February to high of 4.2 inches for August. A monthly rain summary is provided as Table 2.12.2.

Table 2.12.2
Cape May Meadows
Monthly Rain Summary
(1949-1993)

Month	Max (inches)	Min (inches)	Average (inches)
Jan	7.30	0.40	3.26
Feb	6.01	0.94	3.01
Mar	8.39	1.36	3.99
Apr	8.25	0.57	3.42
May	8.02	0.18	3.33
June	7.47	0.13	3.01
Jul	10.52	0.52	3.41
Aug	11.62	0.56	4.23
Sep	7.52	0.17	3.18
Oct	7.13	0.25	3.11
Nov	9.20	0.69	3.46
Dec	10.40	0.50	3.36

However, there is a great deal of variability in the monthly rain totals from year to year as indicated by the large difference between the monthly maximum and minimum totals. A distribution of monthly rain totals for the 45 year period of record is provided in Table 2.12.3. A further characterization of the period of record rainfall is provided by Table 2.12.4 which is a breakdown by month of the daily rain totals.

For any particular rain event it is impossible to predict with any certainty the percent of rain which runs off directly, the percent intercepted by vegetation and the percent reaching the groundwater table. However, the USGS as part of the study entitled "Ground-Water Hydrology and Simulation of Saltwater Encroachment, Shallow Aquifer System of Southern Cape May County, New Jersey" Water-Resources Investigations Report 91-4191 has estimated that on an annual basis 55% of the rain is accounted for as evapotranspiration, leaving 45% of the rain as direct runoff or groundwater recharge. Of this rainfall it is difficult to predict the percentage which runs off directly into The Meadows and that portion which reaches The Meadows as ground water. However, considering the low relief of the basin and the absorptive capacity of the soils (The majority of the soils throughout the basin are classified as SCS hydrologic soil group B - defined as soils having moderate infiltration rates when thoroughly wetted.) it is likely that for the majority of rain events a large percentage will reach The Meadows as ground-water.

Table 2.12.3
Monthly Rain Totals
For Period 1949-1993

Monthly Rain Total(in)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Missing Years	3	2	0	1	0	0	0	1	1	2	3	2
0.0-0.5	1	0	0	0	3	3	0	0	2	1	0	0
0.5-1.0	1	1	0	2	1	2	6	2	3	3	2	3
1.0-1.5	3	4	2	3	1	4	3	3	4	2	5	4
1.5-2.0	1	5	4	4	6	5	4	2	0	6	5	3
2.0-2.5	3	2	5	1	4	6	5	7	9	5	4	3
2.5-3.0	11	9	3	9	5	7	3	5	5	8	2	8
3.0-3.5	9	9	3	7	5	4	5	3	2	6	7	3
3.5-4.0	4	6	8	5	5	1	5	2	2	1	1	7
4.0-4.5	2	4	6	3	5	4	3	3	5	4	3	4
4.5-5.0	1	0	2	3	2	3	0	4	5	2	4	1
5.0-5.5	2	0	3	2	3	2	4	4	2	0	3	1
5.5-6.0	1	2	3	1	2	1	1	1	1	2	3	1
6.0-6.5	1	1	1	2	0	0	2	2	2	2	2	2
6.5-7.0	1	0	1	1	1	1	1	1	1	0	0	1

Table 2.12.3
(continued)

Monthly Rain Total(in)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
7.0-7.5	1	0	3	0	1	2	1	1	0	1	0	1
7.5-8.0	0	0	0	0	0	0	0	1	1	0	0	0
8.0-8.5	0	0	1	1	1	0	0	0	0	0	0	0
8.5-9.0	0	0	0	0	0	0	1	0	0	0	0	0
9.0-9.5	0	0	0	0	0	0	0	0	0	0	1	0
9.5-10.0	0	0	0	0	0	0	0	0	0	0	0	0
10.0-10.5	0	0	0	0	0	0	0	1	0	0	0	1
10.5-11.0	0	0	0	0	0	0	1	0	0	0	0	0
11.0-11.5	0	0	0	0	0	0	0	1	0	0	0	0
11.5-12.0	0	0	0	0	0	0	0	1	0	0	0	0

Table 2.12.4
Cape May Meadows
24 Hour Rainfall Distribution For Period 1949-1993

Daily Rain (inches)	Number of Days											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
0.0	995	888	1048	980	1069	1075	1104	1103	1126	1143	1041	1092
0.0-0.2	116	128	106	135	111	109	101	89	85	81	91	89
0.2-0.4	66	84	77	68	78	56	63	55	56	60	63	65
0.4-0.6	40	35	58	56	49	39	38	50	37	36	50	43
0.6-0.8	30	27	26	26	27	17	20	21	22	14	24	34
0.8-1.0	21	23	26	21	25	17	17	15	13	16	17	22
1.0-2.0	32	24	41	27	28	29	33	37	29	37	36	35
2.0-3.0	0	0	6	3	3	5	8	12	8	4	6	2
3.0-4.0	0	0	1	0	1	1	2	4	2	2	2	0
4.0-5.0	0	0	0	0	0	1	0	2	0	0	0	0
5.0-6.0	0	0	0	0	0	0	0	0	0	0	0	0
6.0-7.0	0	0	0	0	0	0	0	0	1	0	0	1
7.0-8.0	0	0	0	0	0	0	0	0	0	0	0	0
8.0-9.0	0	0	0	0	0	0	0	1	0	0	0	0

Table 2.12.4
(continued)

Total Rainfall (inches)	139.3	131.1	184.3	147.0	153.4	138.4	153.8	195.6	147.9	140.8	161.1	157.5
Total # of Days	1300	1202	1389	1316	1391	1349	1386	1389	1379	1393	1330	1383
Average Daily Rainfall (inches)	0.11	0.11	0.13	0.11	0.11	0.10	0.11	0.14	0.11	0.10	0.12	0.11

2.12.2 The Meadows

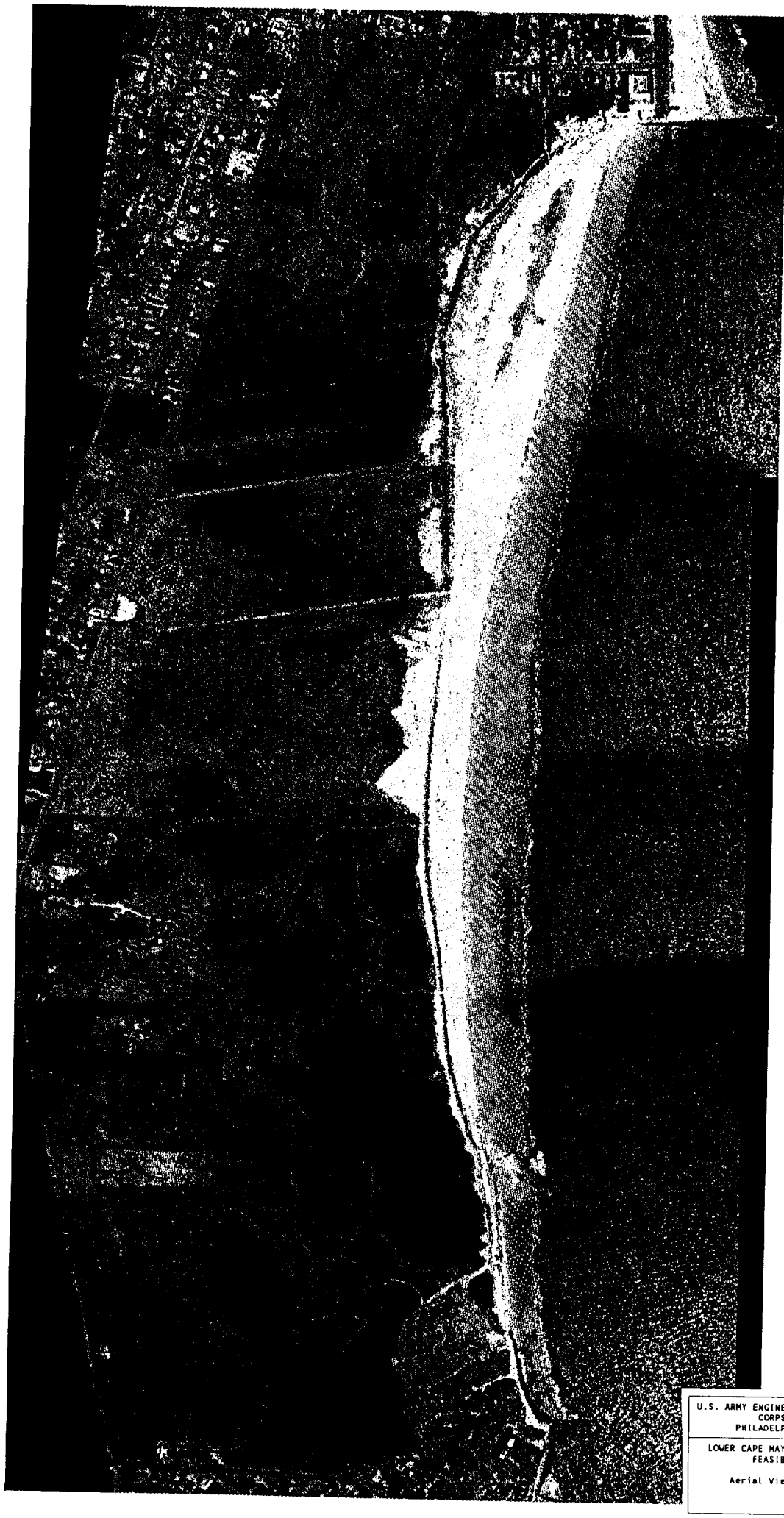
An aerial view of the study area is provided in Figure 2.12.1. Interior drainage patterns within The Meadows follow a general West to East direction proceeding from the State Park at an average ground elevation of 5 ft-NGVD towards the Nature Conservancy property with an average ground elevation of 1.5 ft-NGVD (elevations referenced to NAVD88 datum are obtained by subtracting 1.27 feet from the NGVD29 elevations). Flow velocities are extremely low due to the small hydraulic gradient and the low relief of the area. At the downstream end of the Conservancy's property the outflow from The Meadows enters Cape Island Creek as an open channel which quickly transitions into a 5 ft diameter concrete pipe at Broadway Avenue. The pipe extends for 2000 ft emptying into the tidally influenced channel of Cape Island Creek which continues for 8000 feet discharging into Cape May Harbor. A plan view of the site is provided as Figure 2.12.2. The topography of the site is provided on Figure 2.12.3. Also included on this figure is a subbasin delineation. Incremental and cumulative drainage areas are provided for various points throughout The Meadows. The 832 acre drainage area (year 2000) at the downstream limit of The Meadows, is divided between 499 acres of residential development and 333 acres (year 2000) of natural preserve.

2.12.2.1 Drainage Structures

There are three notable drainage structures relevant to an understanding of the drainage patterns of The Meadows: Broadway Street Culvert, Drainage East and Drainage West.

Broadway Street Culvert:

The Meadows ends as a small open channel approximately 10 ft wide, and 700 feet long which terminates as a 5 ft diameter concrete pipe at Broadway Avenue. This pipe extends approximately 2000 ft ending at West Perry Street (a continuation of Sunset Blvd). The outfall is fitted with a flap gate. This pipe was installed by the County of Cape May in 1987 and replaces a corrugated metal pipe which had deteriorated. The inverts of the pipe at the entrance and exit are 0.0 and -2.2 ft-NGVD respectively. The tidal range at West Perry St is -1.6 to +2.5 ft-NGVD. A pipe and flap gate has existed at this location since 1927, but in the years immediately prior to 1987 the tide was bypassing the flapgate, and salt water was reaching the lower reaches of the Nature Conservancy property. Since 1987, the flap gate has worked as designed and the Meadows is a freshwater ecosystem except for those occasions of dune overtopping. Interviews with locals indicate that the maximum rain induced rise of water surface in the lower reaches of The Meadows is 1 ft. With a normal water surface elevation of 1.0 ft-NGVD in the lower portion of The Meadows this is consistent with the recent survey of the fluvial high water mark of 1.8 ft-NGVD. Residents have complained of odor problems during hot summer months on occasions of limited rainfall. The problem arises because the ground is not properly graded



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Aerial View of Cape May Meadows

FIGURE 2.12.1

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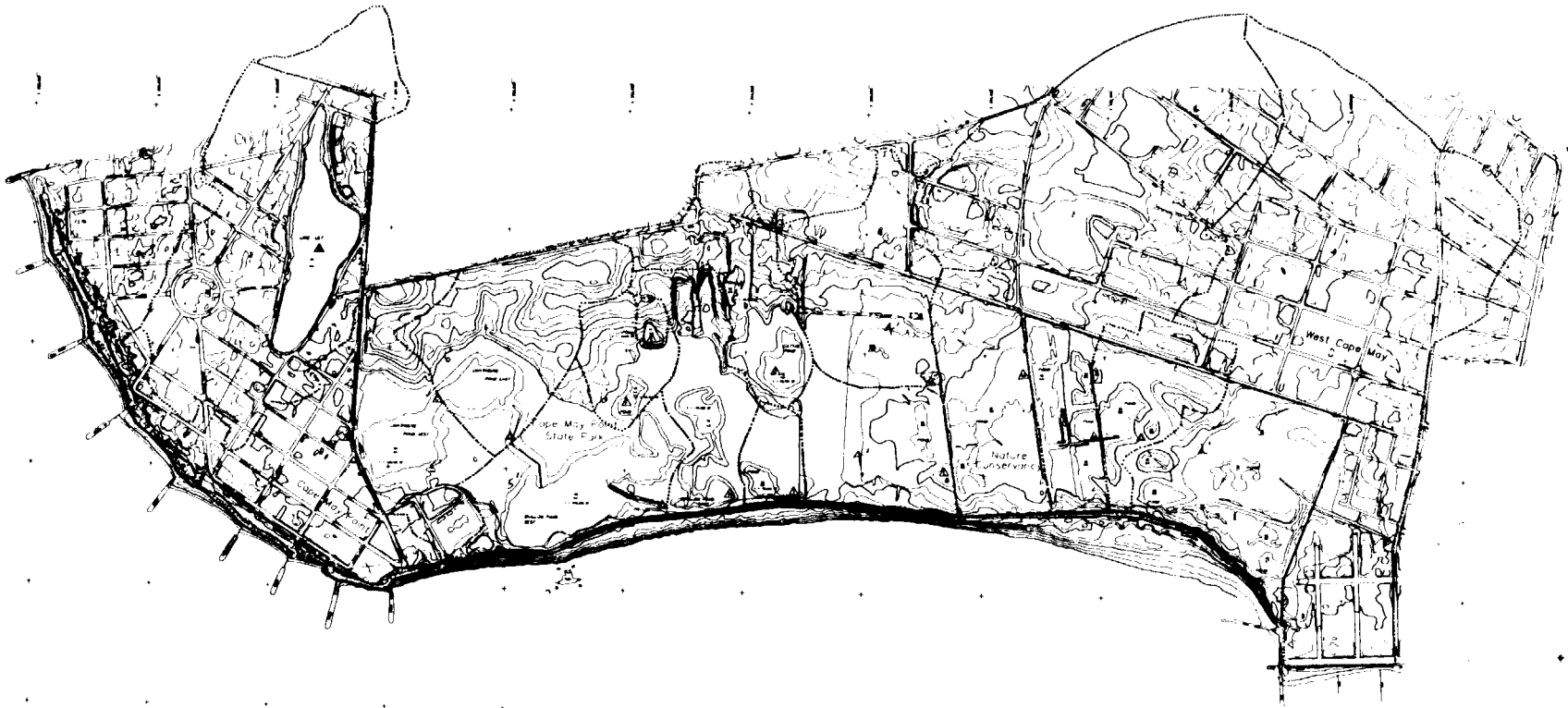
Plan View - Cape May Point to Cape May Harbor

FIGURE 2.12.2



DRAINAGE POINT	INCREMENTAL DRAINAGE AREA (ACRES)	TOTAL DRAINAGE AREA (ACRES)
A	113.1	113.1
B	53.7	185.8
C	38.4	202.2
D	44.1	246.3
E	3.2	
F	14.1	
G	46.2	302.8
H	27.1	329.9
I	8.2	338.1
J	32.2	
K	41.4	
L	28.8	442.3
M	35.0	
N	144.2	621.5
O	24.6	646.1
P	208.1	851.2

DRAINAGE SUBBASIN

200 100 0 200 400

SCALE 1" = 200'
CONTOUR INTERVAL 2'
DATE OF PHOTOGRAPHY 1/7/93
N.J. STATE PLANE NAD 83
VERTICAL DATUM NGVD 29

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FEASIBILITY STUDY

Site Topography and Subbasin Delineation

FIGURE 2.12.3

resulting in pockets of ponded water which stagnate. Some locals have suggested periodic lifting of the flap gate to allow a tidal flushing during extended periods of zero rainfall.

Drainage East:

During the March 1992 northeaster, the dune fronting The Meadows breached, resulting in the blockage of the main drainage ditch. This blockage interfered with the normal drainage from Cape May Point and resulted in the inundation of a portion of Lighthouse Ave for months. To rectify this problem Cape May Point installed an outfall structure from Shallow Pond West to the ocean in the vicinity of the abandoned military bunker. This structure consists of a 300 foot long 2 foot diameter ductile iron pipe through the dune, with a concrete inlet drop structure. The inlet is screened, 3 feet long, 1.5 ft high with an invert of 3.5 ft-NGVD. There is a 1.0 ft drop to the pipe which then slopes uniformly to the exit at an elevation of 1.9 ft-NGVD. The outfall is fitted with a backflow preventer. Between a headwater of 3.5 to 5.0 ft-NGVD for a normal ocean range the capacity of this outfall is approximately 10 cfs. Historically, rain induced surcharges of Lighthouse Pond as reported by the locals have not exceeded 1 foot.

Lake Lily located in the middle of Cape May Point is a fresh water lake fed by groundwater and storm runoff from the surrounding 113 acres of residential development. Lake Lily drains to Lighthouse Pond West through a 1200 ft long 18 inch cast iron pipe. This pipe has a limited capacity of approximately 3 cfs for a normal range of headwaters and tailwaters. The borough is in the process of preparing plans and specifications for a drainage improvement called "Drainage West". This plan calls for the installation of a 15 cfs capacity pump at the Northern end of the lake with a connection to an existing but abandoned pipe under Sunset Blvd draining to the Delaware Bay. The plan calls for the activation of the pump whenever the elevation of Lake Lily exceeds 4.5 ft-NGVD. At elevations greater than 4.5 ft-NGVD, surrounding storm drains are filled with standing water and nuisance ponding occurs on some street intersections. The runoff pumped to the bay will be fresh water lost to The Meadows ecosystem. However, on an annual basis the loss is conservatively estimated to be 7 percent of the annual runoff. This estimate is based on the fact that the volume between the normal lake elevation of 3.5 ft-NGVD and the pump trigger elevation of 4.5 ft-NGVD is 15 acre-ft. This requires 1.6 inches of runoff from the surrounding 113 acres of drainage area. Yet examination of precipitation data in Table 2.12.4 indicates that over the period of record, a total of 133.7 inches of rain or 7% out of a period of record total of 1850.2 inches occurred after the 1.6 inch threshold was reached. The analysis was also performed for the growing season of May to September, and for the period of record only 10.6% of the rainfall exceeds the 1.6 inch threshold. The actual percentage of freshwater diverted is smaller because the analysis was based on rainfall, not the direct runoff which fills Lake Lily. The analysis also does not consider the fact that when the level of Lake Lily is greater than 4.5 ft-NGVD only 83% of the volume above that elevation will be pumped with the remainder draining to Lighthouse Pond West. Based on this operating plan Drainage West will be used infrequently and will not seriously diminish the annual freshwater runoff volume from Cape May Point to The Meadows. However, there are indications that this plan will not be implemented by the base year due to funding limitations and hence Drainage West was excluded from the hydrologic analysis.

2.12.3 Hydrologic Modeling

A hydrologic model of The Meadows' watershed has been developed. The model was used to assess the advisability of and limits to water level adjustment of the ponds. Raising of the water levels during the hot summer months has environmental benefits by reducing the risk of the ponds drying out during an extended period of hot and dry weather. However higher initial pond elevations also increase the risk of flood damage from an intense rainfall event, in conjunction with the elevated pond water levels. The hydrologic model was used to assess the effect of the initial pond elevations on the risk of obtaining damaging water levels during a severe rain event.

The drainage area has been divided into 16 subbasins and The Meadows has been divided into 3 hydrologic segments as shown on Figure 2.12.3. Flow generally starts at Cape May Point and flows east through The Meadows to the Cape Island Creek culvert. However, there is substantial lateral inflow to The Meadows from the northern subbasins. The runoff response of each subbasin was quantified with the Soil Conservation Service (SCS) dimensionless unit hydrograph and loss rate function. The time of concentration is the sum of shallow and concentrated flow travel time only, since there are no defined open channels. Antecedent Moisture Condition III (AMC III) was selected since it produces the greatest volume of runoff and provides the most conservative assessment of flooding impacts due to changes in pond starting water levels. The percent imperviousness of each subbasin was accounted for and for those subbasins with large bodies of water the curve number was weighted to reflect zero losses from the open water portion.

For each precipitation event the runoff hydrographs of each subbasin were determined and routed through the storage of The Meadows. The Meadows was divided into 3 hydrologic segments based on common ground elevations and the historic water level response of individual ponds acting as a unit. The inflow hydrographs were modified by the storage effects of each segment. Outflow from one segment to the next downstream segment was allowed. The outflow relationship for each segment was specified as a rating curve. The outflow from Lake Lily into segment 1 is approximately 3 cfs for a range of headwaters and tailwaters. When Lake Lily exceeds elevation 6.0 ft-NGVD it spills and flow towards The Meadows. Segment 1 drains in two directions, directly to the ocean through drainage east and into hydrologic segment 2. Flow enters segment 2 as overland flow when the water level in segment 1 exceeds elevation 5.2 which is the ground elevation separating the two hydrologic segments. Segment 2 discharges into segment 3 when it's water level exceeds elevation 3.0 ft-NGVD, which is the elevation of the divide between the two segments. Segment 3 drains through the Broadway Ave culvert. The effect of daily tidal fluctuations of Cape Island Creek on the outfall of this culvert at West Perry Street is reflected in the rating.

For without project condition the 10 and 50 year rain events were analyzed. The 24 hour rain totals of 5.5 and 7.0 inches respectively were temporally distributed with an SCS type III distribution. The runoff volumes and peak flows for the hydrologic segments are provided in Table 2.12.5. Water level hydrographs for Lake Lily and the three hydrologic segments were calculated under the assumption that the starting elevations for hydrologic segments 1, 2 and 3 were 3.5, 2.5 and 1.0 ft-NGVD respectively. Peak interior water surface elevations for the 10

and 50 year events are provided in Table 2.12.6. Drainage West was not considered to be part of the base condition because of uncertainty of installation by the base year. In addition, its exclusion provides a conservative estimate of water levels in The Meadows and Lake Lily.

Table 2.12.5
Without Project Hydrologic Modeling Results

Hydrologic Segment	Rain Event	Runoff Vol(in)	Runoff Vol(ac-ft)	Peak Runoff (cfs)
Lake Lily	10 yr	3.1	28.8	209
	50 yr	4.4	41.2	284
HS1	10 yr	1.6	28.5	141
	50 yr	2.5	45.5	225
HS2	10 yr	1.5	37.0	130
	50 yr	2.4	60.8	227
HS3	10 yr	2.5	41.9	160
	50 yr	3.7	62.3	244

Runoff is based on Antecedent Moisture Condition III.
Lake Lily consists of subbasin: A
HS1 consists of subbasins: B,C,D,E,F,G,H,I
HS2 consists of subbasins: J,K,L,M,N,O
HS3 consists of subbasins: P
Results correspond to the predicted 2000 year shoreline.
Runoff is incremental not cumulative.

Table 2.12.6
Without Project
Interior Water Surface Elevations
for the 10 and 50 Year Rain Events

Segment	**Elevation (ft-NGVD)**	
	10 Year	50 Year
Lake Lily	5.5	6.2
Hydrologic Segment 1	4.9	5.4
Hydrologic Segment 2	3.3	3.4
Hydrologic Segment 3	2.6	3.2

Note: Results are based on a 24 hour storm under antecedent moisture condition III and initial pond elevations of:
Lake Lily and HS1 --- 3.5 ft-NGVD
HS2 --- 2.5 ft-NGVD
HS3 --- 1.0 ft-NGVD
Results correspond to the predicted year 2000 shoreline.

3. PROBLEM IDENTIFICATION

3.1 Problem Analysis

Problems associated with the study area have been identified during site visits, public and interagency coordination, review of historical photographs, offshore and beach surveys, and literature review. The principal problems identified can be categorized as follows:

a. Ecosystem degradation and habitat loss at The Meadows
b. Storm damage vulnerability to the towns of Cape May Point and West Cape May

These problems are attributed to beach erosion due to both long-term and storm-related shore processes along with the influence of man-made structures along the shoreline, namely the jetties at Cape May Inlet. Erosion has resulted in the direct loss of beach and wetland habitat and has left the existing, unique freshwater ecosystem in The Meadows substantially degraded by allowing oceanwater overtopping during storm events. Breaching of the dunes at The Meadows also causes flooding to Cape May Point, West Cape May. See Figure 3-1 for a visual summary of problems.

3.2 Problem Identification by Area

Lower Cape May Meadows. The Meadows has been severely impacted by long-term and storm-induced shoreline erosion. This can be observed in Photos 3-1 to 3-6. Erosion of the shoreline and dune system at The Meadows has led to degraded fish and wildlife habitat and has reduced the productivity of the ecosystem. Since 1936, erosion has removed more than 1100 feet of shoreline. Erosion to the dune system has left the existing freshwater ecosystem substantially degraded through saltwater intrusion and subsequent drainage pattern alteration. Since 1991, the dunes protecting the wetlands have been breached seven times, resulting in saltwater intrusion to the freshwater wetlands (Photos 3-7,3-8). Very few plant or animal species have the adaptive ability needed to survive such large fluctuations or range of salinities (freshwater to saltwater). The saltwater intrusion has also encouraged the subsequent proliferation of the nuisance plant species Phragmites australis, also know as common reed. These conditions have significantly reduced the ability of the wetlands to support the wildlife and endangered plant species which reside there.

The existing ecosystem continues to encounter serious impacts related to erosion and flooding. It is estimated that an additional 138 acres of habitat will be lost to erosion alone between the years 1997 and 2050 if it is to continue unabated while oceanwater inundation from storm events would impact the remaining acres. If allowed to continue, further erosion and habitat degradation will likely force the abandonment of both Cape May Point State Park and the Cape

May Migratory Bird Refuge.

The importance of the unique freshwater habitat at The Meadows, especially with regard to migrating birds, cannot be underestimated. Declines in the numbers of many Neotropical migratory bird species have been detected over the past several decades. This can be attributed to the continued loss and degradation of stopover habitat, nearly 40% having been lost over the last two decades along the Cape May peninsula. Since birds spend as much as half of the year or more en route between breeding grounds and wintering areas, the habitats they depend on during this period are critical links to their survival. Recent studies have found a significant link between the quality of habitat and survival during migration - the better the habitat, the longer the stay, the healthier the birds. If appropriate habitat is not available for a needed stopover, birds must either fly farther, even if a weakened condition makes it unlikely that they will survive, or remain in poor habitat and risk starving or becoming easy prey for a predator. Loss and degradation of stopover habitat not only can result in more birds dying while on migration, but it can also have serious repercussions in terms of nesting success.

In addition to its environmental significance, The Meadows serves as a buffer during storms between the ocean and the developed portions of the surrounding towns of Cape May Point and West Cape May. Erosion has created a narrow shoreline with little or no natural dunes at The Meadows. These dunes have required frequent repair due to breaches and washovers caused by coastal storms. When these breaches occur, oceanwater either flows into the surrounding towns (Photos 3-9, 3-10) or the impoundment of flood waters in The Meadows creates a backup of storm water in the neighboring communities causing extensive flood damage that otherwise would not occur if a protective beach and dune were in place.

Cape May Point & West Cape May. Breaching of the dunes fronting The Meadows causes ocean storm surges to combine with the existing ponds and eventually overtop Lighthouse Avenue and Sunset Boulevard, flooding portions of Cape May Point and West Cape May (Photos 3-9, 3-10).

In addition, Lake Lily, located in Cape May Point, serves as a stormwater detention basin for the town and is linked to The Meadows via an 18" underground pipeline. Cape May Point is surrounded by higher ground which allows storm water from Lake Lily to drain to Lighthouse Pond, which is located in the State Park portion of The Meadows. As stormwater overtops the dunes and floods The Meadows, water from Lake Lily is then unable to empty into The Meadows due to the insufficient hydraulic head difference.

Records of historical monetary storm damages to Cape May Point and West Cape May are poor except for the 1962 Northeaster. This storm caused damage to 689 structures in the study area at a cost of $4,864,000 (1996 dollars).

The years 1991-1992 brought three significant storms to the study area. These storms caused extensive damage to The Meadows, Cape May Point, and West Cape May through the

overtopping and subsequent breaching of the dunes fronting The Meadows. As in the past, the State of New Jersey and Borough of Cape May Point repaired the dunes to a limited extent while FEMA paid out approximately $500,000 in damage claims for public infrastructure damage. Further information regarding recent significant expenditures due to storm damage can be found in section 1.5 of this report (these figures do not necessarily represent the potential damage that could be prevented by a Federal shore protection project).

The Borough of Cape May Point has tried to alleviate the flooding situation by installing an intake structure and 24" ocean outfall pipe in The Meadows in 1994. This lowers the pond elevations in the State Park (mostly Lighthouse Pond) and Lake Lily (since they're connected) and provides increased stormwater storage capacity to lessen flooding magnitudes. However, this only provides relief during small storms. During a significant storm, when The Meadows' dunes are breached, the inflow of oceanwater is more than the additional storage capacity produced by the drain pipe. Also, during larger storms with associated storm surges, the ocean outfall of the drain pipe is underwater and is ineffective until the storm surge recedes. The Borough of Cape May Point is currently examining other methods of increasing the storage capacity of Lake Lily by being able to lower the elevation of the lake prior to oncoming large storm events.

Besides flooding due to the breaching of the dunes at The Meadows, the shoreline of Cape May Point is vulnerable to storm damage through wave attack, storm erosion, and inundation. During the early part of this century, the complex tidal/wave/current interaction of the Delaware Bay and the Atlantic Ocean led to persistent long-term shoreline erosion at Cape May Point. This unstable shoreline necessitated repeated local action in the form of construction and rehabilitation of numerous groins, beach nourishment, dune construction, and seawall fortification since the 1930's. These actions have made much of the shoreline relatively stable, fluctuating between periods of erosion and accretion. The extensive man-made dune system that has been developed over the years along the western portion of Cape May Point has been particularly effective is providing shore protection for that area. However, while these efforts have for the most part "held-the-line" in most shoreline sections with regard to erosion, that "line" is at a critical position. There is virtually no buffer to deal with forces due to storm events which can severely damage the area, and also contribute to the saltwater intrusion to The Meadows. An especially critical area is at the eastern portion of CMP from approximately the Lighthouse Ave groin to the Whildin Ave groin, where recent significant erosion has left the deteriorating stone revetment and residential structures highly vulnerable to storm damages (Photo 3-11).

3.3 Problem Linkage to Existing Federal Project

Problems at The Meadows can be linked to the Federal navigation project at Cape May Inlet. The Cape May Inlet (Cold Spring Inlet) Federal navigation project is located approximately 3.6 miles east of the study area. This Federal navigation project was completed in 1911. The two parallel jetties provide a stable and safe navigable inlet to Cape May Harbor, home to a

significant commercial fishing industry. The construction of these jetties have acted as a near total littoral barrier, resulting in substantial downdrift erosion affecting both Cape May City and Lower Cape May Meadows. The jetties have prevented new littoral material from entering the longshore transport system from updrift. With the predominant waves coming out of the east, the longshore transport system is a very efficient one in moving sand in a westerly direction. The sand still moves downdrift, but no new sand replaces it from updrift. The result is a deficit of sand. With time, the erosion problem moves downdrift and away from the littoral barrier (for more analysis on this subject, please refer to Section 7.6.1.1 of this report).

The problem-linkage relationship has been supported previously in the following USACOE documents:

- *Survey Report, Cold Spring Inlet (Cape May Harbor, New Jersey).* House Document No. 206, 83rd Congress, 1st Session (1953)

- *Shore of New Jersey - Barnegat Inlet to Cape May Canal, Beach Erosion Study.* House Document 208, 86th Congress, 1st session (1959)

- *New Jersey Coastal Inlets & Beaches - Hereford Inlet to Delaware Bay Entrance to Cape May Canal.* House Document 94-641, 94th Congress, 2nd session (1976)

- *Phase I GDM - Cape May Inlet to Lower Township, New Jersey* (Aug 1980)

- *CERC Report on Questions Referenced to Phase I GDM " Cape May Inlet to Lower Township, New Jersey."* CERC Report (Feb 1981)

In response to the erosion caused by the jetties, the City of Cape May and the State of New Jersey constructed seawalls and groins to stabilize their shoreline. The majority of the approximately 12,000 ft of seawall and bulkhead was built in the early 1960's. Groins were constructed, rebuilt, and rehabilitated since 1926. The majority of the present groins were built in 1946. The effect of these groins has been to decrease the erosion rate in Cape May City and have also undoubtedly affected littoral flow to The Meadows. However, it is important to note that the shoreline erosion rate at The Meadows did not change significantly in response to the 1952 construction of the 3rd Avenue terminal groin in Cape May City. Analysis by Dr. Everts of the Corps of Engineers Coastal Engineering Research Center (CERC) during the early 1980's determined that without the construction of the groins in Cape May City, the shoreline would have rapidly trended toward a large crenulate-shaped bay with the west Cape May Inlet jetty acting as an updrift "headland" and the Cape May Point groins as the downdrift control. Basically, without the groins at Cape May City, the shoreline would have looked similar to the present-day Meadows' shoreline.

Due to storm damage vulnerability and continued shoreline erosion, a Federal beachfill project was initiated at Cape May City in 1988. While a beachfill and groin construction project had originally been planned to extend through The Meadows (referred to then as Lower Township),

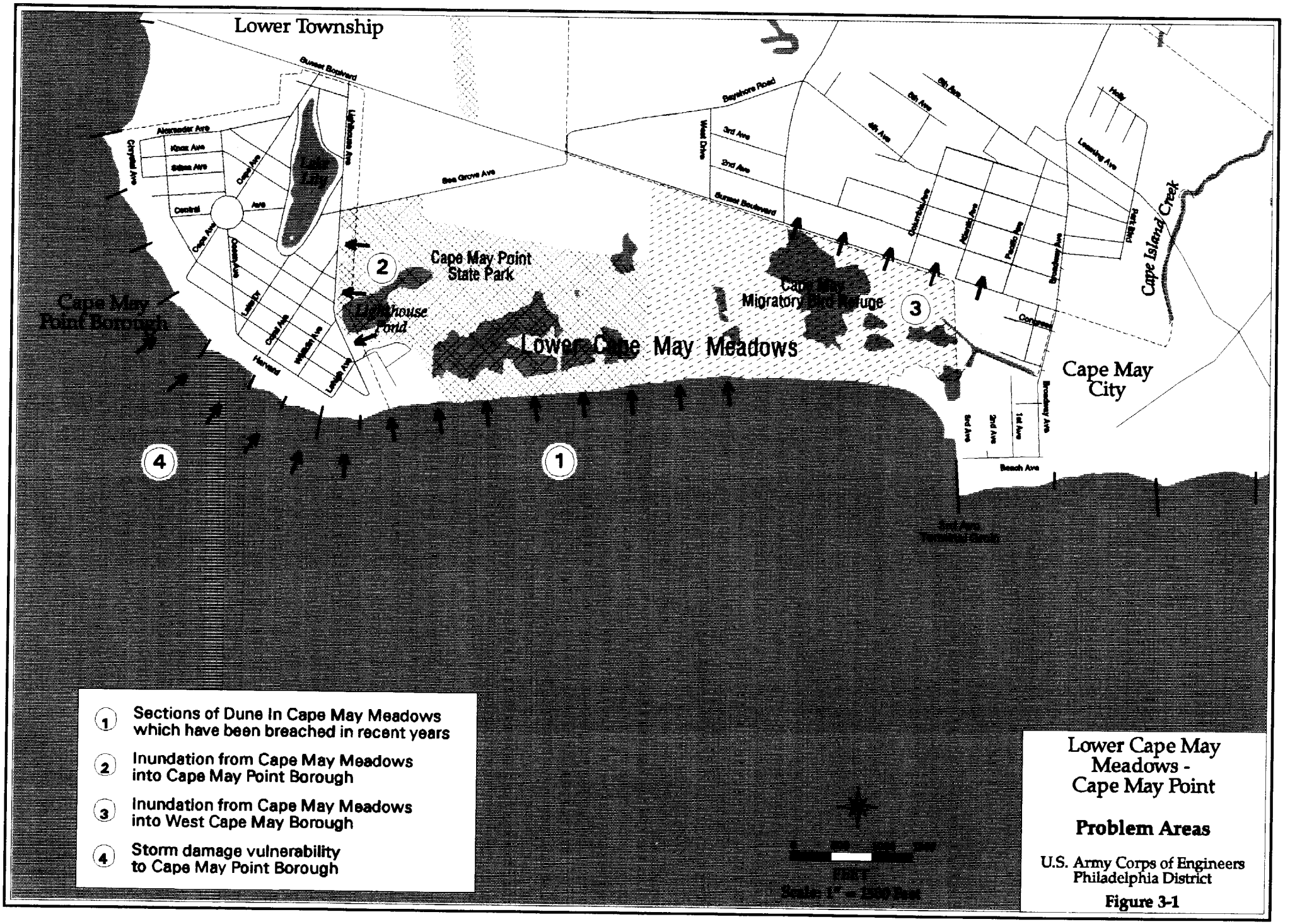
this potential project was eventually deemed "unjustified" due to the lack of NED (National Economic Development) benefits on this undeveloped section of shoreline. (Since current Corps policy gives priority status to the restoration and protection of fish and wildlife habitats, CENAP was able to reexamine this area and recommend solutions.)

3.4 Anticipated Future Conditions

Lower Cape May Meadows. Long-term and storm induced erosion will continue to affect this area. Following storms, the State of New Jersey historically repairs the dunes fronting The Meadows at whatever location the shoreline has receded to. This process is expected to continue until erosion has removed "most" (assumed half) of the existing land. Once this occurs, abandonment of The Meadows by the State of New Jersey is a likely scenario. In addition, saltwater intrusion will have further degraded any remaining habitat. It is estimated that more than half of The Meadows will be lost to erosion by the year 2050 with all of the remaining land inundated with saltwater even during minor storm events.

Cape May Point. The existing shoreline position is at a critical location. Historically, the local governments (state and borough) have performed small, stop-gap measures to "hold the line" at its present location. This is expected to continue indefinitely. In addition, while the borough actively examines ways to decrease inundation from The Meadows, these ideas are still in the concept phase. Therefore, current inundation levels at Cape May Point are expected to continue. The Borough of Cape May Point is developing a plan called "Drainage West" which may be in place by the base year. This plan calls for the installation of a 15 cfs capacity pump at the northern end of Lake Lily and connected to an abandoned pipe under Sunset Blvd. This pipe allows for drainage to the Delaware Bay. The pump would be activated whenever the elevation of Lake Lily exceeds 4.5 ft NGVD to lessen the amount of minor, nuisance flooding to Cape May Point. If constructed and operated in this manner, this project would be used infrequently and will not affect any potential Corps project.

West Cape May. There are no expected plans to reduce oceanwater inundation at this location.



Lower Cape May Meadows - Cape May Point

Problem Areas

U.S. Army Corps of Engineers
Philadelphia District

Figure 3-1

Photo 3-1 Cape May Point - 6/26/67, looking northeast. Note bunker position in background.

Photo 3-2 Cape May Point - 6/9/94, looking northeast. Note bunker position in background.

Photo 3-3 The Meadows - 8/30/95, looking northeast towards Cape May City. Note bunker location.

Photo 3-4 The Meadows and Cape May Point - 6/26/67. Note bunker location.

Photo 3-5 The Meadows and Cape May Point - 7/31/97. Note bunker location.

Photo 3-6 The Meadows - 7/31/97, looking southwest from Cape May City.

Photo 3-7 Breach of dune and overwash at The Meadows, March 1984.

Photo 3-8 Breaching of dunes at The Meadows, October 1991.

Photo 3-9 Flooding at Cape May Point, January 1992.

Photo 3-10 Flooding at Cape May Point, January 1992.

Photo 3-11 Cape May Point - 10/22/96

4. WITHOUT PROJECT CONDITIONS

Due in large part to the influence of the jetties at Cape May Inlet, the existing hydraulic conditions will cause further ecosystem degradation to The Meadows and economic damages to Cape May Point and West Cape May. The purpose of this section is to estimate the conditions if no project is implemented at the study area. The future hydraulic conditions will be analyzed as will potential environmental and economic impacts.

4.1 Without Project Hydraulic Analysis

4.1.1 Storm-induced Inundation and Erosion Analyses

Storm inundation and erosion analyses were conducted for the study area shorelines to determine the potential for damage caused by the waves and elevated water levels which accompany storms. Storm-induced erosion and coastal flooding are first evaluated for the without project condition, which is a projection of conditions existing in the base year of 2000. Similar analyses will then be conducted for the with project conditions.

4.1.2 Factors Influencing Storm Effects

A brief summary of the mechanisms which result in erosion and inundation from coastal storms is provided in this section. The major causes of damage and loss of life are storm surge, storm duration, and wave action.

Under storm conditions, there is typically a net increase in the ocean water level which is superimposed on the normal astronomic tide height fluctuations. The increase in water level caused by the storm is referred to as "storm surge." The effect of storm surge on the coast depends on the interaction between the normal astronomic tide and storm-produced water level rise. For example, if the time of normal high tide coincides with the maximum surge, the overall effect will be greater. If the surge occurs at low or falling tide, the impact will likely be lessened. The term "stage" as applied in this analysis pertains to the total water elevation, including both tide and storm surge components, relative to a reference datum, NGVD used herein. (Elevations referenced to the NAVD88 datum are obtained by subtracting 1.27 feet from the NGVD29 elevations.) The term "surge" is defined as the difference between the observed stage and the stage that is predicted to occur due to normal tidal forces, and is thus a good indicator of the magnitude of storm intensity. Slowly moving "northeasters" may continue to build a surge that lasts through several high tides. Such a condition occurred during the devastating March 1962 storm which lasted for five high tides.

In addition to storm surge, a rise in water level in the near shore can occur due to wave setup. Although short period surface waves are responsible for minimal transport in the direction of wave propagation in open water, they may cause significant transport near shore upon breaking. Water is propelled landward due to breaking waves rather rapidly, but water returned seaward under the influence of gravity is slower. This difference in transport rates in the onshore/offshore direction results in a pileup of water near shore referred to as wave setup. Wave setup was computed and included in this storm analysis.

There is typically also an increase in absolute wave height and wave steepness (the ratio of wave height to wave length). When these factors combine under storm conditions, the higher, steeper waves and elevated ocean stage cause a seaward transport of material from the beach profile. The net movement of material is from the foreshore seaward toward the surf zone. This offshore transport creates a wider, flatter nearshore zone over which the incident waves break and dissipate energy. The beach profile evolves in this manner toward an equilibrium configuration with the storm conditions.

4.1.3 Modeling Storm-induced Erosion

Analyses of storm-related erosion for coastal sites require either a long period of record over which the important storm parameters as well as the resultant storm erosion are quantified, or a model which is capable of realistically simulating erosion effects of a particular set of storm parameters acting on a given beach configuration. There are very few locations for which the necessary period of prototype information is available to perform an empirical analysis of storm-induced erosion. This is primarily due to the difficulty of directly measuring many important beach geometry and storm parameters before, during, and immediately after a storm. Thus, a systematic evaluation of erosion under a range of possible starting conditions requires that a numerical model approach be adopted for the study area.

The USACE has developed, adopted, and released the numerical storm-erosion model SBEACH (Storm Induced BEAch CHange) for use in field offices (Rosati, et al., 1993). SBEACH is available via a user interface available for the personal computer, or through the Coastal Modeling System (CMS) (Cialone et al., 1992). Comprehensive descriptions of development, testing, and application of the model are contained in Reports 1 and 2 of the SBEACH series (Larson and Kraus 1989; Larson, Kraus, and Byrnes 1990)

4.1.4 SBEACH Methodology

SBEACH is a geomorphic-based two-dimensional model which simulates beach profile change, including the formation and movement of major morphologic features such as longshore bars, troughs, and berms, under varying storm waves and water levels (Rosati, et al. 1993). SBEACH

has significant capabilities that make it useful for quantitative and qualitative investigation of short-term beach profile response to storms. Since SBEACH is based on cross-shore processes, caution should be used when using the model in the vicinity of inlets, structures, and areas with strong longshore gradient in transport processes.

Input parameters include varying water levels as produced by storm surge and tide, varying wave heights and periods, and median grain size in the fine-to-medium sand range. The initial beach profile can be input as either an idealized dune and berm configuration or surveyed total profile configuration. SBEACH Version 3.0 allows for variable cross-shore grid spacing, simulates water-level setup due to wind, provides an estimate of dune overwash and includes advanced procedures for calculating the wave breaking index and breaker decay. Also the wave model has been upgraded to provide a more realistic simulation of beach change under random waves.

Shoreward boundary conditions that may be specified include a vertical structure (that can fail due to either excessive scour or instability caused by wave action/water elevation) or a beach with a dune of arbitrary configuration. Output results from SBEACH include calculated profiles, cross-shore parameters, a log for each SBEACH run, and a report file.

4.1.4.1 Model Parameters

Various model parameters required to run SBEACH are included in the input configuration file. The configuration file is separated into five sections: A - Model Setup; B - Waves/Water Elevation/Wind; C - Beach; D - Beachfill; and E - Seawall/Revetment. Section A (Model Setup) deals with the initial and measured profiles, grid arrangement, output parameters, and calibration parameters. Section B facilitates entry of information about waves, water elevations, and winds. Section C allows entry of basic information related to beach profile data, and Section D allows for definition of a beachfill placed on the initial profile.

In Section E, the location and failure criteria for a seawall or revetment can be entered. Unlike other storm erosion models, SBEACH can account for the presence of a vertical structure such as a seawall or bulkhead. A stone revetment, approximately 650 linear feet, is located in Cell C. The revetment extends from the first groin in Cape May Point to approximately one third the way between the second and third groins. A gabion mattress revetment in Cell B was completed in the Spring of 1996 by the State of New Jersey. It has a length of 450 feet fronting the State Park buildings. The remaining cells in the study area are fronted with dunes.

4.1.4.2 Water Elevation

The water level is the most important or first-order forcing parameter controlling storm-induced beach profile change, normally exerting greater control over profile change during storms than

either waves or wind. Water level consists of contributions from the tide, storm surge, wave- and wind-induced setup, and wave runup; the latter three are computed within SBEACH. Input data in this case is tide and storm surge data. The combined time series of tide and surge is referred to as the "hydrograph of total water level." The shape of the hydrograph is characterized by its duration (time when erosive wave conditions and higher than normal water elevation occur) and by its peak elevation.

4.1.4.3 Wave Height, Period, and Angle

Elevated water level accompanying storms allows waves to attack portions of the profile that are out of equilibrium with wave action because the area of the beach is not normally inundated. Significant wave height and peak period are combined in an empirical equation within SBEACH to determine if the beach will erode or accrete for a time step. In beach erosion modeling, a storm is defined by the combination of these parameters (water level and waves) that produce offshore transport. The modified version of SBEACH used in this analysis allows for the input of random wave data, that is, waves with variable height, period, and direction or angle.

4.1.4.4 Frequency Storm Hydrographs

The OCTI hindcast and statistical analysis described in section 2.9 provided the frequency peak values of wave height and water level elevation. However, SBEACH requires a storm hydrograph of wave and water level. These hydrographs, (at a 1 hour time interval) were developed by adopting the November 1950 northeaster as a template and scaling the waves and elevations of that historic storm to match the water levels and significant wave heights of the 2, 5, 10, 20, 50, 100, 200 and 500 year values. For all events the wave hydrograph was shifted in time such that the peak significant wave height occurred at the same time as the peak water level. The frequency storms hydrographs are applicable to all cells.

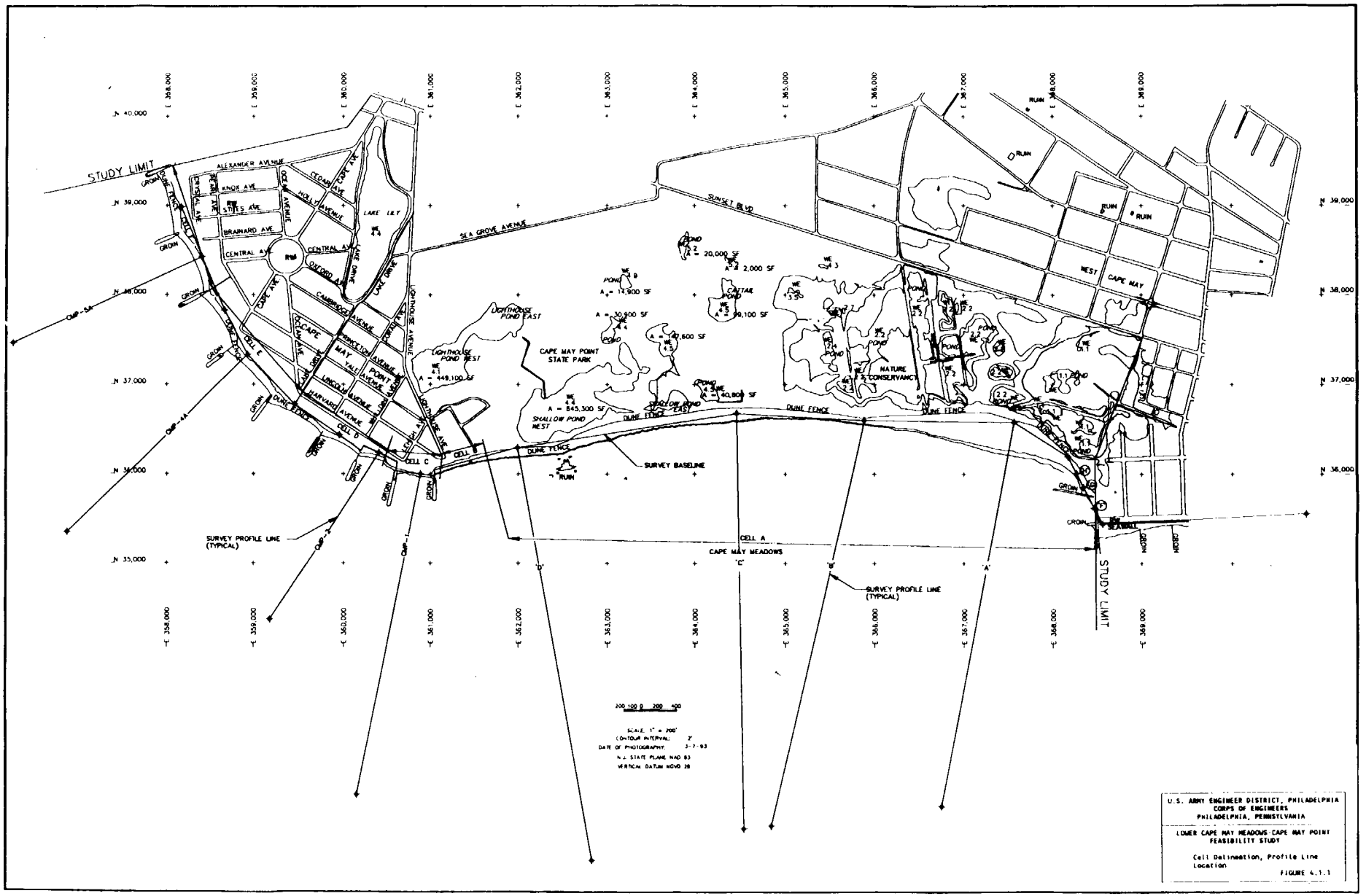
4.1.4.5 Profile Data

The study area was separated into 6 cells reflecting uniformity of beach/dune configuration, longterm erosion potential, expected storm induced shoreline response and back dune topography. For each delineated cell, one profile line was selected representing the "average" conditions for that cell. Each profile line is horizontally referenced to a baseline which runs parallel to the shore. For most cells the baseline is set at the dune crests. Storm erosion and inundation were both computed relative to the designated baseline and the results presented later are provided relative to that baseline. The hydraulic baseline is the same as the economic baseline. Figure 4.1.1 provides a plan view of the study area, cell delineation, baseline orientation and profile line locations. Based on the long-term erosion analysis described in

section 2.10, the developed input profiles represent the predicted beach in the base year and throughout the project life. The profile lines for the Cape May Point cells of C through F reflect critical condition, defined as the beach/dune configuration at which the locals will mobilize for remedial work. Even though cell A has a substantial long term erosion rate the shape of the profile line for cell A is not adjusted. Historically as the beach retreated and the dune overwashed, the State of NJ rebuilt the dune at its new landward location. The longterm continuation of this practice is expected. While the line itself will retreat landward it's shape is assumed unchanged since the depth of closure is considered to move landward. This assumption is supported by the past 40 years of shoreline retreat accompanied by substantial (over 20 feet) near shore deepening as documented in Section 2.11. Cell B is protected by a revetment completed in the Spring of 1996 by the State of New Jersey. The profile line for this cell is reflective of base year conditions in light of the State's commitment to stabilize this threatened section of the shoreline.

4.1.5 Storm Inundation Evaluation

The project area consisting of the towns of Cape May Point and West Cape May are subject to inundation from two separate mechanisms: 1) Static flooding due to damaging ocean induced water surface elevations in The Meadows and 2) dynamic attack, the result of wave runup overtopping the dunes and protective structures or superelevated ocean stages exceeding the dune crests causing them to breach. All of West Cape May and the majority of the structures in Cape May Point are subject to static flooding from The Meadows. In Cape May Point only those structures closest to the dune are exposed to dynamic flooding. Static Meadow's flooding occurs in two ways: 1) dunes fronting The Meadows are breached and the ocean elevation obtains in the interior or 2) wave runup volumes overtopping the dunes drain to The Meadows where it ponds to damaging elevations. (Cells A, B, C, D and E drain to The Meadows .) When the water elevation in The Meadows reaches elevation 5 ft-NGVD water flows across Lighthouse Ave and Sunset Boulevard, flooding Cape May Point and West Cape May respectively. This type of flooding has occurred several times since 1989. Based on High Water Marks in Cape May Point



U.S. ARMY ENGINEER DISTRICT, PHILADELPHIA
CORPS OF ENGINEERS
PHILADELPHIA, PENNSYLVANIA

LOWER CAPE MAY MEADOWS-CAPE MAY POINT
FEASIBILITY STUDY

Cell Delineation, Profile Line Location

FIGURE 4.1.1

the maximum interior water surface elevation reached during the October 1991 storm was 6.8 ft-NGVD and 7.5 ft-NGVD for both the January and December 1992 storms.

The SBEACH program was applied to assess the effect of frequency storms on the beach/dune configuration, as represented by the profile line for each of the 6 cells. The storms analyzed are the 2yr, 5yr, 10yr, 20yr, 50yr, 100yr, 200yr and 500yr events. Model output includes a post-storm profile plot, and several report and post-processing files. Simulation results from each particular combination of profile geometry and storm characteristics yield predicted profile transformation through time and nearshore water levels due to surge and wave setup. The output for each run was generated at 15 minute intervals consisting of end of period beach profile, total water level including wave setup near the dune crest and offshore water level wave height and peak period. These parameters served as input to a computer program which solves a regression equation predictive of the average overtopping flow rate for the period. The regression equation is based on work done by the Delft Hydraulics Laboratory (1983) which prepared a series of small and large scale laboratory tests directed at evaluating wave runup and overtopping on eroded beach/dune profiles during severe storms. For each frequency storm event the cumulative overtopping volume of each cell was obtained by integrating the unit discharge hydrograph of overtopping flows and then multiplying by the length of the cell. The storm volumes of each cell were then added to obtain the total overtopping volume draining to The Meadows. The volumes obtained in this manner were adjusted to match documented overtopping volumes. When a breach occurs the interior water surface elevation is set equal to the ocean frequency still water elevation. Without project performance is summarized in Table 4.1.1.

Table 4.1.1
Without Project Performance

Area	Storm Frequency							
	2 yr	5 yr	10 yr	20 yr	50 yr	100 yr	200 yr	500 yr
The Meadows	OT	OT	BR	BR	BR	BR	BR	BR
Cape May Point	---	OT	BR	BR	BR	BR	BR	BR

OT=dune is overtopped, BR=dune is breached

Consideration of overtopping and breaching performance of all cells which drain to The Meadows was the basis for determining the frequency static interior water levels by decade. When a breach occurs the interior water surface elevation was set equal to the peak ocean stillwater elevation. For the overtopping events the interior water surface elevations were determined by applying the overtopping volumes, assumed constant with time, to the elevation

capacity curves decreasing with time. The without project condition reflects the longterm erosion of The Meadows beachfront which reduces the storage capacity of the interior to contain overtopping volumes. The retreat of The Meadows beach has been analyzed in 10 year blocks. Starting at the year 2000 and ending at the year 2050, elevation-area and elevation-capacity tables were determined for each end of decade taking into account the effects of 15 ft/yr of long term erosion on the topography of The Meadows. The interior elevation-frequency relationship for The Meadows , which is applicable to all structures of West Cape May and to those structures of Cape May Point distant from the dunes is provided as Table 4.1.2

Table 4.1.2
Without Project
Frequency Water Surface Elevation
By Decade (ft-NGVD)

	Year					
Event	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**
2 yr	4.4	4.5	4.6	4.7	4.9	5.0
5 yr	5.8	5.9	6.1	6.2	6.3	6.5
10 yr	6.9	6.9	6.9	6.9	6.9	6.9
20 yr	7.4	7.4	7.4	7.4	7.4	7.4
50 yr	8.1	8.1	8.1	8.1	8.1	8.1
100 yr	9.1	9.1	9.1	9.1	9.1	9.1
200 yr	10.0	10.0	10.0	10.0	10.0	10.0
500 yr	11.3	11.3	11.3	11.3	11.3	11.3

The interior frequency water surface elevations correspond to acres of The Meadows inundated by salt water. However, the unit of account to quantify the environmental effects of salt water inundation is acres not inundated rather than acres inundated because of the effect of long term erosion. If one uses acres inundated one finds that the acres inundated decrease with time suggesting an improved condition. But of course there are fewer acres inundated because there are fewer acres, due to their loss from long term erosion. The acres not inundated for each end of decade were determined by first converting the frequency water surface elevations to acres of The Meadows inundated by salt water and then subtracting this value from the total acres of The Meadows remaining at that time. The frequency-acres of The Meadows not inundated by end of decade is provided as Table 4.1.3.

Table 4.1.3
Without Project
Frequency Acres not Inundated by Saltwater
By Decade (ft-NGVD)

	Year					
Event	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**
1 yr	333	310	287	264	241	218
2 yr	186	169	152	137	118	105
5 yr	84	75	65	62	60	58
10 yr	56	56	56	56	56	56
20 yr	48	48	48	48	48	48
50 yr	38	38	38	38	38	38
100 yr	29	29	29	29	29	29
200 yr	21	21	21	21	21	21
500 yr	9	9	9	9	9	9

4.1.6 Wave Attack

Coastal structures can be exposed to forces in addition to stillwater flooding which are attributed to the direct impact of waves and high velocity runup. This phenomenon will be considered the wave attack for the purpose of this analysis. Reducing wave attack with a proposed project such as a beach fill would reduce the severity of coastal storm damage and also improve the integrity of stone revetment which limits wave and erosion damage. The wave attack analysis applies only to those structures of Cape May Point nearest the dunes.

4.1.6.1 Criteria for Damage

To evaluate the added potential for structural damage, the boundaries of the wave attack must be delineated, and the critical damage wave height identified. Return periods of 2, 5, 10, 20, 50, 100, 200, and 500 years associated with the inundation-frequency curve were evaluated for each cell. The analysis estimates the location of a wave attack line and the associated zones of high energy stages. The wave attack line is the most landward position of the swash zone where the force due to waves and high velocity flow exceeds the force required to damage typical coastal structures. Any structure located landward of this line is subject to the equivalent of stillwater flooding because the dynamic forces are not sufficient to cause the accelerated damages incurred seaward of the wave attack line.

At Cape May Point for those structures falling within the first two blocks landward of the dunes, the water surface inundation profile is controlled by the dynamics of wave overtopping. For those events which do not breach the dunes, the inundation water surface elevations were determined by adding 1 ft or 2 ft of water to the ground elevations of the profile line landward of the dune crest based on whether the wave runup exceeded the dune crest by less than or more than 3 feet respectively. However, if either of these elevations were less than the static frequency water surface elevation for the event the static water level from the Meadow controlled. For those frequency events which breach the dune, the inundation profile reflects a depth of water, estimated to be 4 feet, which rushes landward as the dune collapses. This depth, augmented by the nonbreaking wave height that can be carried by this depth was added to the ground elevations landward of the dune. When greater, the static frequency water surface elevation of The Meadows was used.

The effects of stage plus setup, wave amplitude, wave runup at structures or crest location were incorporated into the total water level. The total water level information for each cell in the study area was compiled, and the values used as input to the economic model which ultimately computes damages associated with storm related inundation.

4.1.7 Storm Erosion Simulations

The SBEACH model was applied to predict storm-induced erosion for the study area. All representative storm events were run against the pre-storm profiles for each cell. Simulation results from each particular combination of profile geometry and storm characteristics yield predicted profile retreat. In this analysis, profile retreat for any given storm event was measured landward from the designated baseline to the location of 0.1 ft of vertical erosion.

Cells B and C reflect the fact that each cell is protected by a stone revetment. In order for storm erosion to affect the community landward of the revetments the structures must fail. SBEACH simulates failure through a number of mechanisms including storm induced scour at the toe of the structure, direct wave attack, or inundation. Failure criteria for the stone revetments were developed based on a synthesis of available data, including design and construction information, existing condition typical cross-sections, and field inspection of the structures. The appropriate failure criteria was input to the SBEACH configuration file. Model simulations typically resulted in the undermining of the toe of the revetment by scour at the 20 yr storm and greater for both Cell B and Cell C.

The limits of without project erosion, as measured from the baseline for all cells and for all frequency storms is provided as Table 4.1.4.

Table 4.1.4
Without Project
Frequency Water Surface Elevation
By Decade (ft-NGVD)

	Cell					
Event	**A**	**B**	**C**	**D**	**E**	**F**
2 yr	60	0	0	5	0	0
5 yr	70	0	0	15	0	10
10 yr	90	0	0	50	0	15
20 yr	135	15	45	55	5	45
50 yr	150	45	60	60	55	55
100 yr	155	80	120	65	70	65
200 yr	160	160	145	70	90	70
500 yr	165	180	165	75	95	80

NOTES:
1. Distances are measured positive landward from the baseline.
2. Cell B was analyzed as a stone revetment.
   Cell C was analyzed as a stone revetment.
3. The baseline is set along the top of the frontal dune except for Cell A and B which recovered the baseline used in the Reconnaissance Study. Since the completion of the Reconnaissance Study the dune has eroded landward.
4. Distance to first structure in the cell:

Cell	Distance from Baseline (ft)
A	No Structures in this cell
B	90
C	40
D	90
E	80
F	80

4.2 Without Project Environmental Analysis/HEP Analysis

4.2.1 Introduction

To quantify existing fish and wildlife habitat values, as well as the impact that erosion and saltwater intrusion have had on the wildlife population, a technique known as the Habitat Evaluation Procedure (HEP) was used. HEP was developed by the U.S. Fish and Wildlife Service (USFWS) in the early 1970's as an approach to a nonmonetary evaluation procedure for use in planning projects. The objective of HEP is to express fish and wildlife habitat conditions in quantitative terms so that changes may be measured and compared. This is accomplished with habitat units (HU's). Subtotals and totals of habitat units provide a basis for comparing different areas or a single area at different points in time. The USFWS describes HEP in the following way:

> *HEP is a procedure that is based on the assumptions that habitat for selected wildlife species can be described by a Habitat Suitability Index (HSI). This index value (from 0.0 to 1.0) is multiplied by the area of available habitat to obtain Habitat Units (HU's), which are used in the comparisons described above. The reliability of HEP and the significance of HU's are directly dependent on the availability of the user to assign a well defined and accurate HSI to the selected evaluation species. With HEP, the geographical area of interest is defined by members of an interagency team; maps of the area are prepared to depict the various land uses/cover types that are evident on aerial photographs; acreage of the land use/cover types are estimated by planimetry of the maps; the current value of each cover type for each of several species of vertebrate animals is assessed in the field by team members using word models of species/habitat relationships; and resulting numerical ratings are multiplied by appropriate acreage values to yield "habitat units" - indices of both the quantity and quality of habitat for terrestrial and aquatic wildlife.*

Future with-project conditions are likewise assessed from assumed future conditions and contrasted with the baseline. The resulting changes, either increases or reductions in habitat units, constitute wildlife impacts. This process can be used for this study to identify past, present, and future habitat values, as well as changes associated with a proposed project. For this study, a HEP report was prepared based on available models of species which frequent The Meadows.

4.2.2 Evaluation of Baseline (Existing) Habitats

A. Pre-field Assessment

The team that conducted the HEP Analysis for this project consisted of 2 members from the U.S. Army Corps of Engineers, 2 members from the U.S. Fish and Wildlife Service, 1 member from The Nature Conservancy, and 1 member from the New Jersey Department of Environmental Protection, Division of Parks and Forestry. The original field work and analysis was completed in 1994, during the reconnaissance study, but was updated in 1997 to reflect current site conditions. After the study area was defined, the study team identified land use/cover types, critical and unique habitats, evaluation species, species models, and sample sites.

The first step in the evaluation process was to define the study area. The HEP team delineated the study area and the scope of the terrestrial and aquatic habitat evaluation during the first site visit. The boundaries were delineated to include only the properties under the jurisdiction of The Nature Conservancy and the State Park, including all beach areas within this property. The U.S. Army Corps of Engineers obtained recent (March 1993 and March 1997) aerial photography on a scale of 1":100' and identified and labeled all cover types from these photos. The land use/cover type map was approved by the team members and used to pick locations of preliminary sample sites. This original map was later converted to a GIS format, and updated in 1997 to produce the cover type map found in this report (Figure 4.2-1). Once the map was converted to GIS, the area of each individual cover type was computed. From these calculations, it was determined that the current acreage of the study site is 343 acres.

Although the study area contains 6 different and unique land use/cover types, the changes that have taken place in recent years have resulted in the greatest percentage of the site being dominated by Phragmites australis. Over 27 percent of the study area is made up of this cover type which consists of very dense monotypic stands surrounding many of the ponds and drainage ditches. The next most dominant land use/cover type is mixed forest at 22 percent. The forested areas are primarily found on the State Park property, but a small quantity is found on The Nature Conservancy property. The remaining acreage is divided between the beach and dune (18 percent), open water (14 percent), emergent wetlands (12 percent), and field/scrub-shrub (7 percent). Representative photos of these habitats can be viewed in Photos 4.2-1 through 4.2-12.

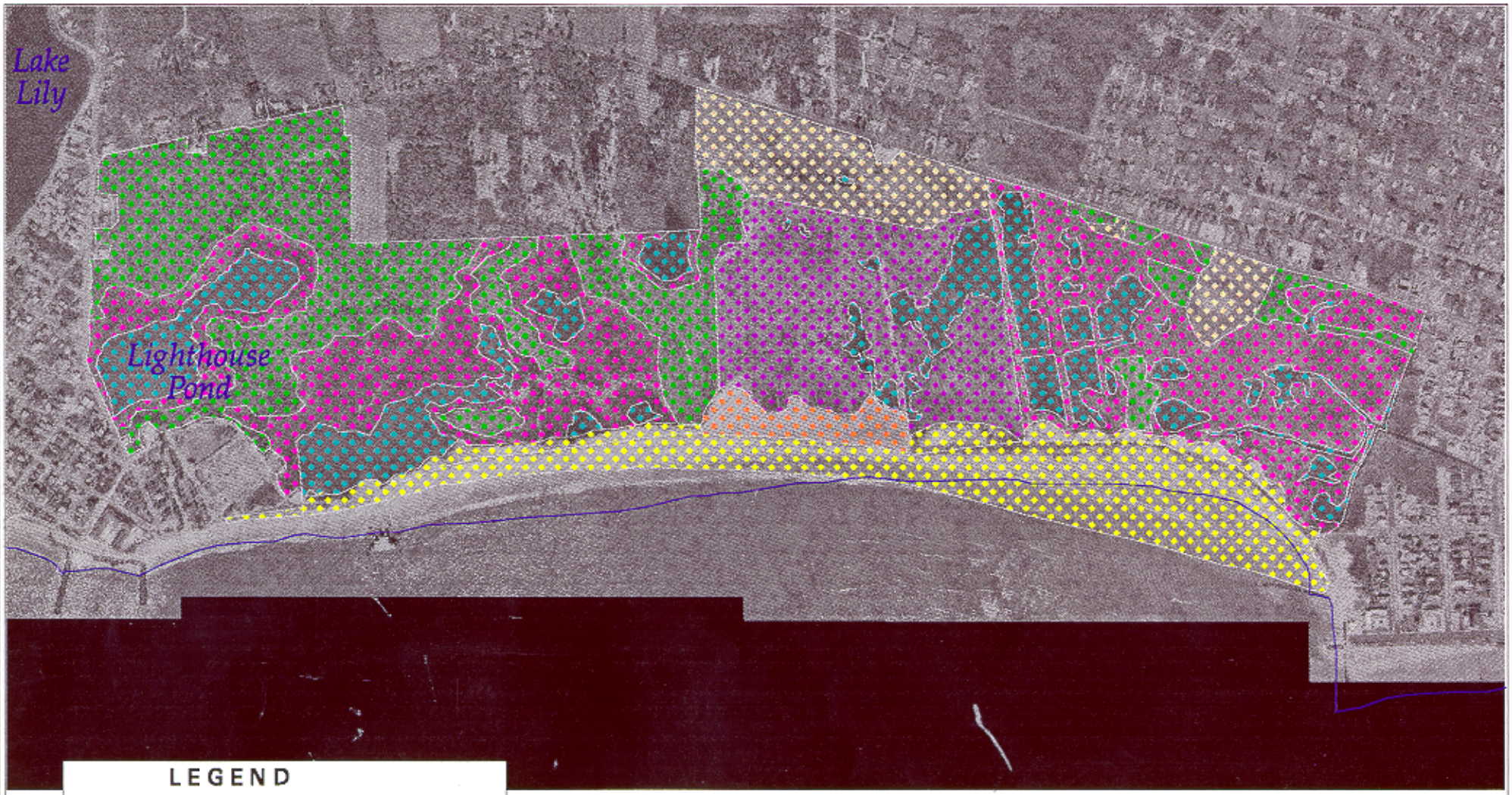
The study area provides habitat for several federally designated threatened and endangered species as well as a number of state designated species. Critical and unique habitats are "areas that have high value, are scarce and vulnerable, and that may be critical to the long-term survival and well-being of one or more species. Most wetlands are considered to have "critical and unique" status by this definition, although each must be considered individually on its own merits."(U.S. Fish and Wildlife Service, 1984). Three Federally protected bird species are known to occur within the study area. These are the peregrine falcon (Falco peregrinus), which is endangered, and the threatened piping plover (Charadrius melodus) and the bald eagle

(Haliaeetus leucocephalus).

Surveys conducted by the Cape May Bird Observatory have demonstrated a significant increase in sightings of both the bald eagle and peregrine falcon over the past several years. Over the past ten years, peregrine sightings have increased five-fold and bald eagle sightings have doubled. There are no known nesting sites for either species within the project area. The piping plover is a migratory shorebird that nests on sandy beaches along the Atlantic Coast of New Jersey between April and mid-August. During the 1993 breeding season, three pairs of piping plovers nested on the beach at The Nature Conservancy property. Despite protective measures taken, the chicks from one pair did not survive, but four chicks fledged from the other two nests (The Nature Conservancy, 1993). The 1994 breeding season produced six fledged chicks from four nesting pairs (Elizabeth Johnson, 1994). Since this time, the number of piping plover nests within The Meadows has increased and in 1996, 10 pairs of piping plovers were present while in 1997, 9 pairs of piping plovers nested on The Meadows' beaches (NJDEP, 1997).

In addition to these Federally protected species, numerous state threatened and endangered species are also known to occur within the project area. These state listed species include the endangered pied-billed grebe (Podilymbus podiceps), Cooper's hawk (Accipiter cooperii), northern harrier (Circus cyaneus), upland sandpiper (Bartramia longicauda), roseate tern (Sterna dougallii), least tern (Sterna albifrons), black skimmer (Rynchops nigra), short- eared owl (Asio flammous), short-billed marsh wren (Cistothorus platensis), and cliff swallow (Petrochelidon pyrrhonota). State threatened bird species include great blue heron (Ardea herodias), yellow-crowned night heron (Nyctanassa violacea), red-shouldered hawk (Buteo lineatus), osprey (Pandion haliaetus), merlin (Falco columbarius), barred owl (Strix varia), red-headed woodpecker (Melanerpas erythrcephalus), boblink (Dolichonyx oryzivorus), savannah sparrow (Passerculus sandwichensis), and grasshopper sparrow (Ammodramus savannarum). In addition to the piping plover nesting success, recently for the first time in several years, a minimum of 15 least tern chicks fledged from The Nature Conservancy property.

In addition to these bird species, the Cape May Point Natural Area Management Plan of 1986 lists several plant species as endangered or rare. The endangered plant species found in The Meadows in 1986 included the awl-leaved rush (Juncaceae coriaceus) and butterfly pea (Clitoria mariana). The rare species include swamp pine (Pinaceae serotina), long's rush (Juncaceae longii), narrow-leaved wild crab apple (Pyrus angustifolia), whorled marsh-pennywort (Hydrocotyle verticillata), and blue boneset (Mikania scandens). Currently however, only three of these species and one additional species can be found within The Meadows. These include the narrow-leaved wild crab apple, whorled marsh-pennywort, blue boneset, and dodder (Cuscuta indecora).



LEGEND

1994 Shoreline

- Beach (51.45 acres)
- Overwash (6.65 acres)
- Emergent Wetlands (42.27 acres)
- Field (24 acres)
- Forest (75.15 acres)
- Phragmites (92.73 acres)
- Water (48.86 acres)

0 900 1800

FEET

Scale: 1" = 900 Feet

Lower Cape May Meadows - Cape May Point

Land Use & Cover Type 1997

U.S. Army Corps of Engineers
Philadelphia District

Figure 4.2-1

Cover Type: Emergent Wetlands (1994)

Photo 4.2-1 The Nature Conservancy, from western path, looking northwest

Photo 4.2-2 The Nature Conservancy, from western path, looking east

Cover Type: Open Water (1994)

Photo 4.2-3 State Park, southwest corner of site, near dune, looking east

Photo 4.2-4 The Nature Conservancy, from east path, looking east

Cover Type: Old Field (1994)

Photo 4.2-5 The Nature Conservancy, looking west

Photo 4.2-6 The Nature Conservancy, looking east

Cover Type: Forest (1994)

Photo 4.2-7 State Park, northeast corner

Photo 4.2-8 State Park, eastern path, looking north

Cover Type: Beach (1994)

Photo 4.2-9 The Nature Conservancy, Endangered Bird Nesting Area , looking east

Photo 4.2-10 The Nature Conservancy (foreground) and the State Park (background), looking west

Cover Type: *Phragmites* (1994)

Photo 4.2-11 State Park, eastern boundary near dune

Photo 4.2-12 State Park, northeast corner, looking towards Nature Conservancy

In 1995 and 1996, a Rare, Threatened and Endangered Plant Survey was conducted in order to develop a current list of rare, threatened, and endangered plant species within The Meadows, and to pinpoint their exact location and general health. The results of this survey, which was conducted in October of 1995, and June of 1996 by Biohabitats, Inc., indicates that there are currently 4 species of protected plants within the meadows. These species are the narrow-leaved wild crab apple (imperiled), blue boneset (rare), whorled marsh-pennywort (imperiled), and dodder (Cuscuta indecora) (endangered). The blue boneset and whorled marsh-pennywort were the most common, being found in several locations within the State Park and Nature Conservancy properties. The populations of blue boneset were generally in good to excellent health and were primarily located in areas that had been cleared or mowed and received full to partial sunlight. The whorled marsh-pennywort was generally found in moist soil conditions in areas receiving full or partial sunlight. The dodder populations were limited to two previously unmapped areas within The Nature Conservancy property. The plants were found in moist soils near a pond edge. In addition, The Nature Conservancy lists Juncus coriaceus and Diodia virginia as being present within The Meadows.

Five of the six habitats within the study area were determined to be critical and unique. Much of this determination was based on the location of The Meadows and its significance to migrating raptors, songbirds, shorebirds, and wading birds. Since a large percentage of these species use The Meadows in their migration, loss of this habitat could have monumental effects on their overall populations. The beach habitat is critical as a nesting location for the federally threatened piping plover and the state endangered least tern. The emergent wetlands provide critical feeding area for numerous wading bird species. They also represent one of the few examples of a freshwater wetland system along the migration route. The forest and field/scrub-shrub habitats are an essential source of food and shelter to the migrating raptors which annually use The Meadows on their long migration route. The only habitat within the study area not deemed critical or unique was the Phragmites australis. This habitat is known to be very invasive and while it does offer cover for some wildlife species, it has little food value, and is not a desired habitat in this system.

Evaluation species form the basis of HEP analysis. They are used to quantify habitat suitability and determine changes as a result of project implementation. Although a HEP assessment is directly applicable only to the evaluation species selected, species selection is intended to indirectly represent other species. Thus, it is important to select species that represent not only themselves, but a significant fraction of the total species population. For example, both the mallard and the black duck have similar habitat requirements, yet only one need be selected to represent the habitat needs of both. Species also share other features besides habitat. The American kestrel and the Cooper's hawk are both carnivores that feed on the ground and in the tree layer. Likewise, the bullfrog, spring peeper and wood frog all breed in the water. Therefore, different species often have common features, such as habitat, feeding behavior and preferred sites for breeding. Knowledge of these features enables one to select a single species that represents the needs of several. This selection process is known as guilding and is critically

important in assessing existing habitat values and project effects (U.S. Fish and Wildlife Service, 1984).

Species selection for the HEP was accomplished during initial team meetings on site. Evaluation species were selected based on the concepts discussed above and the current availability of species models. Species lists from each property were evaluated to find species common to both the State Park and The Nature Conservancy. These species were compared in terms of feeding, breeding, and migration requirements. Since many species only migrate through the area and do not breed here, those life requirements were not examined for this study. Twelve species were selected for evaluation, including one amphibian, ten birds, and one mammal. Specifically, these species include the spring peeper (Pseudacris crucifer), black duck (Anas rubripes), sharp-shinned hawk (Accipiter striatus), wood thrush (Hylocichla mustelina), marsh wren (Cistothorus palustris), sanderling (Calidris alba), least tern (Sterna antillarum), American kestrel (Falco sparverius), field sparrow (Spizella pusilla), green heron (Butorides virescens), clapper rail (Rallus longirostris), and muskrat (Ondatra zibethicus). Two species were selected for each of the six land use/cover types within the project area. A listing of land use/cover types studied, along with their evaluation species is found in Table 4.2-1.

Once the evaluation species are selected, it then becomes necessary to develop detailed species models which are used to evaluate habitat. Fortunately, the USFWS has been developing models for several years and many are available for use. Existing models were available for a majority of the selected evaluation species. In order to properly define the study area however, it was necessary to modify the models for the sharp-shinned hawk, least tern, and clapper rail. In addition, it was necessary to create models for the spring peeper and sanderling. A model was created for the spring peeper because it was necessary to have at least one species model that showed a sensitivity to salinity impacts, and no models like this currently exist. Since it is extremely difficult to quantify saltwater impacts, it was assumed that any saltwater would be detrimental to the spring peeper and would cause it to abandon the site. Since the spring peeper is no longer present in the area due to saltwater impacts, it was assumed that this would be the case throughout time if conditions were not changed. Saltwater impacts are addressed in greater detail in Sections 2.3 and 2.4 of this report. All model modifications and the creation of models was done by members of the team with assistance from outside experts. All species models can be found in Appendix B.

Each species model evaluates life requisite factors (primarily food, cover, breeding and water) on a scale of 0 to 1.0. The individual life requisite factors are usually based on several conditions that must be considered together in order evaluate a life requisite (USFWS, 1984). For example, the life requisite "food" for the American kestrel is based on a combination of three different factors; percent of ground cover, height of ground cover, and number of perches per 10 acres. Numerical values between 0 and 1.0 are calculated for each condition and averaged to determine the life requisite value.

Table 4.2 - 1
Land Use/cover Types, Number of
Sample Sites and Evaluating Species

Land Use/Cover Type	No. of Sample Sites	Evaluation Species
1. Emergent Wetlands	4	Green Heron Clapper Rail
2. Forest	4	Sharp Shinned Hawk Wood Thrush
3. Beach/Dune	3	Sanderling Least Tern
4. Open Water	5	Spring Peeper Black Duck
5. Field/Scrub-shrub	3	American Kestrel Field Sparrow
6. *Phragmites australis*	4	Marsh Wren Muskrat

For this study, six land use/cover types and their corresponding evaluation species were reviewed (See Table 4.2-1). The first land use/cover type evaluated was open water using black duck and spring peeper. The habitat value of open water, expressed in habitat units, was needed to assess the past, present and future value of the water and the impacts that saltwater intrusion has on this habitat and the species that utilize it. The second land use/cover type evaluated was forest which used the sharp-shinned hawk and wood thrush as evaluation species. This cover type also provides information on past, present and future conditions and how these conditions are impacted by salt water intrusion and erosion. The third land use/cover type evaluated was field/scrub-shrub using the American kestrel and field sparrow as evaluation species. The fourth land use/cover type evaluated was beach/dune using sanderling and least tern as evaluation species. The fifth land use/cover type evaluated was Phragmites australis using marsh wren and muskrat as evaluation species. This cover type provided an opportunity to compare the suitability of Phragmites australis with the suitability of the emergent wetlands that it has replaced. The final land use/cover type was emergent wetlands. The evaluation species chosen for this land use/cover type were green heron and clapper rail. The evaluation of this cover type gave the opportunity to compare past values of an area that was mostly emergent wetland, with the present value of an area dominated by Phragmites australis.

Many factors were taken into account in order to choose the location of the sample sites within each cover type. The main factor was the size of each cover type. Generally the larger sites, such as forest and Phragmites australis were sampled 4 times, while the field/scrub-shrub and beach/dune were only sampled 3 times. The exception to this was the open water habitat. Even though open water accounts for only 14% of the area, 5 sample sites were selected. Open water is primarily in the form of small ponds or even smaller drainage ditches which are distributed throughout both sites. Due to the saltwater intrusion, erosion, and breaching that occurs on this site, many of the open water areas are significantly different. For this reason it was determined that more sampling was required to properly categorize the site. Other factors such as the importance of the cover type to wildlife were also taken into account when choosing the location and number of sampling sites. A total of 23 sample sites were evaluated within the 6 land use/cover types. Table 4.2-1 provides the number of sample sites for each land use/cover type. A map showing the location of all sample sites can be found in Figure 4.2-2.

B. Field Assessment and Data Analysis

Site visits to collect the 1994 baseline data were conducted on November 23 and 30, 1993; January 11, 1994; March 15, 1994; and April 11, 1994. These values were subsequently updated during site visits in the summer of 1997. Weather conditions were generally clear and sunny with little cloud cover or precipitation. Average spring conditions were assumed for most measurements, so the data was not impacted by seasonal variability.

The following procedures were implemented to obtain life requisite measurements for

determining Habitat Suitability Index (HSI) values. As stated earlier, preliminary sample sites were first identified on the land use/cover type map. These sites were confirmed in the field by the study team. To complete the evaluation, the team examined the quantity, quality, and type of vegetation on site as well as the amount of water present at each location. The team walked each site and assessed components of each life requisite for the evaluation species. Differences in opinions were talked out on site and an average consensus was arrived at by all team members. HSI values were then recorded on the data sheets. These HSI values were reviewed in 1997 by team members from the U.S. Army Corps of Engineers and the U.S. Fish and Wildlife Service. Based on changes in the site conditions between 1994 and 1997, some HSI numbers were adjusted to reflect current conditions.

Once the individual HSI values were determined, it was necessary to calculate the mean species habitat suitability indices (mean species HSI) for each cover type. In order to calculate this value, each species HSI was multiplied by the sample area to give habitat units (HU's). This was repeated for each sample site and the resulting HU's were totaled. The mean habitat suitability index was then calculated by dividing the sample total habitat units by the sample total area.

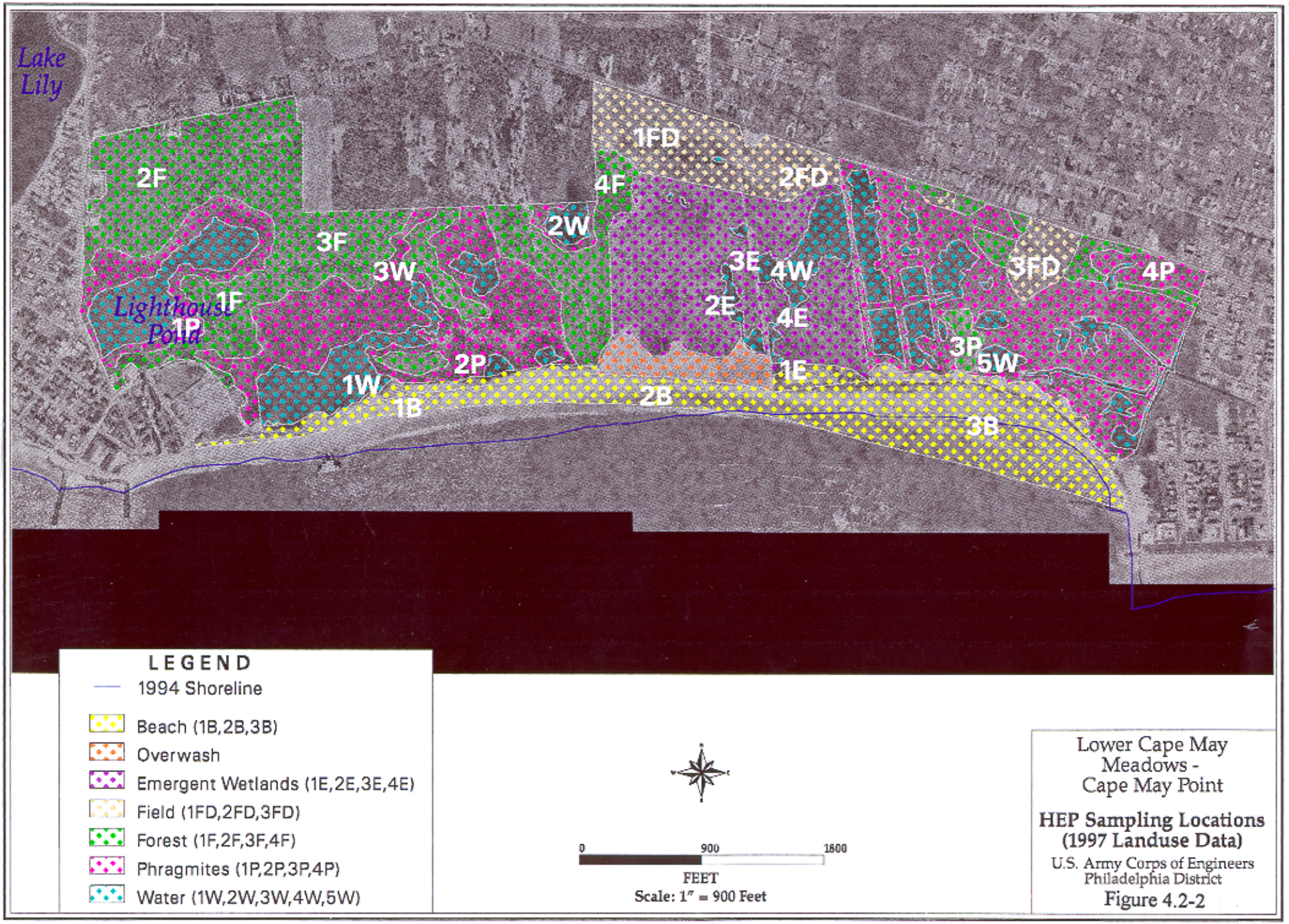
Once the mean HSI was determined for each species and each cover type it was possible to calculate the HU's for the entire Meadows area (Table 4.2-2). Based on these calculations, the 343 acres which comprise The Meadows currently (1997) provide 45 HU's for the sharp-shinned hawk, 37.5 HU's for the wood thrush, 19.2 HU's for the American kestrel, 14.4 HU's for the field sparrow, 25.2 HU's for the green heron, 33.6 HU's for the clapper rail, 48 HU's for the sanderling, 60 HU's for the least tern, 37.2 HU's for the marsh wren, 27.9 HU's for the muskrat, 34.3 HU's for the black duck and 0.0 HU's for the spring peeper. These numbers were obtained my multiplying the mean HSI for each species by the total number of acres of each cover type. Table 4.2-2 also serves to compare the 1997 HU's with the estimated HU's for the years 1955, 2000, and 2050. In order to estimate these values the number of acres were determined by using past and current aerial photographs and data concerning the erosion rates which impact The Meadows. This information indicates that in 1955 approximately 467 acres of wildlife habitat existed within The Meadows. A review of literature, aerial photographs and personal communication reveals that the greatest changes in habitat took place in the Phragmites australis and emergent wetland cover types. It appears that emergent wetlands dominated the project area in 1955, occupying approximately 209 of the 467 acres (Figure 4.2-3). As a result of the erosion, saltwater intrusion, ditching and other disturbance however, only 42 acres currently exist, all of which are located in The Nature Conservancy property. It is estimated that by the years 2000 and 2050 that number will be reduced to 38 and 2 acres, respectively. This reduction in acreage will continue to reduce the value of this area for habitat, as crucial requirements for the survival of migrating shorebirds, songbirds and raptors continue to be lost. Phragmites australis on the other hand, did not exist within The Meadows in 1955 but now occupies 27 percent of the site (93 acres). It is predicted that over time this acreage will remain fairly constant due to the invasive nature of Phragmites australis. For the purpose of this study and these calculations, it was assumed that the Phragmites australis would invade one additional acre of habitat each year.

An estimate of past and future HU's was calculated for each evaluation species. For the 1955 habitat, estimates were based on present conditions and past aerial photography to determine possible conditions at that time. Future conditions were estimated based on predicted future erosion rates, as well as the predicted future vegetation conditions and the impacts of continued exposure to saltwater. Since it is difficult to estimate the exact quality of the habitat at these times, it was necessary to make some assumptions with regard to the conditions which may have existed, or may exist in the future. In terms of the open water and emergent wetland habitat that existed in 1955, it was assumed that more water was available on the site and that, saltwater intrusion and dune breaching were not occurring. These conditions would have led to an increase in the amount of vegetated areas with open water, the amount of shallow water habitat, the amount of permanent water, the amount of emergent vegetation, and the amount of freshwater areas. Based on this, the HSI values for the green heron, clapper rail, spring peeper, and black duck probably would have been higher in 1955 than in the present. Based on these assumptions, HSI values were calculated for the evaluation species for each cover type. The results estimate that in 1955, The Meadows supported approximately 742 HU's. These values can be seen in Table 4.2-2.

Similar assumptions apply to the fact that based on predicted conditions, the HSI values for the years 2000 and 2050 would be expected to be lower than they are now. It is expected that by the year 2050, if no steps are taken to stop the erosion and saltwater intrusion, that saltwater impacts would extend to the forested areas on the site. This would eventually lead to the alteration of this habitat in terms of size of forest, amount of leaf litter, height of shrubs, and percent of ground and canopy cover. These changes would result in lower HSI values for the sharp-shinned hawk and wood thrush. Similar impacts would affect the open water, old field, and emergent wetland habitats, lowering the HSI values for the species utilizing these areas. Based on these assumptions, and the calculations associated with them, it is estimated that if protective action is not taken, by the year 2000, the value of the habitat will be approximately 375 HU's and in the year 2050, that number will have been further reduced to approximately 179 HU's. These values were calculated by adding the individual evaluation species HUs found in Table 4.2-2.

Table 4.2 - 2
HEP RESULTS
Past, Present, and Future w/out Project Conditions

	1955			1997			2000			2050		
	Acres	HSI	HU's	Acres	HSI	HU's	Acres	HSI	HU's	Acres	HSI	HU's
Forest												
Sharp Shinned Hawk	83	0.8	66.4	75	0.6	45	72	0.6	43.2	38	0.1	3.8
Wood Thrush	83	0.5	41.5	75	0.5	37.5	72	0.5	36	38	0.3	11.4
Field												
American Kestrel	70	0.8	56	24	0.8	19.2	23	0.8	18.4	15	0.7	10.5
Field Sparrow	70	0.6	42	24	0.6	14.4	23	0.6	13.8	15	0.6	9
Emergent Wetlands												
Green Heron	209	0.8	167.2	42	0.6	25.2	38	0.6	22.8	2	0.5	1
Clapper Rail	209	0.9	188.1	42	0.8	33.6	38	0.8	30.4	2	0.4	0.8
Beach												
Sanderling	65	0.8	52	60	0.8	48	64	0.8	51.2	48	0.7	33.6
Least Tern	65	1.0	65	60	1.0	60	64	1.0	64	48	1.0	48
Phragmites												
Marsh Wren	0	0.0	0	93	0.4	37.2	95	0.4	38	95	0.3	28.5
Muskrat	0	0.0	0	93	0.3	27.9	95	0.3	28.5	95	0.3	28.5
Open Water												
Black Duck	40	0.9	36	49	0.7	34.3	41	0.7	28.7	7	0.5	3.5
Spring Peeper	40	0.7	28	49	0.0	0.0	41	0.0	0.0	7	0.0	0.0
Total	467			343			333			205		



Lower Cape May Meadows - Cape May Point

HEP Sampling Locations (1997 Landuse Data)

U.S. Army Corps of Engineers
Philadelphia District

Figure 4.2-2

LEGEND

- Beach
- Emergent Wetlands
- Field
- Forest
- Water

0 900 1800

FEET

Scale: 1" = 900 Feet

Lower Cape May Meadows - Cape May Point

Land Use & Cover Type 1955

U.S. Army Corps of Engineers
Philadelphia District

Figure 4.2-3

4.3 Without-Project Economic Analysis

General. The purpose of this section is to describe the information and methods used in the economic analysis of incidental storm damage reduction and erosion protection benefits for the developed areas surrounding Lower Cape May Meadows. The boroughs of Cape May Point and West Cape May are the focus of the economic analysis.

Conditions. A March 1996 price level, 50 year project life, and a base year of 2000 were used in the economic analysis. The values of costs and benefits were converted to an annual equivalent time basis using a 7-⅜% discount rate as applicable to public works projects.

Methodology and Assumptions. The traditional analytical approach of using damage-frequency and erosion-frequency relationships was employed to calculate probable benefits. Residential, commercial, and public-use structures in the Lower Cape May Meadows drainage basin were inventoried to determine the extent of flooding in the surrounding area. This limit was chosen based on past experience of the extent of flooding in the area. The inventory focused on structures located in the boroughs of Cape May Point and West Cape May. Figure 4.1.1 in the Without Project Hydraulic Analysis section of this report further outlines the cells in Cape May Point. Cells were assigned based on hydraulic, economic, and political factors. The following table describes the influence of the different damage mechanisms on the structures by cell designations.

Borough	Primary Cells	Types of Damage
Cape May Point	B	Wave, Erosion, Inundation
	C	Wave, Erosion, Inundation
	D	Wave & Inundation
	E	Wave, Erosion, Inundation
	F	Wave & Inundation
West Cape May	WCM	Inundation Only

A database of approximately 360 ocean block, and inland structures in Cape May Point, and 370 structures in West Cape May was compiled containing information described in the following paragraphs. The majority of the developed land in the study area is residential. Between 1993 and 1996 construction of approximately 3 new residences in Cape May Point and 6 new residences in West Cape May were completed. Furthermore, several structures were renovated or in the process of being renovated. Commercial activity in Cape May Point consists of a general store, bed and breakfast inns, and an antique shop. In West Cape May several commercial enterprises such as restaurants, a service station, a convenience store, and specialty shops are located on Sunset Boulevard and Broadway Avenue. A few commercial structures in West Cape May are vacant and available for rent.

Each structure was specifically inventoried and mapped on aerial photography at a scale of 1"=100'. Information collected includes address, construction and quality type, number of stories, first floor elevation, ground elevation, and foundation type. For multi-family residential and commercial structures the number of units and names of businesses were also gathered. Table 4.3.1 lists these physical characteristics obtained for each structure. The assimilation of this data was enhanced by using aerial orthodigital mapping and the geographic information system, MIPS (Micro Imaging Processing System). Next, the information was coded and entered into the appraisal program and the appropriate storm damage computer models.

The structures's depreciated replacement cost values were appraised by using the Marshall and Swift Residential and Commercial Estimator Programs. The values were based on several of the characteristics listed above such as size, number of stories, construction material, quality, and condition (worn out, badly worn, average, good, very good, and excellent). The associated content value of each residential structure is estimated to be 25% of the structural replacement cost. This estimate is based on previous studies that established content value to be about 40% of structural value in primary homes and 15 to 20% of structural value in secondary/vacation homes. The study area consists mainly of vacation homes, but does contain some year round residential homes, hence the value of 25% was selected. Affluence was not claimed. The estimated total replacement cost for all structures is over 98 million dollars with contents worth almost 28 million dollars. The average replacement cost for residential structures included in the database for Cape May Point, and West Cape May is $137,000, and $117,000, respectively.

Table 4.3.1
Physical Characteristics Obtained for
Building Inventory

1.) Type
2.) Address & Block #
3.) Number of Stories
4.) Basement/Foundation
5.) Exterior Material
6.) Roof Material
7.) Quality
8.) Condition
9.) Garage/Shed
10.) Ground Elevation
11.) First Floor Elevation
12.) Structure Size
13.) Distance from Reference Line

Damages (for without and with project conditions) were calculated for eight frequency storm events (2, 5, 10, 20, 50, 100, 200, and 500-year events) for erosion, wave, and inundation damage to structures, infrastructure, and improved property. The calculations were performed using one of two damage analysis computer models, COSTDAM or the Hydrologic Engineering Center's

(HEC) Structure Inventory for Damage Analysis (SID) package, depending on the structure's susceptibility to wave and/or erosion damage. Structures subject to wave attack or storm erosion were evaluated in the COSTDAM model. COSTDAM is a Fortran program originally written by the Wilmington District and updated for the Philadelphia District. COSTDAM reads an ASCII 'Control' file which contains the storm frequency parameters for each cell and an ASCII 'Structure' file which contains the database information of each structure as previously described. COSTDAM checks if a structure has been damaged by wave attack, based on the relationship between a structure's first floor elevation and the total water elevation that sustains a wave. Then COSTDAM checks for erosion damage at a structure. Finally, COSTDAM calculates inundation damages if the water elevation is higher than the first floor elevation. To avoid double counting, if damage occurs by more than one mechanism, the program takes the maximum damage of any given mechanism (wave, erosion, inundation) and drops the rest of the damage from the structure's total damages.

The SID computer model develops stage-damage curves. The primary function of this program is to generate elevation-damage functions by damage categories and reaches. SID also aggregates structures by flood zone based on zero-damage elevation. Samples of COSTDAM and SID structure files are shown below in Tables 4.3.2a and 4.3.2b, respectively.

Table 4.3.2a
Excerpt of COSTDAM Structure File

1A P4001	67.7	117.5	7.8	1.5	138.	117S20S06 1 1
1B R4004	282.8	301.1	8.5	0.0	134.	33S03S04 1-1
2A R5005	340.2	366.0	8.6	3.0	215.	54S03S04 1-1
2B C4901	265.3	298.2	6.8	5.0	505.	399S16MT3 1 1
3A R4501	569.2	585.6	5.0	6.5	176.	44S03S04 1-1
3B R3802	542.0	559.5	5.8	4.4	71.	18S03S04 1-1
4 R1602	177.3	208.2	8.9	6.0	211.	53S03S04 1-1
5A R0701	162.4	188.0	9.1	5.5	113.	28S03S04 1-1

Columns 1-3 contain the Cell ID (format-A3).
Columns 4-9 contain the Structure ID (format-A6).
Columns 10-19 are blank.
Columns 20-27 contain distance to front of structure (format-F8.1)
Columns 28-35 contain distance to middle of structure (format-F8.1)
Columns 36-40 contain the ground elevation (format-F5.1)
Columns 41-44 contain the distance between the first floor and the ground (format-F4.1)
Columns 45-53 contain the structure replacement cost value (format-F9.0)
Columns 54-62 contain content replacement cost value (format-F9.0)
Columns 63-65 contain the structure depth damage curve (format-A3)
Columns 66-68 contain the content depth damage curve (format-A3)
Columns 69-70 contain a code to make structure "active" (format-I2)
Columns 71-72 contain the damage category (format-I2)

Table 4.3.2b
Excerpt of SID Structure File

SL	1B	R3203	8.5	-0.01	4.0
SD	1B	R3203	RESS03209.0S04	-25	
SA	1B	R3203	615 LIGHTHOUSE		
SL	1B	R3205	8.9	-1.0	8.0
SD	1B	R3205	RESS03103.0S04	-25	
SA	1B	R3205	621 LIGHTHOUSE		
SL	1B	R3201	8.8	-0.01	3.5
SD	1B	R3201	RESS03122.0S04	-25	
SA	1B	R3201	601 SEA GROVE		

Depth-damage curves for the structures were derived from previous studies of similar areas and Flood Insurance Administration (FIA) depth-damage curves adjusted for increased salt water damageability. Table 4.3.3 displays examples of these curves. Content and depth-damage curves

for certain semi-public and/or historical activities were modified using site specific interview data.

Table 4.3.3
Excerpt of Depth Damage Curves

S03 (2 story, no basement, residential structure)
# of Rows (free format)
12
Depth Damage (expressed as a decimal) (free format)

0	.0
.5	.01
1	.10
2	.24
3	.30
4	.36
5	.39
6	.42
7	.47
8	.49
9	.56
10	.64

S15 (1 story, masonry, no basement, commercial structure)
# of Rows (free format)
13
Depth Damage (expressed as a decimal) (free format)

-1	.0
0	.01
.5	.05
1	.21
2	.29
3	.38
4	.46
5	.48
6	.53
7	.55
8	.59
9	.67
10	.73

Storm Damage Reduction Categories

Inundation Damage. Most of the damage to structures in Cape May Point is caused by flooding rather than wave attack or erosion. Therefore, the majority of the study effort was focused on quantifying inundation reduction benefits. When the ponds and lakes in Lower Cape May Meadows flood, the water spills over into the adjacent community. During infrequent storm events wave attack would be a more prevalent cause of damage to structures closest to the ocean. In addition, most of the water that overtops dunes in Cape May Point drains to The Meadows. The area bounded by the extreme northwestern groin cells in Cape May Point drains to

undeveloped land adjacent to the Delaware Bay. The depth-damage curves were verified using site-specific information whenever available. FIA flood claim data for Cape May Point was obtained. Damage information from structures which could be matched by address was reviewed. The curves were tested for reasonableness on a structure by structure basis and revised accordingly.

Wave Attack Damage. Oceanfront structures are subject to damage as a result of direct wave impact. However, damage is not claimed for a structure from both wave attack and erosion for the same event to avoid double counting. A structure is considered to be damaged by a wave when there is sufficient force in the total water elevation to completely damage the structure. It was assumed that a structure is destroyed if the wave strikes it at an elevation two feet above the first floor. Partial wave damages are not calculated; instead the structure is subjected to inundation damage.

Storm Recession Damage. The distance between the reference (profile) line and the oceanfront and back walls of a structure were measured in AutoCAD using the georeferenced MIPS mapping of the study area. For the structure damage/failure analysis, it was assumed that a structure is destroyed at the point that the land below the structure is eroded halfway through the structure's footprint if the structure is not on a pile foundation. If the structure is on piles, the land below the structure must have eroded through the footprint of the structure before total damage is claimed. Prior to this, for both foundation types, the percent damage claimed is equal to the linear proportion of erosion under the structure's footprint relative to the total damage point.

In addition to erosion damage to structures, damage to the land the structures are on (hence forth called improved property) was calculated. The improved property value was determined by comparing market value of the near shore land to the cost of filling in the eroded land for reutilization and using the more conservative estimate. The cost of filling/restoring the improved property is based on the different depths, widths and cubic yards of erosion produced by each storm frequency. The cost of filling/restoring eroded improved property was determined to be less expensive. The cost was prorated for the width of each cell to estimate total land erosion damages.

Erosion damages for infrastructure was also calculated. An erosion damage curve was developed for damage to infrastructure within the erosion limits. Values for roads, land, tensar mattresses, and revetments were estimated using standard engineering criteria. The judgement was made that all infrastructure damaged in Cape May Point would be replaced in-kind. The replacement cost does not necessarily relate to the number of structures in the area. Road and utilities replacement costs consisted of fixed and variable costs based on ranges of feet of replacement/repair. In general, the replacement cost of roads decreased with greater quantities eroded reflecting economies of scale. Distance from the reference line and feet of erosion per event for each road and associated utilities were used to determine damage susceptibility.

Emergency/Clean-up Costs. Clean-up costs for individual structures are based on the time for clean-up and additional meal and travel costs. Travel and meal costs are included as opposed to

evacuation costs because the majority of residential and commercial structures are occupied only on a seasonal basis, and even then, not always by the structure's owner. Clean-up costs are applied to those structures affected by a particular storm event.

Emergency and clean-up costs are also calculated for the local governments. The costs are based on available post storm reports for the December 1992 storm, which had a stage frequency of approximately a 20-year event. The report includes information for Cape May Point but not West Cape May. The damage estimates represent initial appraisals of damage losses and not all costs incurred from the storm. Municipal emergency and clean-up costs include costs to remove debris, emergency protective measures, road systems, water control facilities, and emergency dunes, sand fence and vegetation. Emergency dunes accounted for almost 50% of damage losses to Cape May Point according to the report. Emergency and clean-up costs for larger events are extrapolated due to limited historical information.

Without Project Conditions

Improved Property & Infrastructure Damages. Annual damages for without project damages of improved property and infrastructure are in Table 4.3.4.

Table 4.3.4
Improved Property & Infrastructure
Without Project Average Annual Damage
(In $000s, Mar. 1996 Price Level)

Category	Annual Damages
Improved Property	$10.9
Infrastructure	$24.8
Total	$35.7

Structure Damages. Table 4.3.5 displays equivalent annual damages for structures in Cape May Point and West Cape May. Annual damages for Cape May Point and West Cape May are $741,000 and $212,700, respectively.

Table 4.3.5
Structures
Without Project Expected Annual Damage
(In $000s, Mar. 1996 Price Level)

	Annual Damages			
Reach	**Inundation**	**Wave**	**Erosion**	**Total**
Cape May Point	$435.0	$298.0	$8.0	$741.0
West Cape May	$212.7	$0.0	$0.0	$212.7
Total	$647.7	$298.0	$8.0	$953.7

Emergency/Clean-up Costs. The number of structures affected and the associated emergency costs for each storm event are in Table 4.3.6. Average annual damages for (all affected) individuals in Cape May Point, and West Cape May are $4,700 and $1,900, respectively. Average annual damages for public entities are $25,700, and $4,100 respectively. Municipal emergency costs for Cape May Point will be significant since the Borough's close proximity to the ocean makes it more vulnerable to damaging elements. In contrast, municipal costs for West Cape May are relatively low because it is inland, and damage susceptibility is limited to inundation from The Meadows.

Table 4.3.6
Structures Affected and Emergency/Clean-up Costs
(in $000s, Mar. 1996 Price Level)

CAPE MAY POINT	**2yr**	**5yr**	**10yr**	**20yr**	**50yr**	**100yr**	**200yr**	**500yr**
Structures	0	16	38	49	121	171	217	268
Indiv. Clean-up Costs $	0	4	10	12	43	85	164	243
Mun. Clean-up Costs $	0	21	50	118	263	454	719	954
WEST CAPE MAY	**2yr**	**5yr**	**10yr**	**20yr**	**50yr**	**100yr**	**200yr**	**500yr**
Structures	0	2	14	30	58	114	164	249
Indiv. Clean-up Costs $	0	0	4	8	15	43	70	132
Mun. Clean-up Costs $	0	1	8	11	35	99	169	309

TOTAL AVERAGE ANNUAL CLEANUP COSTS

CAPE MAY POINT:
(all) Individuals: $4,700
Public entities: $25,700

WEST CAPE MAY:
(all) Individuals: $1,900
Public entities: $4,100

Total Annual Damages. Total annual damages for structures, improved property, infrastructure, and emergency costs is displayed by cell in Table 4.3.7.

Table 4.3.7
Total Damages for All Categories
Without Project Average Annual Damage
(In $000s, Mar. 1996 Price Level)

Reach	Annual Damages
Cape May Point	$807.1
West Cape May	$218.7
Total	$1,025.8

Future Without Project Conditions

Future without project conditions in the absence of measures to mitigate long-term erosion in front of Cape May Meadows were evaluated. Storage capacity of The Meadows would be reduced if the shoreline were allowed to retreat at a rate of 15 feet per year, therefore allowing interior water elevations to increase over time from the ocean overtopping the dune by storm events. Estimated future water surface elevations were provided in ten year increments until the year 2050, or 50 years from the base year. Table 4.3.8 presents the equivalent average annual number of acres not inundated by salt water. The acreage of The Meadows decreases as the shoreline erodes, subsequently acres inundated decreases. The impact of future shoreline position on equivalent average annual damages for inland structures in Cape May Point and West Cape May is displayed below in Tables 4.3.9a and 4.3.9b, respectively. The impact of future conditions and trial plans was evaluated for inland structures only in order to conserve time and effort.

Table 4.3.8
Lower Cape May Meadows
Number of Ares NOT Inundated
Without Project

Category	Time Period					
	Base Year 2000	2010	2020	2030	2040	2050
Total # of Acres	333.0	310.0	287.0	264.0	241.0	218.0
Acres Not Inundated	179.6	166.3	151.2	138.2	123.7	111.4

Table 4.3.9a
CAPE MAY POINT
FLOOD DAMAGES IN DECADE WITHOUT PROJECT
($000; Mar. 1996 p.l.; 7.375%)

Property Type	Time Period					
	Base Year 2000	**2010**	**2020**	**2030**	**2040**	**2050**
Residential	55.4	57.0	60.5	63.1	66.5	71.4
Public	1.6	1.6	1.8	1.9	2.0	2.2
Total	57.0	58.6	62.3	65.0	68.5	73.6

Table 4.3.9b
WEST CAPE MAY
FLOOD DAMAGES IN DECADE WITHOUT PROJECT
($000; Mar. 1996 p.l.; 7.375%)

Property Type	Time Period					
	Base Year 2000	**2010**	**2020**	**2030**	**2040**	**2050**
Residential	105.0	106.3	109.5	111.8	114.7	120.3
Commercial	88.4	90.4	95.8	99.8	105.0	115.9
Public	2.5	2.6	2.8	2.9	3.1	3.3
Total	195.9	199.3	208.1	214.5	222.8	239.5

5. PLAN FORMULATION

The plan formulation process involved the establishment of plan formulation rationale, identification and screening of potential alternatives, and the evaluation of detailed plans which are responsive to the identified problems and needs. The purpose of this section is to provide information on the criteria used in the formulation process, to present the procedures followed in evaluating various alternatives, and the subsequent designation of the selected plan(s).

This section will describe the formulation procedure and results for the Lower Cape May Meadows - Cape May Point Feasibility Study. ER 1105-2-100 requires the systematic preparation and evaluation of alternative solutions for addressing identified problems, needs and opportunities. The purpose of the formulation analysis is to identify plans which are publicly acceptable, implementable, and feasible from environmental, engineering, economic and social standpoints. EC 1105-2-210 requirements for plan formulation for ecosystem restoration projects were also followed.

The formulation was undertaken in three phases, or cycles: Cycle 1 - Initial Screening of Solutions Considered, Cycle 2 - 2nd Level Screening of Solutions Considered and Cycle 3 - Final Screening and Optimization of the Selected Alternative Solutions. By analyzing the alternative solutions in this manner, the solution that best fits the planning objectives and constraints can be formulated in a logical and efficient manner. An incremental analysis was performed as per EC 1105-2-210 to optimize solutions and is presented in Section 6 of this report.

Interagency coordination for plan formulation included contacting various agencies and organizations. All of these agencies/organizations were briefed on the conduct of the study along with possible alternatives being considered. Some agencies, such as USFWS, NJDEP, and The Nature Conservancy provided significant input.

These agencies/organizations were as follows:

- New Jersey Department of Environmental Protection (NJDEP)
- U.S. Fish and Wildlife Service (USFWS)
- The Nature Conservancy
- Waterways Experiment Station (WES)
- Cape May County Mosquito Commission
- U.S.D.A., Natural Resource Conservation Service

Plan formulation ideas were formally presented to the member agencies of the Mid-Atlantic Regional Implementation Team of the Coastal America Program in October 1996.

5.1 Planning Objectives

Existing problems were organized so that general objectives and subsequent detailed solutions could be developed in an effective and efficient manner. Following is the list of problems, objectives, and goals developed by the study team:

I. PROBLEM: LONG-TERM ECOSYSTEM DEGRADATION AND HABITAT LOSS AT LOWER CAPE MAY MEADOWS

CAUSE: Long-term erosion due to interruption of littoral material by the jetties at Cape May Inlet has allowed for beach and wetland erosion, wave overtopping, and breaching of dunes during storm events at Lower Cape May Meadows.

A.) OBJECTIVE: PROTECT AND RESTORE BEACH AND FRESHWATER WETLAND HABITAT

Goal #1) Protect Existing Habitat from Future Degradation
Goal #2) Restore Previously Eroded or Overwashed Habitat

B.) OBJECTIVE: IMPROVE INTERNAL WATER QUALITY

Goal #1) Reduce Saltwater Intrusion Due to Storm Activity
Goal #2) Reduce Organic Loading from Lake Lily
Goal #3) Increase Water Movement through Meadows

C.) OBJECTIVE: ELIMINATE/CONTROL NUISANCE PLANT SPECIES (Phragmites australis)

D.) OBJECTIVE: INCREASE AVAILABILITY OF FRESHWATER

II. PROBLEM: STORM DAMAGE TO THE TOWNS OF CAPE MAY POINT AND WEST CAPE MAY

CAUSE: Long-term erosion due to the interruption of littoral material by the jetties at Cape May Inlet has allowed for beach and wetland erosion, breaching of dunes, and wave overtopping during storm events at Lower Cape May Meadows. This subsequently allows oceanwater storm inundation to extend to both towns of Cape May Point and West Cape May. In addition, the shoreline of Cape May Point is vulnerable to storm damage through wave attack and storm erosion.

A.) OBJECTIVE: *REDUCE OCEANWATER INUNDATION VIA THE MEADOWS TO THE TOWNS OF CAPE MAY POINT AND WEST CAPE MAY POINT*

B.) OBJECTIVE: REDUCE STORM DAMAGE VULNERABILITY ALONG CAPE MAY POINT OCEANFRONT

5.2 Planning Constraints

General Environmental Constraints. USACOE ecosystem restoration studies have inherent constraints associated with them since guidance on the conduct of these types of studies within the Corps' planning context is still evolving. In addition, there does not yet exist a large body of completed studies and projects which could provide valuable information, references, and "lessons learned" to assist in assessing the restoration problem, potential benefits and cost effectiveness of the identified solutions. In general, appropriate measures must be taken to ensure that any resulting projects are consistent with local, regional and state plans, and that necessary permits and approvals are likely to be issued by the regulatory agencies. In addition, the recommended plan should produce "high priority" environmental outputs.

Economic Constraints. Since many of benefits associated with a potential project at the study area are Environmental Quality (EQ) benefits, traditional monetary benefit-to-cost ratios were not required. Justification would be based on an incremental analysis. However, traditional economic constraints would apply to any aspect of the project that would provide traditional hurricane and storm damage reduction (H&SDR) to Cape May Point and West Cape May. There is a direct relationship between the erosion and flooding problems which has led to the environmental degradation of The Meadows' ecosystem and the inundation damages experienced at Cape May Point and West Cape May. Therefore, protecting The Meadows' ecosystem from further storm damage (environmental quality or EQ benefits) incidentally provides traditional monetary inundation protection (National Economic Development or NED benefits) to Cape May Point and West Cape May. Any additional inundation protection to Cape May Point and West Cape May over-and-above what was incidentally provided by ecosystem protection/restoration at The Meadows would have to be justified based on NED benefits. The ratio of damage reduction economic benefits must be equal-to or greater- than the costs of implementation. Additionally, any shore protection placed along the Cape May Point shoreline based solely on NED benefits would have to be justified as such.

5.3 Plan Formulation Rationale

Acknowledging the extreme importance and uniqueness of The Meadows's ecosystem, a number of considerations were used in the plan formulation process. Alternatives were developed and considered that would accomplish the following:

a. Combine naturally with the physical characteristics of the existing ecosystem

b. Be in accordance with desires and guidelines expressed by various Federal, state and local agencies and organizations

c. Integrate with other related programs in the study area

d. Be implementable with respect to the financial capabilities of the non-federal sponsor

e. Be in accordance with current Corps guidelines and policy

f. Minimize, where possible, long-term Federal expenditures

In addition, final plan selection is required by EC 1105-2-210 to address the following criteria:

- Acceptability
- Completeness
- Efficiency
- Effectiveness
- Partnership
- Reasonableness of Costs

5.4 Cycle 1 Plan Formulation - Initial Screening of Alternatives

In cycle 1, alternatives were identified and evaluated on the basis of their suitability, applicability and merit in meeting the planning objectives and engineering criteria for the study.

Without undertaking an in-depth analysis, the goal of the cycle 1 analysis is to screen out those alternatives which obviously do not fulfill the needs of the study area or are inappropriate due to other factors such as having a low level of suitability for the existing ecosystem. Judgements were made about each alternative based on knowledge gained from researching past reports, the professional experience of each study team member and other CENAP personnel. In addition, input from the non-Federal sponsor, NJDEP, concerning the effectiveness of alternatives was considered as well as input from local officials and organizations.

There were two general categories of solutions that can be initially considered for implementation in the study area, namely, non-structural measures and structural measures. Non-structural measures are those which control or regulate the use of land such that damages may be reduced or eliminated. When implementing non-structural measures, no attempt is made to reduce, divert or otherwise control the rate of shoreline erosion or subsequent ecosystem degradation. Typically, specific non-structural solutions include: no action, regulation of any future development (setback limits, building elevation restrictions..etc), and permanent abandonment or evacuation of the study area. These options are usually not feasible due to the level of development or economic base of a region.

Structural measures are those which restore habitat and/or protect property. Some of these alternatives are used to provide protection against potential storm damage or act to impede or otherwise interfere with erosive processes. These typical structural alternatives consist of seawalls, bulkheads, revetments, breakwaters, groins and beach/dune fill. In general, seawalls,

bulkheads and revetments are shore parallel structures used to retain fill and/or reduce direct wave attack on the backshore. Breakwaters are also shore parallel structures usually constructed of stone/rubble and placed offshore to absorb incoming wave energy. Groins, on the other hand, are shore perpendicular structures used to interrupt the long shore sediment transport to hold sand on the beach. Beach/dune fill is the actual placement of sand from a borrow source on the beach to provide a larger berm/dune. Of these structural alternatives, seawalls, bulkheads, revetments, breakwaters and groins are typically expensive to construct and may conflict with the natural ecosystem. The beach/dune fill option, however, is usually less expensive and is more environmentally favorable since it blends with the natural beach environment. However due to existing erosion, long-term periodic nourishment is normally required over the project life (50 years).

Other structural alternatives considered in this study concentrate on specific restoration activities and include alternatives such as herbicidal treatment of nuisance plant species, water level management structures..etc.

The following summarizes the alternatives examined for each specific problem, objective, and goal considered in cycle 1:

I. Problem: ***Long-term Ecosystem Degradation and Habitat Loss at Lower Cape May Meadows***

A.) Objective: Protect and Restore Beach and Freshwater Wetland Habitat

Goal #1) Protect Existing Habitat from Future Damages

Non-Structural Alternatives:
- No action

Structural Alternatives:
- Berm restoration
- Dune restoration
- Berm and dune restoration
- Berm and dune restoration using structural reinforcement (geotextile tubes..etc)
- Berm and dune restoration with groin field
- Berm and dune using structural reinforcement and groin field
- Bulkhead, seawall..etc
- Offshore detached breakwater
- Berm and dune restoration with offshore detached breakwater
- Perched beach
- Offshore submerged feeder berm
- Beach dewatering
- Mechanical sand bypassing from Cape May City

- Groin modification at Cape May City
- Modification of the Cape May Inlet jetties
- Sand-bypassing from Cape May Inlet

Non-Structural Alternatives

No Action. The no action alternative does not restore or protect The Meadows' ecosystem. This alternative would allow for the continued degradation of valuable habitat. Since this plan fails to meet the desired objective it will be eliminated from future consideration.

Structural Alternatives

A. Berm restoration. This alternative involves the placement of beachfill material (sand), directly onto the existing beach in order to widen and stabilize the existing beach profile. The sand is normally pumped from an offshore borrow source onto the existing shoreline using a dredge. The restored beach is graded to a certain design elevation and width to provide the optimal restoration and protection levels. The berm pushes the wave breaker zone and inundation profile seaward and provides sacrificial sediment during storms. It also incidentally provides beach habitat for species like the piping plover. Normally, the beach requires future additional sand placement (periodic nourishment), on a periodic basis so that the required design is maintained. Since experience has shown that the incremental cost of adding a dune to the berm is minor compared to the storm protection benefits that a dune provides (especially overtopping protection), this alternative will not be considered in the cycle 2 formulation.

B. Dune restoration. Involves using sand to restore the existing dunes to a desired height and width (NJDEP has been currently doing this at The Meadows). This would add significant protection from overtopping during storm events. However, the lack of existing beach in front of the dune makes this option ineffective during significant storm events. The dune would be vulnerable without a "sacrificial" berm to protect it. During a significant storm event, the ocean would erode the existing dune. Therefore, this alternative will not be considered in the cycle 2 formulation.

C. Berm and dune restoration. This alternative is a combination of the previous two. This alternative provides a high level of storm protection and merges favorably with the existing environment and has been shown in numerous Corps' studies to be the most effective and cost efficient in terms of providing protection from storms. Therefore, this alternative will be included in the cycle 2 formulation.

D. Berm and dune restoration using structural reinforcement. Similar as the previous alternative with the addition of structural reinforcement such as geotextile tubes, Tensar mattresses..etc placed either inside or fronting the dunes. Depending on placement location, structural

reinforcement may provide greater protection under certain conditions. Stability during high wave environments is questionable. It needs to be determined whether the added costs of the reinforcement is worth the additional benefits. This alternative will be further examined in the cycle 2 formulation.

E. Berm & dune restoration w\groin field (stone or geotextile tubes). Combination of prior alternative with the addition of groins. Groins are coastal structures built perpendicular to the shoreline. They extend from the upper beach face into the surf zone and are designed to trap some of the littoral drift. Groins can effectively reduce long term erosion and reduce future nourishment needs (costs). The cost of the groins would have to be offset by the reduced periodic nourishment sand quantities. As mentioned previously, seven groins were recommended for The Meadows in a 1976 Corps report.

In general, various agencies and locals are concerned regarding the construction of numerous, large groins for fear of negative environmental effects due to the covering up of habitat or drastic reduction of the dynamic beach habitat required by piping plovers. The use of geotextile tubes as "low-profile" groins possibly addresses these concerns. However, they may be too easily moved out of place during storm events. In addition, questions arise regarding foundation stability due to a shoreward migrating deep offshore trench. This alternative will be further examined in the cycle 2 formulation.

F. Berm and dune creation with structural reinforcements and groin field See above. Provides highest level of storm protection and erosion control with same concerns. Initial costs will be high. This alternative will be included in the cycle 2 formulation.

G. Bulkhead, seawall..etc. This alternative includes the construction of either a bulkhead or seawall placed along portions of the project length. This alternative would provide storm damage protection consistent with other structural alternatives at high initial expense. The primary purpose of these structures is to withstand, deflect and/or dissipate wave energy. Costs of construction would be high with values of thousands of dollars per linear foot depending on the size and construction material used. Because these types of structures protect only the land immediately behind them, erosion would eventually remove the seaward beach. Therefore, maintenance of the beach in front of the structures would be necessary to reduce probable scour that would undermine the seawall. There is also an academic debate regarding whether a seawall actually induces erosion of sand from the beach face due to the reflection of waves. Most importantly, a seawall or bulkhead along The Meadows oceanfront is environmentally and aesthetically incompatible with the existing ecosystem and would most-likely meet with much opposition from other government agencies and local organizations. It would be especially harmful to piping plovers which require a somewhat dynamic shoreline. For these reasons, this alternative will not be examined further in cycle 2 plan formulation.

H. Offshore detached breakwater. An offshore detached breakwater is a structure which reduces the wave energy impacting the shoreline thus reducing erosion. This option could reduce wave

impact on the shoreline, depending on placement. One type of offshore detached breakwater has been present off of Cape May Point since 1994. Placed by itself, an offshore detached breakwater does not protect against storm surge or provide a protective berm, which is needed at The Meadows during storm events. Complex wave, current, and tidal influences at the study area may also reduce effectiveness. Also, possible foundation stability may exist in some area due to migrating deep offshore trench. This alternative will not be examined further in cycle 2 plan formulation.

I. Berm & dune restoration w\offshore detached breakwater at Meadows Combination of prior alternatives, see concerns listed previously. Berm/dune combo would provide storm protection. Breakwater may be able to reduce erosion and therefore future renourishment quantities. Cost must be offset by reduced future renourishment. This alternative will be included in the cycle 2 formulation.

J. Perched beach This alternative is similar to the "berm restoration" alternative listed above except it provides a submerged structure which is used to support the offshore end of the placed beachfill. This eliminates the outer part of the beach profile near its closure with the ocean bottom and therefore, the actual amount of fill material to be placed is less than in a typical beachfill. The submerged structure would act in the same way as a natural bar formed offshore during storm events creating a "perched beach" with a wider berm. The main problem with this alternative is that the angled swell scours in front of and behind the offshore structure resulting in the need for heavy maintenance. In addition, any interception of littoral drift will cause erosion downcast, even if only temporarily. Perched beaches are not usually designed for high wave energy open ocean coastlines and wouldn't be very effective in this area due to the dynamic wave, current, and tidal influences. By its very design, perched beaches do not follow foreshore beach slopes which are characteristically gentle along the south Jersey shore. Due to these factors and the potential danger posed by the structures to recreational bathers, this alternative will not be considered in cycle 2.

K. Offshore submerged feeder berm Potentially high costs associated with onshore placement have led to the development of alternate less expensive methods of beach nourishment. One such method is nearshore berm placement. In some areas, nearshore berms can reduce wave damage and provide sand to the littoral system with a cost as little as half that of onshore placement (Allison and Pollock, 1993 and McLellan et. al, 1990).

Prototype experience with berms is limited, and proper design techniques are still being researched and developed. For the berm to function successfully as a beach nourishment technique, several factors such as berm depth, wavelength, wave height, and wave velocity must be within proper ratios (Hands and Allison, 1991). Long term sediment transport trends, both longshore and cross-shore, must also be examined. Berm placement site must be a proper distance downdrift of an inlet or jetty to reduce the tendency of the sediment to return to the inlet or be caught by the jetty (McLellan et. al, 1990). Wave and current conditions at The Meadows oceanfront make success of this alternative unlikely. Therefore, this alternative will not be

considered in the cycle 2 formulation.

L. Beach dewatering. The concept of beachface drainage as a method to increase beach stability has been tried in Florida and Denmark. Sand in the swash zone is typically in a buoyant state. Erosion is diminished by beach dewatering due to the discontinuity in the water table and the draining sand, and due to the intergranular pressure and stability which occurs because of the vertical downward flow of water. Accretion is promoted because the sediment laden swash is absorbed by the dewatered sand, causing a deposition of new sand on the foreshore slope.

This alternative requires an initial beachfill placement along with the installation of pipes underneath the beach. Frequent maintenance of the system is also required. Costs would have to be offset by reduced future nourishment requirements. Life cycle costs for a large scale implementation are unknown. Technology and performance is still unproven for an open ocean coastal environment especially in an area as complex as The Meadows frontage. Therefore, this alternative will not be considered in the cycle 2 formulation.

M. Mechanical sand bypassing from Cape May City. This involves mechanically bypassing, through some type of pumping system, sand from the existing Federal shore protection project at Cape May City. This could be used to replace some of the sand that has eroded at The Meadows. Questions regarding the amount sand that would be available to bypass without comprising the existing Federal project and its corresponding cost effectiveness.

During the last few years, some sand has been naturally bypassing around the Third Avenue Terminal groin at Cape May City to The Meadows, settling along the northeastern edge of the shoreline. This has necessitated beachfill placement at Cape May City along the Third Avenue Terminal groin area. Therefore, at this time, there is no "excess" sand available from the Cape May City project to bypass to The Meadows without compromising the shore protection design at Cape May City. Therefore, this alternative will not be included in the cycle 2 formulation.

N. Modify groin(s) at Cape May City Similar concept as previous but would use natural processes to transport sand to The Meadows. This would involve lowering the height existing groin(s) at Cape May City to allow for increased downdrift sand flow. Similar concerns as previous alternative as this would also compromise the existing Federal project at Cape May City. This alternative was previously analyzed in 1981 in response to questions raised by the Board of Engineers for Rivers and Harbors (BERH) following the *Cape May Inlet to Lower Township, New Jersey, Phase I General Design Memorandum.* The analysis was summarized as follows:

> "Modification of the Third Avenue groin (and others) at Cape May City was not recommended because of the following reasons:
>
> a.) The existing groins have functioned well. Modifications might result in adverse affects to the beaches of Cape May beaches which are appreciably

seaward of the adjoining shoreline to the east and the west, and as such are much more vulnerable to erosion than a beach that is in alignment with the adjoining shorelines. Modifications to groins that are functioning well particularly when the expected results are uncertain and is discouraged. Local resistance to modification which is bound to have some adverse impact on the present adjacent beach to the east is inevitable."

b.) To be effective, groin modification would have to be rather substantial. For example, the Third Avenue groin would have to be lowered by as much as 9 feet and shortened by about 200 feet. This would provide a groin profile approximating the design fill section. This would be necessary to maximize the amount of sand passage since only a small percentage of that amount could be expected to reach Lower Township. Modifications of lesser magnitude such as minor reduction in length and top elevations or notches would only serve to reduce the potential for passing sand and therefore lessen the amount of sand available for nourishing Lower Township."

This analysis is still considered applicable. Therefore, this alternative will not be analyzed further in the cycle 2 formulation.

O.) Modification of the Cape May Inlet jetties. This concept would involve modifying the jetties to allow for more sand to naturally reach The Meadows. This alternative was analyzed previously during the Phase I pre-construction planning study for the existing Cape May City Federal beachfill project. Based on the technical evaluation, modification or shortening of those structures was not found to provide viable solutions to the erosion problem at Cape May City or The Meadows since there would be no improvement in longshore sediment transport to those downdrift beaches. Instead, an adverse impact would occur to the Cape May Inlet navigation project as the additional sand is trapped in the inlet itself, causing maintenance of the authorized navigation project to become more difficult. These impacts coupled with the high cost of jetty stone removal led to the conclusion that the existing jetties should not be modified. Therefore, this alternative will not be analyzed further.

P.) Sand-bypassing around Cape May Inlet. The Philadelphia District has previously considered bypassing sand from the fillet updrift (northeast) of Cape May Inlet to beaches downdrift of the inlet. The planned source of sand for periodic nourishment of the Cape May City beachfill project, as presented in the June 1983 Phase II General Design Memorandum, was the updrift fillet at Cape May Inlet. However, investigations by the District prior to initial construction of the Cape May City project led to a decision to utilize offshore shoals closer to the project site as a borrow source. Direct bypassing of sand from the fillet updrift of Cape May Inlet to Cape May City was not implemented for several reasons. First, it was determined that a fixed, continuously operating bypass plant, similar to that constructed by the District at Indian River Inlet, DE, might not have sufficient mobility to assure access to an adequate supply of sand, given the limited range of the crane-mounted eductor pump. Second, coordination between the District and

representatives of the dredging industry indicated their unwillingness to bring floating dredging plant into the nearshore zone adjacent to the updrift fillet, given its proximity to the beach and the associated risk during storms. Adequate supplies of suitable borrow material were located at approved sites directly offshore of Cape May City, and hence those sites have been used for both initial construction as well as subsequent periodic nourishment at Cape May City.

Notwithstanding the factors that have prevented the use of the updrift fillet as a source of sand for beaches downdrift of the inlet to date, it is our view that the updrift fillet contains a large reservoir of sand which has accumulated over the past eight decades largely as a result of the original Cape May Inlet jetty construction, and to the detriment of the downdrift beaches. From the standpoint of coastal sediment transport, there is ample sand "stored" on the updrift fillet and its submerged nearshore zone that could be bypassed to the downdrift beaches. Up to the present time, it has simply been more economical and institutionally simpler to utilize borrow sources directly offshore of Cape May City. The District is presently evaluating the available volume of sand within the permitted borrow site offshore of Cape May City. If it is determined that additional borrow sources are required for future periodic nourishment, the fillet updrift of Cape May Inlet would again become a viable candidate site for further consideration as a borrow site, or true "bypassing."

Regardless of the source of sand to be placed on the shoreline of Lower Cape May Meadows, either initially as construction or subsequently as periodic nourishment, it is our view that the material will require direct placement on the proposed project shoreline. For purposes of beach restoration at Lower Cape May Meadows, it will not be effective to bypass sand from the updrift Cape May Inlet fillet to the adjacent downdrift beach of Cape May City. This is due to the fact that the groin field at Cape May City is not conducive to continuous transport along the shoreline in the net downdrift (southwest) direction. The groin field <u>is</u> effective at retaining sand within each groin compartment along the Cape May City frontage. But the same characteristic of the groin field which serves to retain sand on the Cape May City beachfront also acts to reduce sand transport into the Lower Cape May Meadows cell. In addition, the decades of shoreline retreat along the unprotected beach at Cape May Meadows, which did not occur in Cape May City due to the presence of a continuous seawall and groin field, has created a significant shoreline offset at the Third Avenue terminal groin, which defines the downdrift end of Cape May City. The shoreline offset causes sand which is transported past the Third Avenue groin to end up too far offshore of the Lower Cape May Meadows littoral cell to be of any benefit in beach restoration.

This alternative will not be considered further in this study, however, the use of updrift sand sources will continue to be evaluated in the future for both the existing Federal project at Cape May City and at The Meadows should a project be recommended at this location.

I. Problem: Long-term Ecosystem Degradation and Habitat Loss at Lower Cape May Meadows

A.) Objective: Protect and Restore Beach and Freshwater Wetland Habitat

Goal #2: Restore Previously Eroded or Overwashed Habitat

Structural Solutions

- Restore beach habitat
- Restore wetland habitat

Restore beach habitat. This alternative involves the extension of the shoreline seaward through the placement of sand, probably from an offshore borrow site, to restore (from the existing shoreline) what has been lost through years of erosion. This would increase beach habitat available for various species as well as incidentally providing storm protection and additional recreational beach. Material would be graded and planted to produce high quality beach habitat that naturally develops to form a substantial dune system. The extent of beach creation would depend on the results of an incremental analysis, as well as coordination with various agencies (for instance there may be an optimal beach habitat length for piping plovers). It would also need to be determined if seaward extension of the shoreline would increase the erosion rate due to increased exposure to wave action. This alternative will be analyzed further in the cycle 2 formulation.

Restore wetland habitat This alternative would involve the restoration of freshwater wetland habitat lost to either years of erosion or overwash by sand. Regarding the former, the current shoreline would be extended seaward so that lost acres of freshwater wetland habitat could be restored. Concerns over possible increased erosion due to the seaward location and high costs need to be addressed. Another solution involves removing overwashed sand that has covered the existing freshwater habitat could be removed relatively inexpensively. This alternative will be analyzed further in the cycle 2 formulation.

B.) Objective: Improve Internal Water Quality

Goal #1) Reduce Saltwater Intrusion Due to Storm Activity

The meeting of Objective A will concurrently satisfy this goal. Descriptions of these alternatives are identical. These same alternatives will be analyzed further in cycle 2 plan formulation.

B.) Objective: Improve Internal Water Quality

Goal #2) Reduce Organic Loading From Lake Lily

Dredge Lake Lily. Lake Lily could be dredged and the material properly disposed if it was determined that the water quality of Lake Lily negatively impacts The Meadows. Other questions include finding a disposal area for the material. This alternative will be analyzed further in cycle 2 plan formulation.

B.) Objective: Improve Internal Water Quality

Goal #3) Increase Water Movement through Meadows

(Re)establish drainage between ponds. This alternative involves restoring drainage/flow among the ponds at The Meadows. Small-scale drainage ditches and some small water-control structures can be constructed at a few optimal locations to provide flushing of The Meadows. This would improve water quality by eliminating some of the shallow stagnant water that exists in some areas. This alternative will be analyzed further in cycle 2 plan formulation.

C.) Objective: Eliminate/control Nuisance Plant Species (Phragmites australis)

Herbicidal spraying and burning. This alterative is the most effective way of eliminating nuisance plants like Phragmites australis. It involves first spraying the desired plants with herbicide and then burning the remaining organic material to ensure destruction of the plant. Need to determine if burning would be acceptable due to the proximity to a residential area and its effect on migrating birds. This alterative will be analyzed further in cycle 2 plan formulation.

Water level management. This alternative involves using water level management to control or eliminate Phragmites australis. If sufficient levels of water could be impounded, it may be able to either "flood out" or at least control the further spread of Phragmites australis. This alternative will be analyzed further in cycle 2 plan formulation.

Planting desirable plant species. This could be used to deter the further spread or reemergence (in areas where it may have been eliminated) of Phragmites australis and would be accomplished in conjunction with elimination of Phragmites australis. Needs to be determined what plants are most appropriate. This alternative will be analyzed further in cycle 2 plan formulation.

Excavation. Excavation of the nuisance plant is not as effective as spraying or burning due to the greater chance of reoccurrence. In addition, will need to use heavy equipment on-site to excavate the 12"-24" of material needed. Excavation may incidentally increase ponding areas. Disposal of material may be a problem. This alternative will be analyzed further in cycle 2 plan formulation.

Improve flushing of wetlands. This alternative is similar to the solution mentioned above in Goal #3 of Objective A. This may also have value in preventing reestablishment or controlling growth area of Phragmites australis. This alternative will be analyzed further in cycle 2 plan

formulation.

D.) Objective: Increase Availability of Freshwater

Create water reservoirs within ponds. Water reservoirs can be created in selected ponds to prevent frequent drying-out of ponds. This alternative will be analyzed further in cycle 2 plan formulation.

Reconnect hydrologic units in combination with water control structures . Creation of hydrologic links along with small-scale water control structures could be constructed at optimal areas to increase ponding areas throughout The Meadows. This alternative will be analyzed further in cycle 2 plan formulation.

II. Problem: Storm Damage to the Towns of Cape May Point and West Cape May

A.) Objective: Reduce Oceanwater Flooding via The Meadows to Cape May Point and West Cape May

Non Structural Solutions
- No action
- Regulation of future development
- Permanent Evacuation

Structural Solutions
- Same as alternatives A through K listed under Objective A. Descriptions are identical. These same alternatives will be analyzed further in cycle 2 plan formulation.
- Dike

Non-Structural Solutions

No Action. The no action alternative involves no measures to provide storm damage protection to structures. This alternative would not prevent property from being subjected to higher storm damages from flooding. The existing Meadows ' shoreline would continue to erode, making the towns of Cape May Point and West Cape May more vulnerable to storm damage. This plan fails to meet any of the objectives or needs of the study. Therefore, it will not be considered in cycle 2.

Evacuation From Areas Subject to Storm Damage. Permanent evacuation of existing developed areas subject to storm damage involves the acquisition of lands and structures either by purchase or through the exercise of powers of eminent domain, if necessary. Following this action, all commercial and residential property in areas subject to erosion/storm damage are either

demolished or relocated to another site. The level of development at Cape May Point and West Cape May would make this measure expensive. The cost of long-term shore protection to this area is low compared to the cost of permanent evaluation of the residences. The towns of Cape May Point and West Cape May contain many structures that house year-round residents, many of which are retired. Permanent evacuation would probably meet with strong opposition from locals. This alternative will not be considered in cycle 2.

Regulation of Future Development. Regulation or land use controls could be enacted through codes, ordinances, or other regulations to minimize the impact of erosion on lands which could be developed in the future. Such regulations are traditionally the responsibility of State and local governments. There are already state and local regulations in place to control future development and reduce susceptibility to damage such as CAFRA as amended. This alternative will not be considered in cycle 2.

Structural Solutions

See alternatives A-K under Objective IA. Most, if not all, of the flooding problems that exist at Cape May Point and West Cape May due to the breaching of the dunes at The Meadows will be eliminated if storm damage protection is provided at The Meadows frontage. Therefore these alternatives, placed along The Meadows' shorefront, would accomplish the desired objective and will be considered further in cycle 2.

Dike construction. A dike can be placed along the perimeter (Lighthouse Ave and Sunset Blvd) to keep out ocean floodwaters flowing from The Meadows. If The Meadows was allowed to continue eroding, resulting in a further reduction in the storm buffer, this dike would have to be substantial in height to prevent storm damages. Interior drainage structure(s) may be needed to be created to ensure flow of water away from towns. This alternative will be further evaluated in the cycle 2 plan formulation.

B.) Objective: Reduce Storm Damage Vulnerability along Cape May Point Oceanfront

Non-Structural Solutions

- No action
- Regulation of future development
- Permanent Evacuation

No Action. The no-action alternative involves no measures to provide storm damage protection to structures. This alternative would not prevent property from being subjected to higher storm damages from flooding. This plan fails to meet any of the objectives or needs of the study. Therefore, this alternative will not be considered in cycle 2.

Regulation of future development. Regulation or land use controls could be enacted through codes, ordinances, or other regulations to minimize the impact of erosion on lands which could be developed in the future. There are regulations in place to control future development and reduce susceptibility to damage such as CAFRA as amended. Such regulations are traditionally the responsibility of State and local governments. The Borough of Cape May Point already has strict regulations on future development. This alternative will not be considered in cycle 2.

Permanent Evacuation. Permanent evacuation of existing developed areas subject to storm damage involves the acquisition of lands and structures either by purchase or through the exercise of powers of eminent domain, if necessary. Following this action, all commercial and residential property in areas subject to erosion/storm damage are either demolished or relocated to another site. The level of development at Cape May Point would make this measure expensive. The cost of long-term shore protection to this area is probably low compared to the cost of permanent evaluation of the residences. The town of Cape May Point contains many structures that house year-round residents, many of whom are retired. Permanent evacuation would probably meet with strong opposition from these locals. This alternative will not be considered in cycle 2.

Structural Solutions

- Berm restoration only
- Dune restoration only
- Berm & dune restoration
- Berm and dune restoration using structural dune reinforcement
- Bulkhead, seawall..etc
- Offshore detached breakwater
- Berm & dune restoration w\offshore detached breakwater at The Meadows
- Perched beach
- Offshore submerged feeder berm
- Beach dewatering

Berm restoration. Same description as found under Objective IA. The presence of an existing significant dune system along some sections of Cape May Point makes this alternative more viable than at The Meadows, where only a small dune system exists. However, since some areas of Cape May Point would benefit greatly from a dune, this alternative will not be examined further in cycle 2.

Dune restoration. Same description as found under Objective IA. The existing dunes are currently vulnerable due to the lack of a protective berm. Since, this alternative does not include a protective berm, this alternative will not be examined further in cycle 2.

Berm & dune restoration. Same description as found under Objective IA. In areas where the existing dunes are greater than the design dune, only a berm would need to be constructed in that

area. This alternative will be considered further in cycle 2 plan formulation.

Berm and dune restoration using structural dune reinforcement. Same description as found under Objective IA. Dune reinforcement may be unnecessary in some areas where significant dunes exist. This alternative will be considered further in cycle 2 plan formulation.

Bulkhead, seawall..etc Same description as found under Objective IA except for the ecosystem concerns. In addition, due to it's unique location, the wave, current, and tide processes would probably allow for severe scour. This alternative will not be examined further in cycle 2.

Offshore detached breakwater Same description as found under Objective IA. Submerged breakwater already in place at most appropriate locations in Cape May Point. Monitoring of the long-term effectiveness of these structures on the shoreline ongoing. This alternative will not be examined further in cycle 2.

Berm & dune restoration w\offshore detached breakwater. Same description as found under Objective 1A. Also see above. This alternative will not be examined further in cycle 2.

Perched beach Same description as found under Objective IA.

Offshore submerged feeder berm. Same description as found under Objective IA. This alternative will not be examined further in cycle 2.

Beach dewatering. Same description as found under Objective IA. This alternative will not be examined further in cycle 2.

A summary of the results of the Cycle 1 formulation process follows:

IA.) OBJECTIVE: PROTECT AND RESTORE BEACH AND FRESHWATER WETLAND HABITAT						
Goal #1) Protect Existing Habitat from Future Damages						
Possible Solutions	Technical Appropriateness	Meet Objective?			Relative Cost	Further Consideration in Cycle 2?
		Erosion Protection	Inundation Protection	Wave Attack Protection		
No action	No	No	No	No		No
Berm restoration only	Yes	Yes	Partial	Yes	Moderate to high depending on amount of sand needed	No
Dune restoration only	Yes	No	Partial	Partial	Low	No
Berm & dune restoration	Yes	Yes	Yes	Yes	Low to moderate depending on amount of material and nourishment frequency	Yes
Berm and dune restoration using structural reinforcement	Yes	Yes	Yes	Yes	Moderate	Yes
Berm & dune restoration w\ groin field (stone or geotextile tube)	Yes	Yes	Yes	Yes	Moderate to high initial	Yes
Berm and dune creation with structural reinforcements and groin field	Yes	Yes	Yes	Yes	High initial	Yes
Bulkhead, seawall..etc	Yes	Yes	Yes	Yes	High	No. Environmentally and aesthetically unfavorable at Meadows frontage.
Offshore detached breakwater	Partial	Partial	No	Partial	Moderate	No

IA.) OBJECTIVE: PROTECT AND RESTORE BEACH AND FRESHWATER WETLAND HABITAT						
Goal #1) Protect Existing Habitat from Future Damages						
Possible Solutions	Technical Appropriateness	Meet Objective?			Relative Cost	Further Consideration in Cycle 2?
		Erosion Protection	Inundation Protection	Wave Attack Protection		
Berm & dune restoration w\offshore detached breakwater at Meadows	Partial	Yes	Yes	Yes	Moderate to high depending on length of breakwater	No
Perched beach	Partial	Partial	No	Partial	High	No
Offshore submerged feeder berm	Partial	Partial	No	Partial	Low. Less cost than direct beachfill placement.	No
Beach dewatering	No	Partial	No	Partial	Moderate. Long-term maintenance costs are unknown.	No
Mechanical sand bypassing from Cape May City	Partial	Partial	Partial	Partial	Moderate	No
Modify groin(s) at Cape May City to allow for increased natural downdrift sand transport to Meadows	Partial	Partial	Partial	Partial	Moderate to high initial	No
Modification of the Cape May Inlet jetties	No	No	No	No		No
Sand-bypassing around Cape May Inlet	No	No	No	No		No

IA.) OBJECTIVE: RESTORE AND PROTECT BEACH AND FRESHWATER WETLAND HABITAT				
Goal #2) Restore Previously Eroded or Overwashed Habitat				
Possible Solutions	Technical Appropriateness	Meet Objective?	Relative Cost	Further Consideration in Cycle 2?
Restore beach habitat	Yes. Beachfill placement could easily and inexpensively be accomplished.	Yes	Low	Yes
Restore wetland habitat	Yes. Some of this may be restored by simply removing sand overwash that covers the existing wetlands. While large scale restoration involving the seaward creation of wetlands would need organic substrate to be placed.	Yes	Moderate to high depending on extent	Yes

IB.) OBJECTIVE: IMPROVE INTERNAL WATER QUALITY				
Goal #1) Reduce Saltwater Intrusion Due to Storm Activity				
Possible Solutions	Technical Appropriateness	Meet Objective?	Relative Cost	Further Consideration in Cycle 2?
See structural alternatives considered under objective IA1	see under objective IA1	Yes	Variable	Yes

IB.) OBJECTIVE: IMPROVE INTERNAL WATER QUALITY				
Goal #2) Reduce Organic Loading from Lake Lily				
Possible Solutions	Technical Appropriateness	Meet Objective?	Relative Cost	Further Consideration in Cycle 2?
Dredge Lake Lily	Yes. Need to find disposal site that would accept material. Could use existing disposal site at Cape May Inlet?	Maybe. Would also improve water quality at Meadows	Low to moderate	Yes

IB.) OBJECTIVE: IMPROVE INTERNAL WATER QUALITY				
Goal #3) Increase Water Movement Through Meadows				
Possible Solutions	Technical Appropriateness	Meet Objective?	Relative Cost	Further Consideration in Cycle 2?
(Re)establish drainage between ponds	Yes	Yes	Low	Yes

IC.) OBJECTIVE: ELIMINATE/CONTROL NUISANCE PLANT SPECIES (Phragmites australis)				
Possible Solutions	Technical Appropriateness	Meet Objective?	Relative Cost	Further Consideration in Cycle 2?
Herbicidal Spraying & Burning	Yes	Yes	Moderate	Yes
Water level management (control structures, excavation...etc)	Partial. Probably not effective in eliminating existing Phragmites due to the difficulty in generating enough water. Can be used for future deterrence.	Partial	Moderate	Yes

IC.) OBJECTIVE: ELIMINATE/CONTROL NUISANCE PLANT SPECIES (Phragmites australis)				
Possible Solutions	Technical Appropriateness	Meet Objective?	Relative Cost	Further Consideration in Cycle 2?
Planting desirable plant species	Yes	Partial. Used in combo following the eradicating nuisance species	Low	Yes
Excavation	Yes. Not as effective as burning and spraying.	Yes	Moderate	Yes
Improve flushing of wetlands	Yes.	Partial. Most effective when used in conjunction with spraying and burning or excavation.	Low	Yes

ID.) OBJECTIVE: INCREASE AVAILABILITY OF FRESHWATER				
Possible Solutions	Technical Appropriateness	Meet Objective?	Relative Cost	Further Consideration in Cycle 2?
Create water reservoirs within ponds	Yes. Material could be excavated to provide more storage space for freshwater retainment.	Yes	Low	Yes
Reconnect hydrologic units in combination with water control structures	Yes. Small-scale ditching and water control structures can be used to increase flow and retain freshwater.	Yes	Low	Yes

IIA.) OBJECTIVE: REDUCE OCEANWATER STORM INUNDATION VIA THE MEADOWS TO CAPE MAY POINT AND WEST CAPE MAY				
Possible Solutions	Technical Appropriateness	Meet Objective?	Relative Cost	Further Consideration in Cycle 2?
Non-structural solutions			Varies	No
No action	No	No		
Regulation of future Development	No	No		
Permanent evacuation	No	No	High	
See structural solutions listed under Objective 1A1	Yes. See table under Objective 1A1	See Objective 1A1	See Objective 1A1	Yes
Dike(s) along with possible drainage structures located to protect Cape May Point and West Cape May.	Yes	Yes	Moderate	Yes

IIB.) OBJECTIVE: REDUCE STORM DAMAGE VULNERABILITY ALONG CAPE MAY POINT OCEANFRONT						
Possible Solutions	Technical Appropriateness	Meet Objective?			Relative Cost	Further Consideration in Cycle 2?
		Erosion Protection	Inundation Protection	Wave Attack Protection		
Non-Struct Alt.					Varies	No
No action		No	No	No		
Regulation of future Development	No. Development already regulated.	No	No	No		
Permanent evacuation	No	No	No	No	High	

IIB.) OBJECTIVE: REDUCE STORM DAMAGE VULNERABILITY ALONG CAPE MAY POINT OCEANFRONT						
Possible Solutions	Technical Appropriateness	Meet Objective?			Relative Cost	Further Consideration in Cycle 2?
		Erosion Protection	Inundation Protection	Wave Attack Protection		
Berm restoration only	Yes	Yes	Partial	Yes	Moderate	No
Dune restoration only	No	No	Partial	Partial	Low	No
Berm & dune restoration	Yes	Yes	Yes	Yes	Low to moderate	Yes
Berm and dune restoration using structural dune reinforcement	Yes	Yes	Yes	Yes	Moderate	Yes
Bulkhead, seawall..etc	Partial	Yes	Yes	Yes	High	No
Offshore detached breakwater	Partial	Partial	No	Partial	Moderate	Yes
Berm & dune restoration w\offshore detached breakwater	Partial	Yes	Yes	Yes	Moderate	Yes
Perched beach	Partial	Partial	No	Partial	High	No
Offshore submerged feeder berm	Partial	Partial	No	Partial	Low	No
Beach dewatering	No	Partial	No	Partial	Moderate	No. Inappropriate at this location.

5.5 Cycle 2 - 2nd Level Screening of Solutions Considered

The purpose of cycle 2 is to further narrow down the number of alternatives for consideration in cycle 3. Only those alternatives that are practical, in terms of the engineering, environmental, social and economic impacts remained after the completion of cycle 2.

Based on the sensitive and significant ecosystem located at The Meadows, heavy consideration was given to alternatives that suit the existing ecosystem. For instance, while a concrete seawall may provide similar protection as a dune and berm restoration, the latter alternative not only provides protection but also increases (restores) valuable wildlife habitat and merges favorably with the existing ecosystem. Favorable alternatives were those which would not create a substantial disturbance to the existing ecosystem, whether it be from construction activities or from the final project characteristics.

Results of the cycle 2 formulation process are as follows:

CYCLE 2 PLAN FORMULATION - 2ND LEVEL SCREENING OF ALTERNATIVES CONSIDERED

I. PROBLEM: **Long-term ecosystem degradation and habitat loss at Lower Cape May Meadows**

CAUSE: **Long-term erosion due to interruption of littoral material by the jetties at Cape May Inlet has allowed for beach and wetland erosion, breaching of dunes, and wave overtopping, and breaching of dunes during storm events at Lower Cape May Meadows**

IA.) OBJECTIVE: PROTECT AND RESTORE BEACH AND FRESHWATER WETLAND HABITAT							
Goal #1) Protect Existing Habitat from Future Damages							
Possible Solutions	Design Considerations	Environmental Considerations	Social Considerations	Relative Costs	Potential to Meet Objective	Further Consideration in Cycle 3?	Remarks
Berm & dune restoration	Provides high level of storm protection. Requires future periodic nourishment.	Impacts benthic habitat at borrow area. Greater dune design height than existing may necessitate covering of existing dune grasses	May encourage recreational beach use. Increases aesthetic value.	Low to moderate, depending on amount of sand needed and frequency of renourishment cycle	High	Yes	
Berm and dune creation with structural reinforcements (geotextile tubes, Tensar mattress...etc)	Similar to previous. May provide greater level of protection and/or reduce future nourishment needs.	Same as previous.	Could be aesthetically displeasing if reinforcement left uncovered	Depends on the amount of structural reinforcement	High	Yes	Difficult to accurately quantify the increased level of shore protection (cost-effectiveness) using available computer storm simulation models.

CYCLE 2 PLAN FORMULATION - 2ND LEVEL SCREENING OF ALTERNATIVES CONSIDERED

IA.) OBJECTIVE: PROTECT AND RESTORE BEACH AND FRESHWATER WETLAND HABITAT							
Goal #1) Protect Existing Habitat from Future Damages							
Possible Solutions	Design Considerations	Environmental Considerations	Social Considerations	Relative Costs	Potential to Meet Objective	Further Consideration in Cycle 3?	Remarks
Berm & dune restoration w\ groin field (stone or geotextile tube)	Same as previous. Groin field should reduce erosion rates and therefore reduce periodic renourishment quantity. Groin foundation stability questionable due to migrating deep offshore trench. Geotextile tube groins may be too easily moved out of place during significant storm events.	Same as above. Groins alter beach habitat characteristics depending on number of groins constructed. Benthic habitat covered up where groins are placed. Environmental agencies not enthusiastic of creation of "rocky" habitat.	Groins may reduce aesthetics. May increase number of people that fish off of the groins similar to Cape May Point	High initial construction but should reduce future nourishment costs	High	Yes	
Berm and dune creation with structural reinforcements and groin field	See above. Provides very high level of protection and erosion control.	see above comments	see above comments	High	High initial	Yes	Combination of above alternatives.

CYCLE 2 PLAN FORMULATION - 2ND LEVEL SCREENING OF ALTERNATIVES CONSIDERED

IA.) OBJECTIVE: PROTECT AND RESTORE BEACH AND FRESHWATER WETLAND HABITAT AT LOWER CAPE MAY MEADOWS							
Goal #2) Restore Previously Eroded or Overwashed Habitat							
Possible Solutions	Design Considerations	Environmental Considerations	Social Considerations	Relative Costs	Potential to meet objective	Further Consideration in Cycle 3?	Remarks
Restore eroded beach habitat	Beachfill placement could easily and inexpensively be accomplished. Would also serve to provide protection for internal freshwater wetlands.	Would remove benthic habitat from offshore borrow area. Would increase beach habitat units (HU).	Increase recreational beach area	Low to moderate, depending on the amount of habitat added	Low. Comparison to past shoreline conditions show that while the shoreline has been eroding, beach acreage seems relatively similar.	No	
Restore freshwater habitat by removing sand overwash	Would simply involve using heavy equipment to uncover wetlands.	Would add valuable freshwater wetland habitat. Increase habitat units (HU) at area.	Increase wetland acreage at State Park and Nature Conservancy properties.	Low	Moderate, wouldn't restore much lost habitat	Yes	
Restore eroded wetland habitat through creating freshwater wetlands	More difficult to design and possibly maintain than beach habitat.	Would add valuable freshwater wetland habitat. Increase habitat units (HU) at area.	Increase wetland acreage at State Park and Nature Conservancy properties.	Moderate to high	High	Yes	

CYCLE 2 PLAN FORMULATION - 2ND LEVEL SCREENING OF ALTERNATIVES CONSIDERED

IB) OBJECTIVE: IMPROVE INTERNAL WATER QUALITY							
Goal #1) Reduce Saltwater Intrusion Due to Storm Activity							
Possible Solutions	Prelim Design Considerations	Environmental Considerations	Social Considerations	Relative Costs	Potential to meet objective	Further Consideration in Cycle 3?	Remarks
Same as structural alternatives listed under objective IA1.	Same as listed under objective IA1	Same as listed under objective IA1	Same as listed under objective IA1	Same as listed under objective IA1	Same as listed under objective IA1	Yes	The alternatives listed under IA1 should reduce future storm damage.

IB.) OBJECTIVE: IMPROVE INTERNAL WATER QUALITY							
Goal #2) Reduce Organic Loading from Lake Lily							
Possible Solutions	Design Considerations	Environmental Considerations	Social Considerations	Relative Costs	Potential to meet objective	Further Consideration in Cycle 3?	Remarks
Remove some of the organic waste material from the bottom of Lake Lily	Can be dredged and disposed.	Temp fix only? A one-time dredge of material would temp alter composition of sediment on bottom of lake but wildlife will continue to produce waste in the lake in the future. Would also need to find disposal site that would accept material. Should improve quality of freshwater flowing into the Meadows. This needs to be quantified.	Local officials are in favor. Will improve aesthetics of lake.	Low initial cost. Uncertain future costs depending on if future dredging is appropriate.	High. Testing still needs to be accomplished to determine levels of organic waste flowing out of Lake Lily and entering The Meadows.	Yes	The organic material that exists in Lake Lily also exists in the Meadows. It needs to be determined whether the material from Lake Lily contributes significantly to any water quality problems at the Meadows.

CYCLE 2 PLAN FORMULATION - 2ND LEVEL SCREENING OF ALTERNATIVES CONSIDERED

IB.) OBJECTIVE: IMPROVE INTERNAL WATER QUALITY							
Goal #3) Increase Water Movement through Meadows							
Possible Solutions	Design Considerations	Environmental Considerations	Social Considerations	Relative Costs	Potential to meet objective	Further Consideration in Cycle 3?	Remarks
(Re)establish drainage between existing ponds	Clearing or excavating of drainage channels along with water control structures (if needed) can be easily implemented. Solar powered pumps could be used if needed to facilitate drainage	Should give net benefits to the entire area due to increased drainage and aeration. Due to limited freshwater availability in system , may have detrimental effect on other areas at Meadows if water is diverted elsewhere.	Improve aesthetic value of Meadows. May temporarily disturb wetlands during construction	Low	High	Yes	Need to identify what areas are most appropriate.

CYCLE 2 PLAN FORMULATION - 2ND LEVEL SCREENING OF ALTERNATIVES CONSIDERED

IC.) OBJECTIVE: ELIMINATE/CONTROL NUISANCE PLANT SPECIES (PHRAGMITES AUSTRALIS)							
Possible Solutions	Design Considerations	Environmental Considerations	Social Considerations	Relative Costs	Potential to meet objective	Further Consideration in Cycle 3?	Remarks
Herbicidal Spraying & Burning	Can aerial spray or use backpacks	The most effective method to eliminate nuisance species. Can potentially be harmful to endangered plant species that exist among Phragmites not precise with spraying/burning	Need to determine if burning would be acceptable due to the proximity to a residential area and presence of migratory birds	Low	High	Yes	Coordination needed with Federal, state and county agencies.
Water level management	Possible methods include water control structures, excavation...etc	Probably not effective in eliminating existing Phragmites due to the limited water availability needed to "drown" out. Can be used to deter Phrag from returning. May incidentally increase waterfowl use.	Would increase aesthetics	Moderate	Moderate	Yes	More effective with regard to future deterrence.
Planting desirable plant species		Can be used to help control future invasion of nuisance plants. Would also increase quality of habitat and wildlife.	Would increase aesthetics	Low	Moderate	Yes	Need to determine what types of plants and areas to plant. May just see what naturally grows following the initial elimination of Phragmites

CYCLE 2 PLAN FORMULATION - 2ND LEVEL SCREENING OF ALTERNATIVES CONSIDERED

IC.) OBJECTIVE: ELIMINATE/CONTROL NUISANCE PLANT SPECIES (PHRAGMITES AUSTRALIS)							
Possible Solutions	Design Considerations	Environmental Considerations	Social Considerations	Relative Costs	Potential to meet objective	Further Consideration in Cycle 3?	Remarks
Excavation and removal of Phragmites	Can excavate 12"-24" inches of material. This would also incidentally increase ponding area.	Not as effective as burning and spraying. Possibility of disturbance of "good" areas may limit use of heavy equipment. Disposal area would have to be found for material.	Would temporarily disturb wetlands during construction.	Moderate	Moderate	Yes	May be used in combination or if previous alternatives are not viable.
Improve flushing/drainage of wetlands	Similar to Objective IB, Goal # 3 above.	Similar to Objective IB3 above. Establishing adequate flushing/drainage can prevent reestablishment of nuisance plant species. Need to determine optimum locations.	Would increase aesthetics. May temporarily disturb wetlands during construction	Low	Moderate. Most effective when used following removal of plants.	Yes	Similar to Objective IB3

CYCLE 2 PLAN FORMULATION - 2ND LEVEL SCREENING OF ALTERNATIVES CONSIDERED

ID.) OBJECTIVE: INCREASE AVAILABILITY OF FRESHWATER							
Possible Solutions	Design Considerations	Environmental Considerations	Social Considerations	Relative Costs	Potential to meet objective	Further Consideration in Cycle 3?	Remarks
Reconnect hydrologic units in combination with water control structures	Can place low-cost water control structures to control depth of certain ponding areas. Ditches can also be constructed to reestablish hydrologic connection.	Will improve habitat and possible increase bird population. May incidentally control Phragmites at these areas. See Objective 1C.	Improve aesthetic value of Meadows. Construction may temporarily disturb wetlands	Low	High	Yes	
Create water reservoirs within ponds	Can excavate material in ponds to create more storage capacity to maintain freshwater.	Help fish survival, mosquito control, and water availability to birds.	Improve aesthetic value of Meadows. Construction may temporarily disturb wetlands	Low	High	Yes	

CYCLE 2 PLAN FORMULATION - 2ND LEVEL SCREENING OF ALTERNATIVES CONSIDERED

II. PROBLEM: Oceanwater inundation via The Meadows to the towns of Cape May Point and West Cape May

CAUSE: Long-term erosion due to the interruption of littoral material by the jetties at Cape May Inlet allows for beach and wetland erosion, breaching of dunes, and wave overtopping during storm events at Lower Cape May Meadows. This subsequently allows oceanwater storm inundation to extend to both the towns of Cape May Point and West Cape May. In addition, the shoreline of Cape May Point is vulnerable to storm damage through wave attack and storm erosion.

IIA.) OBJECTIVE: REDUCE OCEANWATER INUNDATION VIA THE MEADOWS TO CAPE MAY POINT AND WEST CAPE MAY							
Possible Solutions	Design Considerations	Environmental Considerations	Social Considerations	Relative Costs	Potential to meet objective	Further Consideration in Cycle 3?	Remarks
Identical to alternatives listed under Objective IA1	Identical to those listed under Objective IA1. Dune height may have to be increased to provide adequate protection to these areas.	Identical to solutions listed under Objective IA1	Identical to those listed under Objective IA1	Identical to those listed under Objective IA1	Identical to those listed under Objective IA1	Yes	Identical to those listed under Objective IA1.
Dike(s) along with possible drainage structures (if needed) located along Cape May Point and West Cape May.	Can be placed along perimeter of towns (Lighthouse Ave and Sunset Blvd). Drainage structure(s) such as a swale may need to be created to ensure flow of water away form towns.	Depending on the size of dike, some upland habitat may be destroyed	May reduce aesthetics of area	Moderate to High	High	Yes	Since most, if not all, of the flooding problem may be incidentally solved by meeting Objective IA. It may not be cost-effective for an "additional" dike. However, this still needs to be verified during the Cycle 3 analysis

CYCLE 2 PLAN FORMULATION - 2ND LEVEL SCREENING OF ALTERNATIVES CONSIDERED

IIB.) OBJECTIVE: REDUCE STORM DAMAGE VULNERABILITY ALONG CAPE MAY POINT OCEANFRONT							
Possible Solutions	Design Considerations	Environmental Considerations	Social Considerations	Relative Costs	Potential to Meet Objective	Further Consideration in Cycle 3?	Remarks
Berm & dune creation	Provides high level of storm protection. Requires future periodic nourishment.	Impacts benthic habitat at borrow area. Greater dune design height than existing may necessitate covering of existing dune grasses	Also increases aesthetic value by dune grass planting.	Low to moderate	High	Yes	
Berm & dune restoration w/offshore detached breakwater	similar as previous	similar as previous	similar as previous	Moderate	similar as previous	No	Breakwater can reduce maintenance quantities. Cost must be offset by reduced future nourishment quantities due to breakwater. Potential for foundation problems at this area.
Berm and dune creation using structural reinforcements (geotextile tube, Tensar® mattress...etc)	Similar to above. Should provide greater level of protection and reduce future nourishment needs.	Same as above.	Could be aesthetically displeasing if reinforcement left uncovered.	Low to moderate depending on the amount of structural reinforcement needed.	High	Yes	Difficult to quantify the increased level of shore protection using current computer storm simulation models.

ALTERNATIVES RECOMMENDED FOR CYCLE 3 PLAN FORMULATION

The cycle 1 and cycle 2 plan formulation screening process eliminated many of the alternative measures considered. The solutions recommended for further study in cycle 3 are listed below:

I. PROBLEM: LONG-TERM ECOSYSTEM DEGRADATION AND HABITAT LOSS AT LOWER CAPE MAY MEADOWS

CAUSE: Long-term erosion due to the jetties at Cape May Inlet has allowed for beach and wetland erosion, breaching of dunes, and wave overtopping during storm events at Lower Cape May Meadows.

A.) OBJECTIVE: PROTECT AND RESTORE BEACH AND FRESHWATER WETLAND HABITAT

Goal #1) Protect Existing Habitat from Future Damages

Structural Solutions

- Berm and dune restoration
- Berm and dune restoration with groin field
- Berm and dune restoration using structural reinforcement
- Berm and dune restoration using structural reinforcement with groin field

Goal #2) Restore Previously Eroded or Overwashed Habitat

- Remove sand overwash
- Create freshwater wetlands

B.) OBJECTIVE: IMPROVE INTERNAL WATER QUALITY

Goal #1) Reduce Saltwater Intrusion Due to Storm Activity

- Same as under IA1 listed above

Goal #2) Reduce Organic Loading from Lake Lily

- Remove material (dredge) from bottom of Lake Lily

Goal #3) Increase Water Movement through Meadows

- (Re)establish drainage between ponds

C.) OBJECTIVE: ELIMINATE/CONTROL NUISANCE PLANT SPECIES (PHRAGMITES AUSTRALIS)

- Herbicidal spraying and burning
- Water level management
- Planting of desirable plant species
- Excavation

- Improve flushing/drainage of wetlands

D.) <u>OBJECTIVE:</u> INCREASE AVAILABILITY OF FRESHWATER

- Create water reservoirs within ponds
- Reconnect hydrologic units in combination with water control structures

II. PROBLEM: STORM DAMAGE TO THE TOWNS OF CAPE MAY POINT AND WEST CAPE MAY

<u>CAUSE:</u> **Long-term erosion due to the interruption of littoral material by the jetties at Cape May Inlet has allowed for beach and wetland erosion, breaching of dunes, and wave overtopping during storm events at Lower Cape May Meadows. This subsequently allows oceanwater storm inundation to extend to both towns of Cape May Point and West Cape May. In addition, the shoreline of Cape May Pointis vulnerable to storm damage through wave attack and storm erosion.**

A.) OBJECTIVE: REDUCE OCEANWATER STORM INUNDATION VIA THE MEADOWS TO CAPE MAY POINT AND WEST CAPE MAY

- See solutions listed under Objective IA1
- Dike(s) along with possible drainage structures (if needed) located along Cape May Point and West Cape May.

B.) OBJECTIVE: REDUCE STORM DAMAGE VULNERABILITY ALONG CAPE MAY POINT OCEANFRONT

<u>Structural Solutions</u>

- Berm and dune restoration
- Berm and dune restoration using structural reinforcement

5.6 Cycle 3 - Final Evaluation of Alternatives

The purpose of the cycle 3 plan formulation is to examine in detail the alternatives that have progressed through the preliminary plan formulation evaluations. A list of these alternatives can be found on the previous page. Benefits and costs are generated so that a selected plan can be determined. Environmental Quality (EQ) based alternatives will be evaluated using an incremental analysis to determine the best plan for the study area.

I. Problem: Long-term Ecosystem Degradation and Habitat Loss at The Meadows

5.6.1 *A.) Objective: Protect and Restore Beach and Freshwater Wetland Habitat*

5.6.1.1 *Goal #1) Protect Existing Habitat from Future Damages*

Structural Solutions

- Protective berm and dune restoration
- Protective berm and dune restoration with groin field
- Protective berm and dune restoration using structural reinforcement
- Protective berm and dune restoration using structural reinforcement with groin field

As discussed in detail previously in this report, during moderate storm events, the protective dunes along The Meadows breach and allow ocean water to inundate portions of this area. This has not only altered the topographical features but also has impacted the freshwater ecosystem. For the ecosystem to recover, protection from both storm erosion and saltwater intrusion is needed.

Solution #1: Protective Berm and Dune Restoration

USACOE feasibility studies involving traditional economic damages (NED) determine dune/berm sizing based on cost-effectiveness, comparing the monetary damages to properties with the cost of the alternatives. The selected plan is the one with the largest net benefits (benefits minus costs). Plan selection is not accomplished with the goal of providing a specific level of protection from storm events (i.e. 50-year frequency event). Since protection at The Meadows cannot be based on reduced monetary damage to property, the cost-effectiveness of different dune/berm combinations and sizes must be analyzed in an innovative manner.

The protective dune/berm should provide protection against 2 damage mechanisms:

1.) Oceanwater overtopping and dune breaching at The Meadows
2.) Long-term and storm-induced beach erosion

Since periodic nourishment is normally a component of a dune/berm alternative, the erosion problem is easily quantified and addressed by the use of periodic nourishment, replacing the sand that is lost to erosion. For instance, if the erosion rate is 15 feet per year, that corresponding volume of sand needs to be replaced. However, quantifying the damage caused to the ecosystem by the oceanwater overtopping and dune breaching is more difficult, therefore making it more complex to measure the performance of different dune/berm combinations.

With this in mind, the following parameters were initially considered by the study team to help determine an effective protective berm/dune combination for The Meadows:

a) Present performance level of the existing dune/berm
b) "Acceptable" level of oceanwater inundation
c) Minimum berm design template desired for beach nesting birds (e.g. piping plovers)

This provided a range of possible minimum and maximum required protection scenarios. For instance, protection should be greater than without-project levels but not in excess of some "maximum" or "acceptable" level of oceanwater inundation protection. However, attempts at determining a maximum or acceptable level of protection (as defined using a HEP analysis) were found to be impractical due to the many factors involved. For instance, different plant species have varied saltwater tolerances. Some species may die with certain inundation frequencies and salinity concentrations while others live. This problem also persists when examining wildlife species. When trying to incorporate salinity effects in the HEP analysis, an appropriate existing species model needed for the HEP could not be found by CENAP-PL-E. The option of having a new species model created by another agency or individual that would be more sensitive to the amount and concentration of saltwater was also investigated with no success. The spring peeper model was created by the HEP team in an attempt to quantify the saltwater impacts. However, due to the limited information and resources available, this model has a very low sensitivity and does not adequately quantify saltwater impacts over the entire area. Therefore, for the purposes of this study, the HEP model indicates that any saltwater, in any concentration, will make the habitat unsuitable for species. Due to the location of the habitat so close to a marine environment, however, this assumption is not a fair indicator of saltwater impacts, but it was the only way these impacts could be analyzed in the HEP. It was determined that the effects of saltwater inundation at The Meadows could not be adequately quantified in the HEP analysis and must be quantified in another way.

It was determined that the method used to rate dune/berm performance would be based on "average annual acres <u>not</u> inundated by oceanwater". This quantified the amount of <u>acres protected</u> under different berm/dune configurations when using SBEACH modeling. An

incremental analysis would then be used to determine the most cost-effective solution. The reduction of saltwater intrusion to The Meadows would also be qualitatively evaluated.

Since there are a great number of berm/dune configurations that could be modeled using the SBEACH program, and since berm width and dune height interact in complex ways in the reduction of wave overtopping and breaching, "sensitivity" runs were initially conducted to obtain a general idea of performance, benefits, and initial sand quantities needed (since quantities~costs). A sensitivity analysis consisting of 12 combinations of dunes heights and berm widths was conducted. The dune heights were varied between elevations +16.0 to +24.0 ft NGVD along with examining "small, medium, and large" berm sizes. The range of dune heights used was based on the size of some dunes existing in the study area. Presently, the dunes that front The Meadows reach a height of approximately +17.0 to +18.0 ft NGVD. This dune is very thin and prone to frequent breaching when compared to a standard Corps constructed dune at the same height. Existing dune heights along Cape May Point range from +15.0 to +22.5 feet NGVD.

The 12 trial templates were placed along the entire Meadows' frontage and were also extended through the entire ocean frontage of Cape May Point since overtopping volumes from Cape May Point drain to The Meadows. Placing the templates on just The Meadows would not prevent saltwater from reaching the ecosystem since large volumes of saltwater can impact The Meadows via Cape May Point. Extending the template along Cape May Point will additionally provide storm damage reduction to residential structures in Cape May Point, thereby maximizing potential benefits to the study area. An incremental analysis will be conducted in the later phase of the optimization to determine the exact benefits and costs of extending the protective dune/berm through Cape May Point.

The interior static frequency water surface elevations for each of the 12 designs was determined and combined with the elevation-area curve of The Meadows for the year 2000 (base year) to calculate the frequency acres not inundated. Both average annual acres not inundated and incidental NED benefits (static flooding only) were calculated as well as approximate initial sand quantities. These trial runs provided an approximate assessment of performances for various berm/dune configurations, showing trends. Numerical results (sand quantities, benefits) from these trials will be different than future, more-detailed analyses. These results are shown in Table 5.6.1.1-1 and Figure 5.6.1.1-1.

Table 5.6.1.1-1

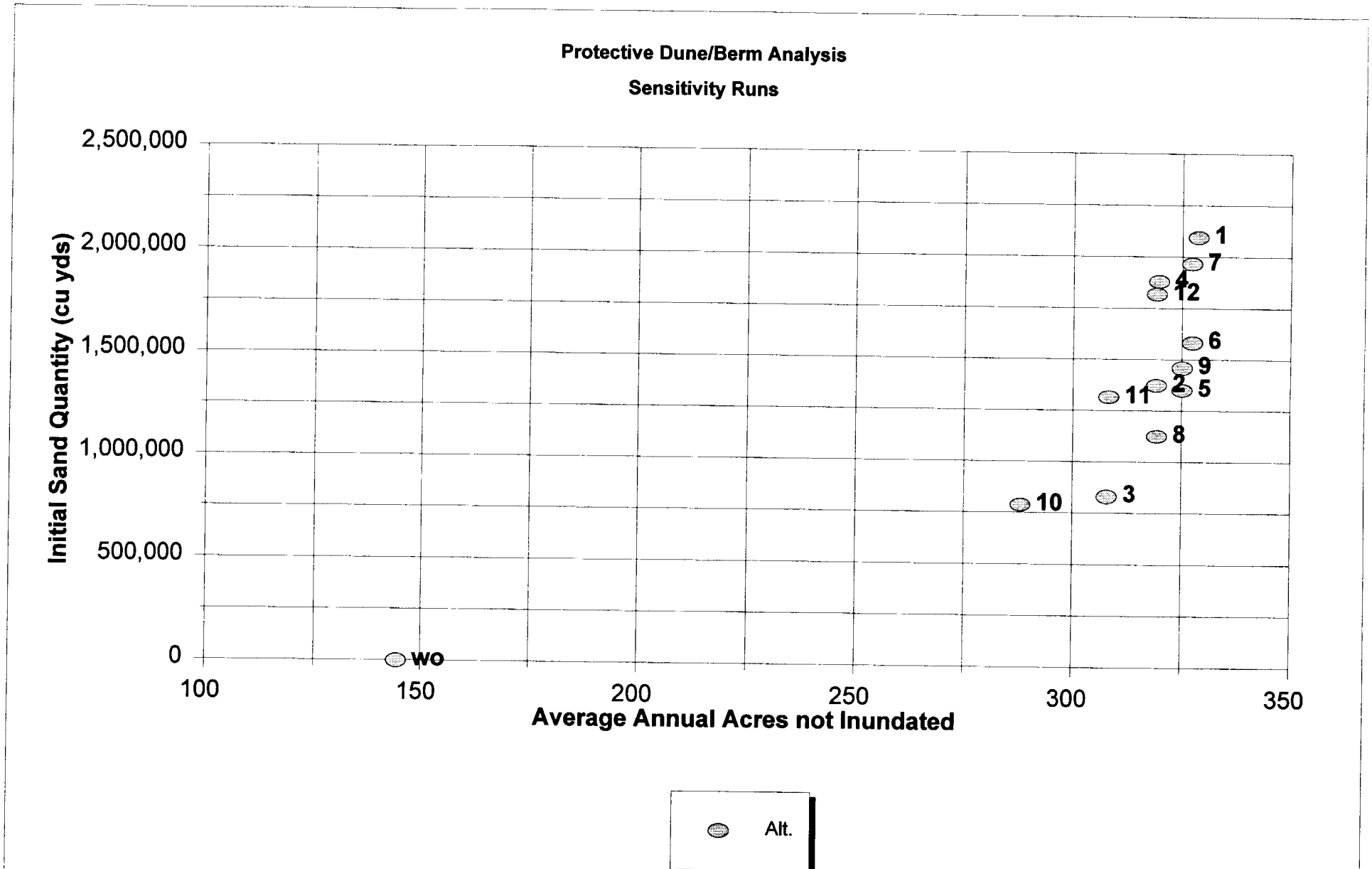
STORM DAMAGES BY PROJECT ALTERNATIVES
Sensitivity Runs
(May 1996 Price Level)

				The Meadows			Cape May Point			West Cape May					
	Berm width feet		Dune Height	Avg Annual Acres	Increased Acres	Avg Annual Structural	Avg Annual Storm Damage	Percent of Damages	Avg Annual Structural	Avg Annual Storm Damage	Percent of Damages	Approx Initial Sand Quantity (cu yds)**		
Alt.	A	B	ft NGVD	Not Inundated	Protected	Damage*	Reduction Benefits	Reduced	Damage*	Reduction Benefits	Reduced	Meadows frontage	Point frontage	Total
wo				**144.5**		**$64,030**			**$212,660**			0	0	0
1	96	207	+24	328.6	184.1	$7,170	$56,860	89%	$22,740	$189,910	89%	1,015,000	1,079,950	2,094,950
2	76	157	+18	319.2	174.7	$25,660	$38,370	60%	$92,920	$119,730	56%	575,000	797,185	1,372,185
3	26	107	+18	307.9	163.4	$34,470	$29,560	46%	$126,870	$85,780	40%	304,200	529,710	833,910
4	126	207	+18	319.6	175.1	$23,580	$40,450	63%	$84,480	$128,170	60%	850,000	1,030,105	1,880,105
5	26	133	+24	325.1	180.6	$19,130	$44,900	70%	$67,260	$145,390	68%	634,200	715,200	1,349,400
6	46	157	+24	327.4	182.9	$11,210	$52,820	82%	$37,550	$175,100	82%	737,300	847,050	1,584,350
7	114	207	+21	327.3	182.8	$14,370	$49,660	78%	$48,060	$164,590	77%	922,000	1,042,805	1,964,805
8	26	119	+21	319.3	174.8	$25,020	$39,010	61%	$90,330	$122,320	58%	440,900	683,475	1,124,375
9	64	157	+21	325.1	180.6	$19,130	$44,900	70%	$67,260	$145,390	68%	650,000	809,885	1,459,885
10	44	107	+16	288.1	143.6	$42,130	$21,900	34%	$152,840	$59,810	28%	265,000	522,930	787,930
11	94	157	+16	308.2	163.7	$32,730	$31,300	49%	$119,710	$92,940	44%	525,000	790,430	1,315,430
12	144	207	+16	319.2	174.7	$25,660	$38,370	60%	$92,920	$119,730	56%	796,000	1,023,330	1,819,330
hl				179.2	34.7	$56,980	$7,050	11%	$195,890	$16,760	8%			

wo - without project condition
hl - holding the position of the existing shoreline (beach nourishment only)
A - berm distance measured from the oceanside toe of dune at elevation +8.0 ft NGVD
B - berm distance measured from the landward edge of the dune at elevation +8.0 ft NGVD

* Static flooding damage only (SID, no COSTDAM)
** Since any periodic sand nourishment is constant for all alternatives, only initial placement quantities were considered

Figure 5.6.1.1-1



As shown in the previous table and graph, using the performance criteria of average annual acres not inundated, all designs performed relatively similar. This is because all designs protect identically against the higher frequency (2,5,10 year frequency) storm overtopping which carries more weight when annualized. Additionally, the performance criteria considers any level (depth) of saltwater in The Meadows to be damaging. However, initial sand quantities (and hence cost) for the designs varied substantially. Analysis shows that dune crest elevations of +18 or +21 feet NGVD and relatively small berms would be cost-effective. It should be noted that, as shown in the previous table and figures, the +16 ft NGVD dune, while lower in initial fill quantity, would not be as cost-effective as the + 18 ft NGVD dune.

Using results from the sensitivity analysis, a more detailed analysis was performed. Subsequent designs refined the configurations from the sensitivity runs. Coordination with USFWS was conducted to determine the minimum beach width required to effectively support nesting populations of the Federally endangered piping plover and state endangered least tern which are known to be present at The Meadows. USFWS records indicate that The Meadows supported the most productive piping plover nesting area during 1996 and 1997 in southern New Jersey. Based on this coordination, a minimum beach width of about 150 feet, as measured from the seaward toe of the dune to Mean High Water (MHW), was considered a favorable condition for plovers. This minimum beach width will be obtained with the construction of a 20 foot berm. The design templates were analyzed in two ways to determine their individual protection benefits; extension along The Meadows' frontage only, and extension along both The Meadows and Cape May Point. The design templates were only extended along the frontage of Cape May Point that drains to The Meadows. Therefore, the area from the Central Avenue groin to the Alexander Avenue groin (Figure 3-1) was not included in the analysis. SBEACH, SID, and COSTDAM modeling were conducted for each design listed in Table 5.6.1.1-2.

Table 5.6.1.1-2
Description of Designs

Design	Meadows Shoreline				Cape May Point Shoreline			
	Dune Height ft NGVD	Berm Width (ft)			Dune Height ft NGVD	Berm Width		
		A	B	C		A	B	C
1	21	50	178	188	21	50	178	188
2	21	50	178	188	no project			
3	21	20	148	157	21	20	148	157
4	21	20	148	157	no project			
5	21	50	178	188	21	20	148	157
6	21	20	148	157	21	50	178	188
7	18	50	155	188	18	50	155	188
8	18	50	155	188	no project			
9	18	50	155	188	21	50	178	188
10	18	50	155	188	21	20	148	157
11	21	50	178	188	18	50	155	188
12	21	20	148	157	18	50	155	188
13	21	50	178	188	18	20	125	188
14	21	20	148	157	18	20	125	157
15	18	50	155	188	18	20	125	157
16	18	20	125	157	18	20	125	157
17	18	20	125	157	no project			
18	18	20	125	157	21	50	178	188
19	18	20	125	157	21	20	178	188
20	18	20	125	157	18	50	155	188

A= distance measured from seaward toe of dune (standard USACOE berm definition)
B= distance measured from landward toe of dune
C= distance measured from seaward toe of dune down to MHW (considered beach width)

The damage mechanisms of the design templates as determined by the SBEACH modeling were compared with the existing conditions and summarized in the following table.

Table 5.6.1.1-3
Summary of SBEACH Damage Mechanism

Area	Plan	Storm Frequency*							
		2 yr	5 yr	10 yr	20 yr	50 yr	100 yr	200 yr	500 yr
The Meadows	W/O Proj	OT	OT	BR	BR	BR	BR	BR	BR
	21-50	---	---	---	---	---	---	OT	BR
	21-20	---	---	---	---	---	OT	OT	BR
	18-50	---	---	---	---	---	OT	BR	BR
	18-20	---	---	---	---	OT	BR	BR	BR
Cape May Point	W/O Proj	---	OT	BR	BR	BR	BR	BR	BR
	21-50	---	---	---	---	---	---	OT	BR
	21-20	---	---	---	---	---	---	OT	BR
	18-50	---	---	---	---	---	OT	BR	BR
	18-20	---	---	---	---	OT	OT	BR	BR

OT=overtopping of dune, BR=breaching of dune
*For comparison, the December 1992 storm was approximately a 20-year frequency storm event (based on maximum stage).

Periodic Nourishment. In order to maintain the design template, periodic sand nourishment is needed, otherwise the design profile would erode. The nourishment volume calculated is considered sacrificial and protects the design template. At the end of the nourishment cycle, the design beach profile remains. Economically, a higher nourishment cycle duration brings a corresponding decrease in the annualized cost of beachfill material, dredge mobilization and demobilization, and engineering and survey work.

However, this economic analysis does not take into account the risk of a large storm occurring during the interval between nourishment cycles or the risk of greater than normal wave action in a given year. These risks grow with every year the nourishment cycle is increased. Everts et al. (1974) found that the rate of loss of fill material is proportional to the quantity placed at one time, and thus recommend placing smaller volumes on a more frequent basis to maximize overall

residence time. Sorenson, Weggel and Douglas (1989) also recommend frequent placement of small volumes, with the nourishment cycle in the two to four year range. Experience with existing CENAP beachfill projects also suggests placing smaller nourishment volumes on a 2-4 year cycle to maximize the residence time of the beachfill.

The nourishment volume developed for The Meadows and Cape May Point is 530,000 cu yds and 121,000 cu yds respectively. The nourishment cycle is 4 years and will be synchronized with the ongoing Federal beachfill project at Cape May City in order to obtain a cost savings (reduced mobilization and demobilization costs). As with the ongoing Federal beachfill project at Cape May City, to minimize impacts on piping plovers, work along the shoreline will be avoided between April 1 and August 15.

For this study, the determination of nourishment quantities included 2 components:

1.) Buffer protecting the design template
2.) Major rehabilitation of the design template due to episodic storm events

The buffer in-turn consists of two components: a quantity of sand to offset long-term erosion, and a quantity of sand sized to compensate for episodic storm erosion such that there is a 50% chance that the cumulative sand eroded over a 4-year period will not exceed the placed episodic component. Major rehabilitation reflects, on an average annual basis, the quantity of sand lost from the design template due to frequency storm events assumed to occur when the buffer is not in place. This quantity was calculated as the area under the SBEACH determined erosion volume-frequency curve. For The Meadows, any sand indicated by the SBEACH modeling to have been displaced to an average depth of water greater than 5 feet was assumed to be unrecoverable because of the tidal currents. For the Cape May Point area, any sand indicated by SBEACH to have been displaced beyond the tips of the existing groins were assumed lost to the tidal currents.

Nourishment quantities listed above compare favorably with quantities placed as part of the ongoing Federal beachfill project at Cape May City and historical quantities placed along the study area by the State of New Jersey.

A comparison of benefits and costs including initial costs and periodic nourishment is shown in Table 5.6.1.1-4 and Figures 5.6.1.1-2 to 5.6.1.1-6. As in the previous trials (Table 5.6.1.1 -1), it can be seen that the alternatives have similar output levels based on the linear extent of the project. Comparison of costs were used to determine the most cost-effective solutions. This comparison was based on average annual acres not inundated (Environmental Quality (EQ) benefits) and incidental storm damage reduction to Cape May Point and West Cape May (National Economic Development (NED) benefits).

Environmental Quality (EQ) Benefits

Table 5.6.1.1-4 and Figures 5.6.1.1-2 to 4 shows the relationship between the alternatives. As discussed previously, many of the alternatives perform similarly when using the performance gauge of "average annual acres not inundated" due to their similar performance against lower level, but more frequent storms. When only considering average annual acres not inundated, alternative #16 (18-20 configuration) is the most cost-effective solution with an average annual cost of $10,141 per acre protected.

The berm and dune combination not only renders protection but also provides habitat for certain species. The 18-20 design template incidentally provides approximately 18 acres of dune habitat and 29 acres of beach habitat measured from the seaward toe of the new dune to the intersection with Mean High Water (MHW). This habitat is considered in the environmental incremental analysis found later in this report.

National Economic Development (NED) Benefits

Storm damage reduction benefits to Cape May Point and West Cape May are provided when the protective dune/berm is extended through Cape May Point. These benefits are shown in Table 5.6.1.1-4 and Figure 5.6.1.1-5. For alternative #16, the reduced average annual storm damages total $710,400. In addition, based on historical records, average annual local costs foregone will produce an additional $201,600 in benefits (which is not reflected in the figures).

Maximizing NED Benefits

Protective dune/berm optimization

An analysis was made to determine if it was incrementally cost-effective (by providing a protective dune/berm design greater than alternative #16) to increase the storm damage reduction benefits to Cape May Point and West Cape May. Table 5.6.1.1-5 shows that, when compared to alternative #16, the incremental costs of other alternatives are greater than the benefits. Therefore, there is no cost-effective justification for any other dune/berm alternative to maximize NED benefits.

Protective Dune/berm termination alternative

The construction of a protective dune/berm requires long-term periodic nourishment. Given the long-term financial commitment involved, consideration was given to eliminating the Cape May Point portion of the dune/berm and replacing it with an alternate method of protecting The Meadows from saltwater inundation via Cape May Point. The cost-effectiveness of terminating the beachfill at the Cape May Point State Park and constructing a dike along Lighthouse Avenue

to protect The Meadows was examined.

The dike would be located along the east side of Lighthouse Avenue (see Figure 5.6.1.1-10) and would basically provide the same level of protection (avg annual acres not inundated) to The Meadows as extending the protective 18-20 dune/berm through Cape May Point. The dike would consist of an earthen levee and a concrete wall, having a crest elevation of +10.0 ft NGVD. Provisions for controlled entry and egress of Cape May Point State Park and private residences will be provided. Currently, rainwater flows from Cape May Point into The Meadows. This freshwater is essential to The Meadows' ecosystem. Therefore, there will be three 3 ft diameter gated concrete pipes through the levee to allow for continued freshwater drainage from Cape May Point to The Meadows.

Under existing conditions, saltwater from overtopping events at Cape May Point would drain back to the ocean through the Drainage East structure and the Cape Island Creek culvert. The construction of the dike will trap saltwater from overtopping events in Cape May Point and prevent it from reaching The Meadows. Therefore, the dike also requires the installation of three additional 3 ft diameter concrete pipes under Lighthouse Avenue extending from a concrete diversion structure to the ocean at the western-most edge of the State Park. This will allow for drainage of the ponded saltwater at the Meadows once the ocean stages are returned to normal levels.

The upstream end of the pipes will be connected to a concrete diversion structure, which is designed to allow rain water to drain to The Meadows and will also divert saltwater from oceanwater overtopping events at Cape May Point back to the ocean. The diversion structure is gated such that during rain events, freshwater passes through the dike to The Meadows while the gates draining to the ocean are closed. In anticipation of an ocean storm and saltwater inflow, the locals will have to manually switch the gate settings such that the flow to The Meadows is prevented and the gates to the ocean are open for the eventual draining of the ponded saltwater when the ocean stages are returned to normal.

As seen in the table below, it is cost-effective to extend the protective dune/berm into Cape May Point. The absence of the dune/berm, coupled with the presence of the dike would leave the structures in Cape May Point vulnerable to induced damage due to increased ponding due to overtopping events. Incidental storm damage reduction benefits (from wave attack) to Cape May Point would also be lost with the dike alternative.

Termination Alternative Comparison (Oct. 1997 Price Level)			
	Dike	**Protective Dune/Berm**	***Incremental Difference***
Avg Annual Construction Costs	$151,000	$547,000	$396,000
EQ Benefits to The Meadows	175 acres	175 acres	0 acres
Avg Annual Induced NED Damages at Cape May Point	$80,000	$0	$-80,000
Avg Annual NED Benefits at Cape May Point	$0	$585,000	$585,000
		Incremental NED Benefits	$665,000
		Benefit-Cost Ratio	1.7
Avg Annual Net NED Benefits to Cape May Point	$-231,000	$38,000	$269,000

Solution #1 Summary

Based on the preceding analyses, the optimized plan for ***Solution #1: Protective Berm and Dune Restoration*** is alternative #16, the 18-20 dune/berm combination. See Figures 5.6.1.1-7 and 5.6.1.1-8 for a typical design profile. The project would extend from the 3rd Avenue terminal groin in Cape May City to the Central Ave groin in Cape May Point (Figure 5.6.1.1-9). The design template requires 1,247,400 cu yds of sand with 650,400 cu yds of periodic nourishment every 4 years, synchronized with the existing Federal beachfill project at Cape May City. The beachfill material would be taken from borrow areas P1 and P2 (Figure 2.6.1).

Planting of dune grass and project performance monitoring will also be accomplished. Costs are detailed further in Section 7 of this report.

Benefits include an increase of 175 acres of valuable habitat protected which translates to an average annual cost of $10,141 per acre. The construction of a dune and berm will also incidentally add 18 acres of dune habitat and 29 acres of beach habitat. Storm damage reduction to Cape May Point and West Cape May equals $710,400 plus $210,600 average annual local costs foregone. (see Section 7 of this report for a complete estimate of costs and benefits)

Table 5.6.1.1-4

SOLUTION #1- PROTECTIVE DUNE/BERM ANALYSIS
Benefits and Costs
(May 1997 Price Level)

	The Meadows		Cape May Point			West Cape May			Total		
Alt.*	Avg Annual Acres Not Inundated	Increased Acres Protected	Avg Annual Structural Damage	Avg Annual Storm Damage Reduction Benefits	Percent of Damages Reduced	Avg Annual Structural Damage	Avg Annual Storm Damage Reduction Benefits	Percent of Damages Reduced	Avg Annual Storm Damage Reduction Benefits	Avg Annual Costs*	Avg Annual Cost per Increased acre protected
wo	**144.5**		**$765,573**			**$219,693**			$0	$0	
1	327.4	182.9	$108,777	$656,796	86%	$35,364	$184,329	84%	$841,100	$2,035,300	$11,128
2	270.9	126.4	$747,669	$17,904	2%	$175,889	$43,804	20%	$61,700	$1,488,400	$11,775
3	325.4	180.9	$125,245	$640,328	84%	$39,073	$180,620	82%	$820,900	$1,948,800	$10,773
4	270.9	126.4	$747,669	$17,904	2%	$175,889	$43,804	20%	$61,700	$1,446,500	$11,444
5	327.4	182.9	$124,398	$641,175	84%	$35,829	$183,864	84%	$825,000	$1,991,000	$10,886
6	325.4	180.9	$109,562	$656,011	86%	$38,349	$181,344	83%	$837,400	$1,993,000	$11,017
7	325.1	180.6	$174,060	$591,513	77%	$62,245	$157,447	72%	$749,000	$1,920,200	$10,632
8	270.9	126.4	$747,669	$17,904	2%	$175,889	$43,804	20%	$61,700	$1,422,700	$11,256
9	325.2	180.7	$115,813	$649,760	85%	$60,892	$158,801	72%	$808,600	$1,968,900	$10,896
10	325.2	180.7	$131,310	$634,263	83%	$60,892	$158,801	72%	$793,100	$1,924,700	$10,651
11	326.6	182.1	$171,322	$594,251	78%	$51,522	$168,171	77%	$762,400	$1,986,500	$10,909
12	325.3	180.8	$172,738	$592,835	77%	$57,163	$162,530	74%	$755,400	$1,944,300	$10,754
13	323.8	179.3	$179,453	$586,120	77%	$54,910	$164,783	75%	$750,900	$1,881,700	$10,495
14	323.6	179.1	$181,468	$584,105	76%	$63,082	$156,611	71%	$740,700	$1,839,500	$10,271
15	323.5	179.0	$183,441	$582,132	76%	$71,151	$148,542	68%	$730,700	$1,815,400	$10,142
16	319.6	175.1	$187,594	$577,979	75%	$87,278	$132,415	60%	$710,400	$1,775,700	$10,141
17	270.9	126.4	$747,669	$17,904	2%	$175,889	$43,804	20%	$61,700	$1,383,400	$10,945
18	319.7	175.2	$121,887	$643,685	84%	$84,757	$134,936	61%	$778,600	$1,929,300	$11,012
19	319.7	175.2	$137,384	$628,189	82%	$84,757	$134,936	61%	$763,100	$1,885,100	$10,760
20	319.7	175.2	$179,742	$585,831	77%	$84,757	$134,936	61%	$720,800	$1,880,600	$10,734

* refer to Table 5.6.1.1-2 for descriptions of alternatives
** includes initial, 50-year project life, and major rehab dredging cost, mob/demob, contingency, S&A and E&D

Figure 5.6.1.1-2

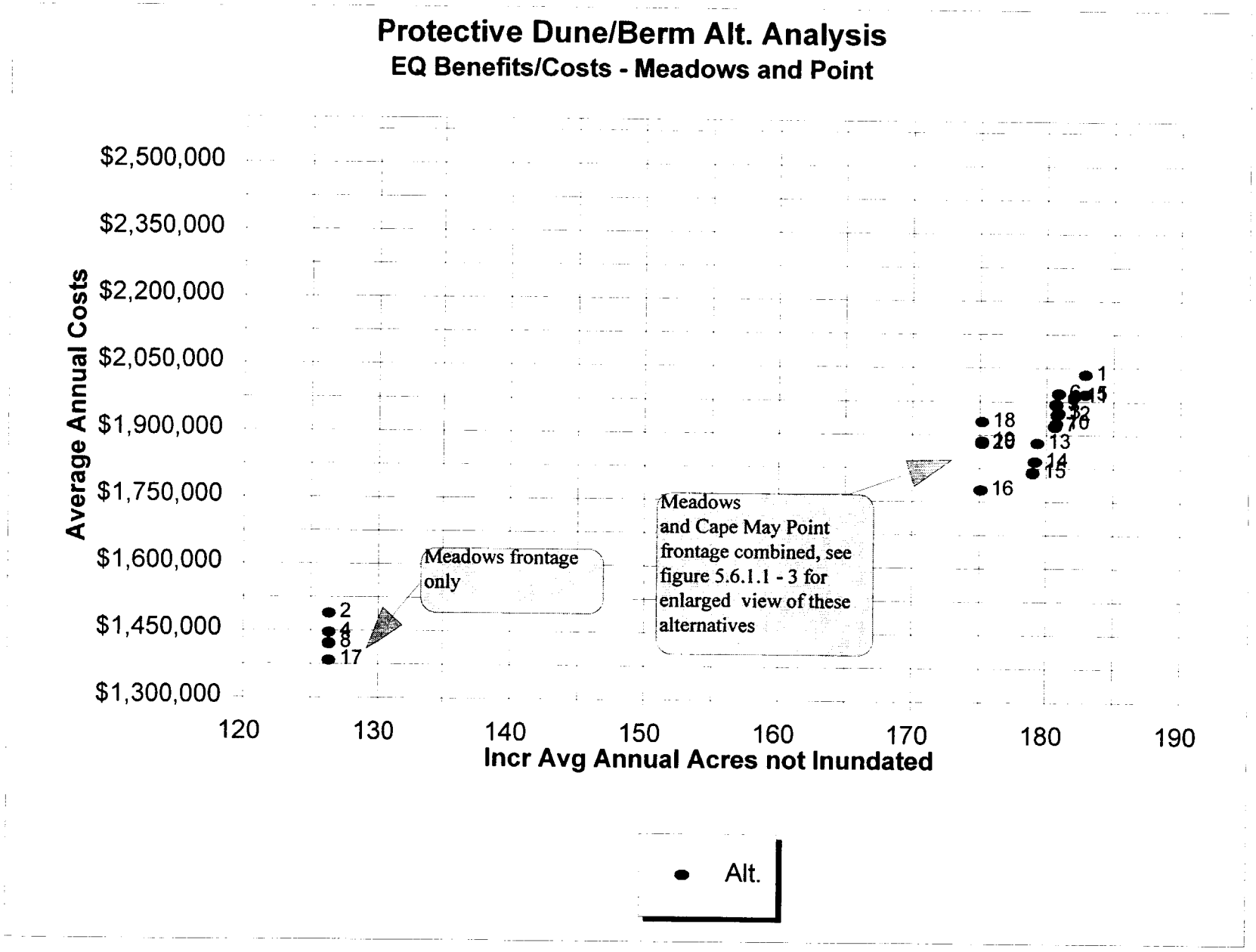


Figure 5.6.1.1-3

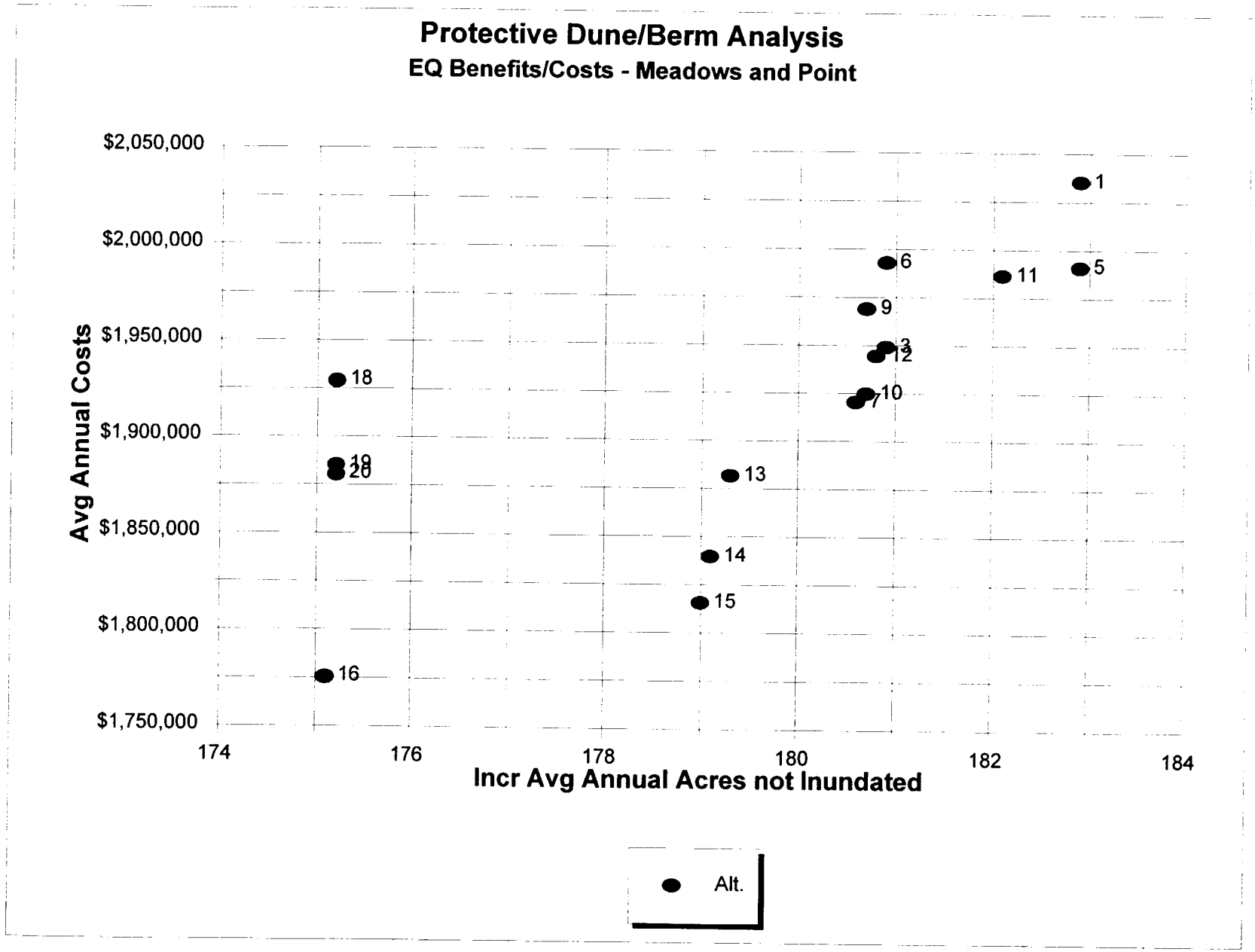


Figure 5.6.1.1-4

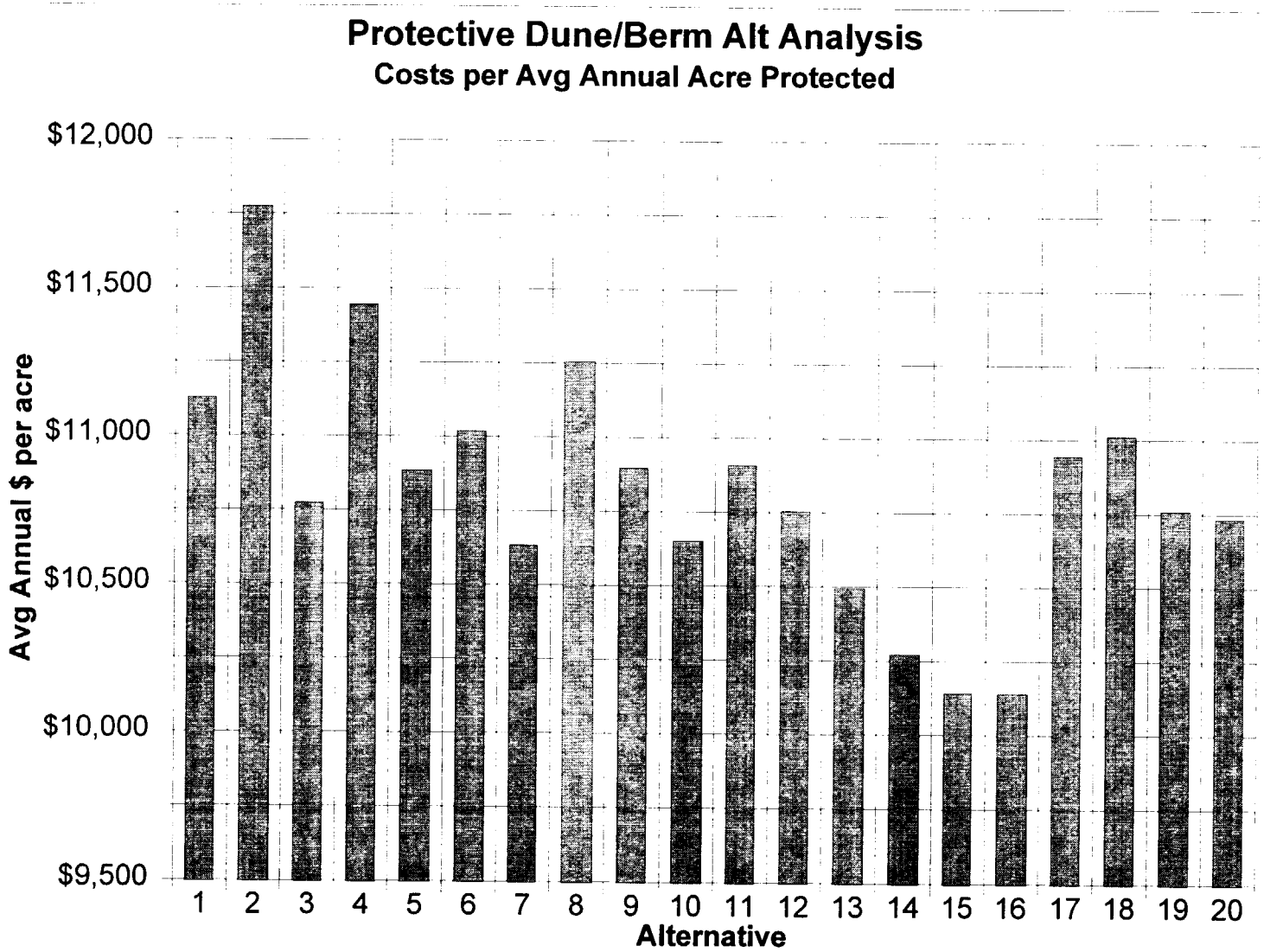


Figure 5.6.1.1-5

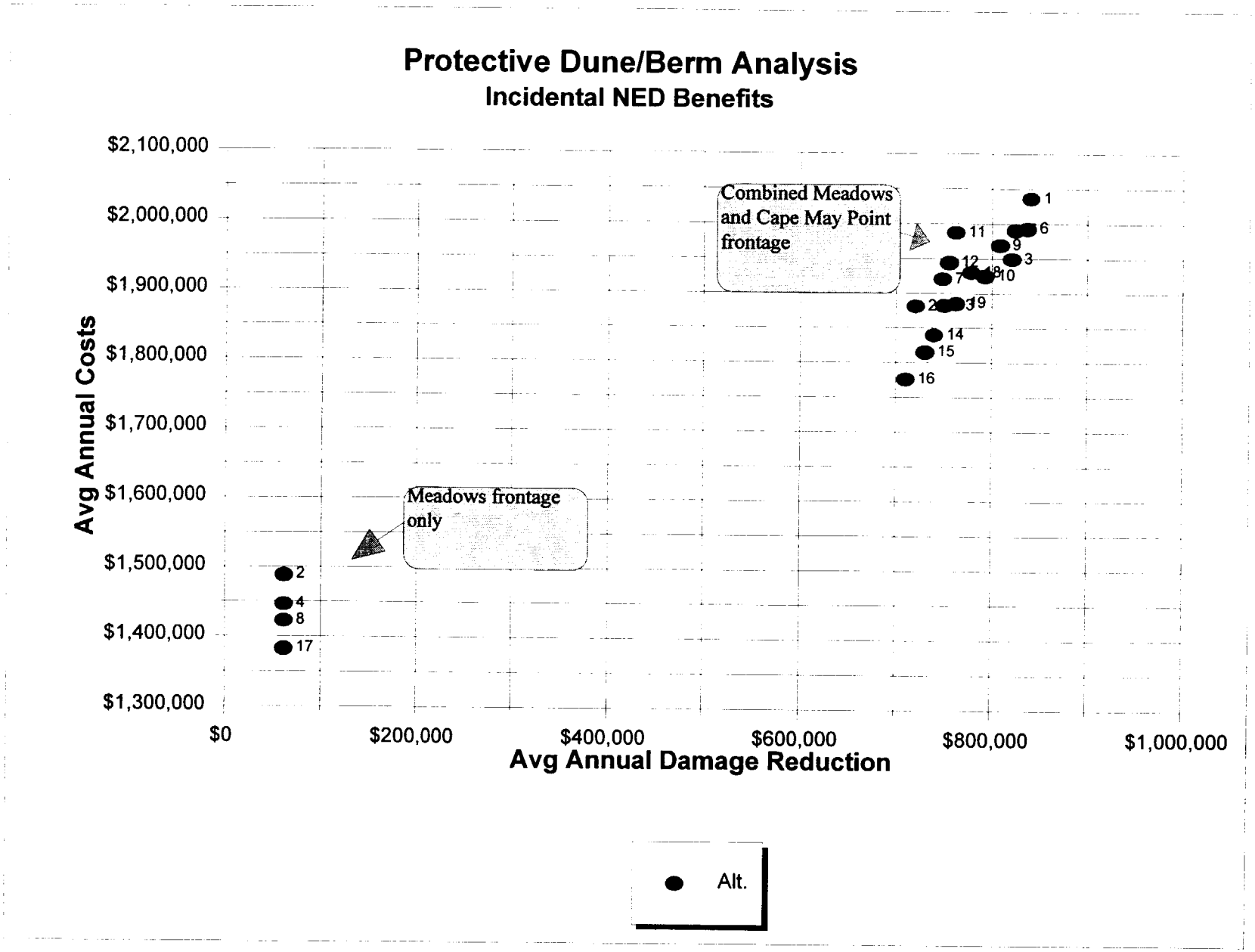


Figure 5.6.1.1-6

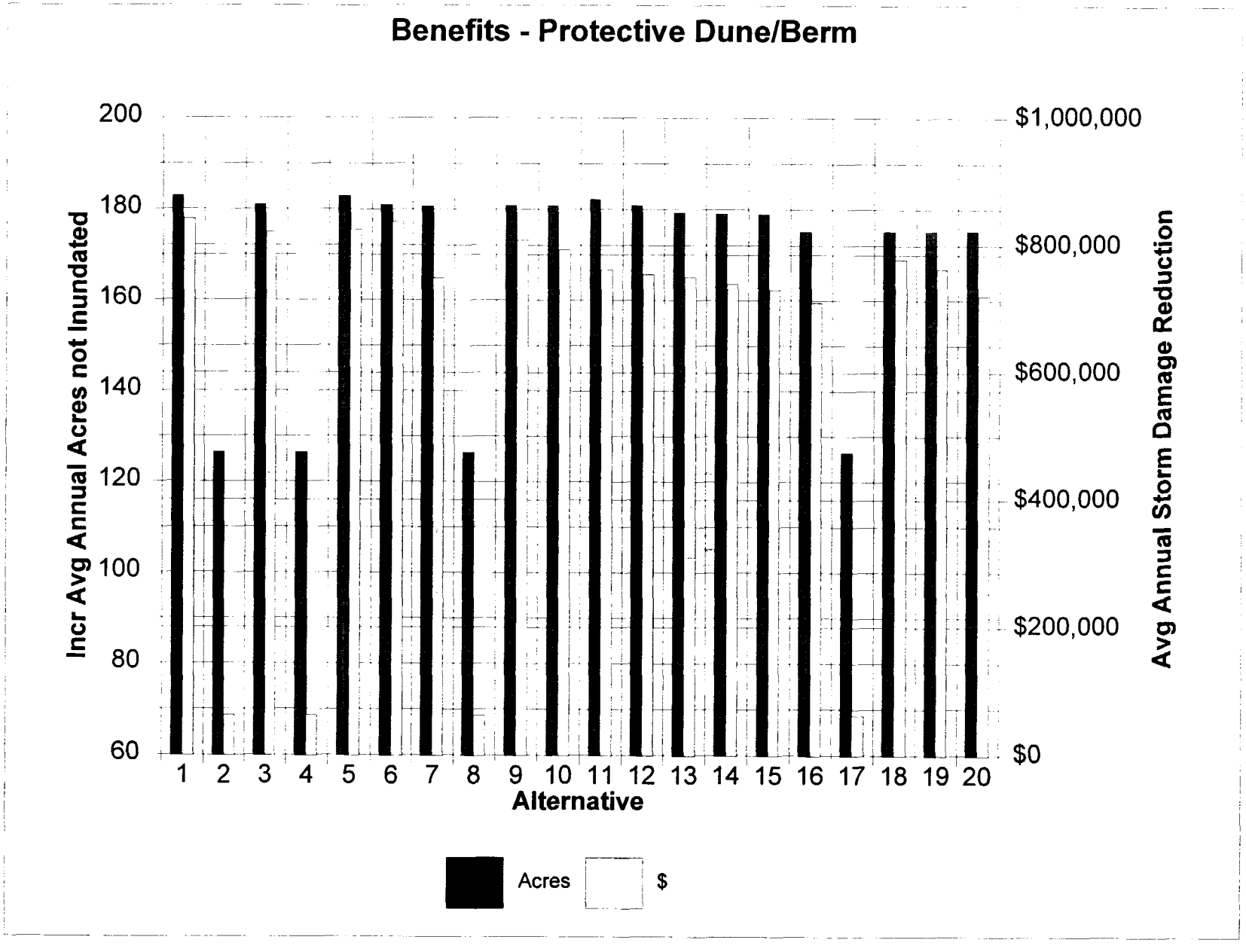
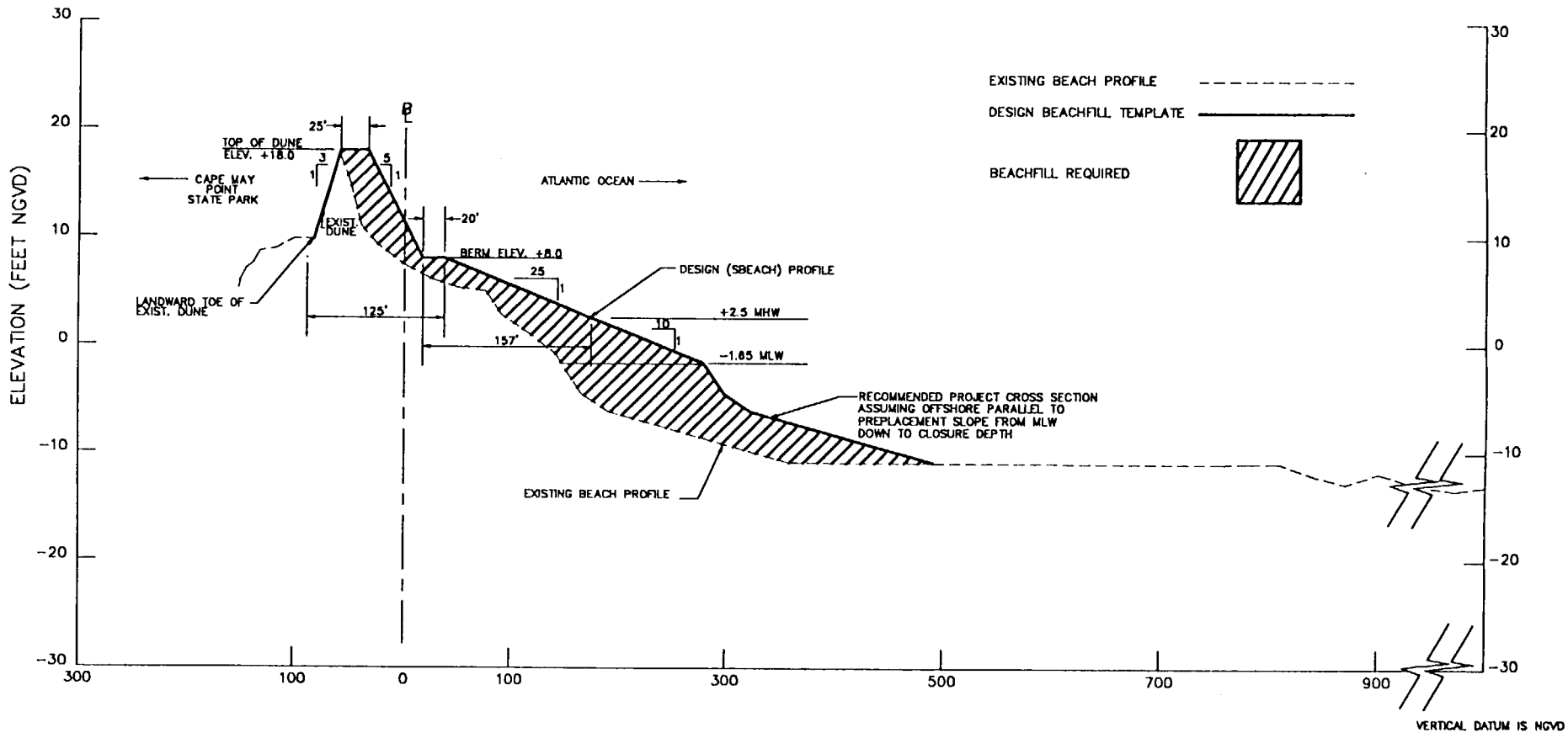


Table 5.6.1.1-5
Average Annual Incremental NED Costs/Benefits*

Alt	Design Dimensions		Incremental Cost	Incremental Incidental Benefits	Incremental Net Benefits	Incremental BCR
	Meadows	Point				
16	18' Dune, 20' Berm	18' Dune, 20' Berm	---	---	---	---
20	18' Dune, 20' Berm	18' Dune, 50' Berm	$104,900	$10,400	$-94,500	0.10
19	18' Dune, 20' Berm	21' Dune, 20' Berm	$109,400	$52,700	$-56,700	0.48
18	18' Dune, 20' Berm	21' Dune 50' Berm	$153,600	$68,200	$-85,400	0.44
15	18' Dune, 50' Berm	18' Dune, 20' Berm	$39,700	$20,300	$-19,400	0.51
7	18' Dune, 50' Berm	18' Dune, 50' Berm	$144,500	$38,300	$-106,200	0.27
10	18' Dune, 50' Berm	21' Dune, 20' Berm	$149,000	$82,700	$-66,300	0.56
9	18' Dune, 50' Berm	21' Dune, 50' Berm	$193,200	$98,200	$-95,000	0.51
14	21' Dune, 20' Berm	18' Dune, 20' Berm	$63,800	$30,300	$-33,500	0.47
12	21' Dune, 20' Berm	18' Dune, 50' Berm	$168,600	$44,900	$-123,700	0.27
3	21' Dune, 20' Berm	21' Dune, 20' Berm	$173,100	$110,500	$-62,600	0.64
6	21' Dune, 20' Berm	21' Dune, 50' Berm	$217,300	$127,000	$-90,300	0.58
13	21' Dune, 50' Berm	18' Dune, 20' Berm	$106,000	$40,500	$-65,500	0.38
11	21' Dune, 50' Berm	18' Dune, 50' Berm	$210,800	$52,000	$-158,800	0.25
5	21' Dune, 50' Berm	21' Dune, 20' Berm	$215,300	$114,600	$-100,700	0.53
1	21' Dune, 50' Berm	21' Dune, 50' Berm	$259,600	$130,700	$-128,900	0.50

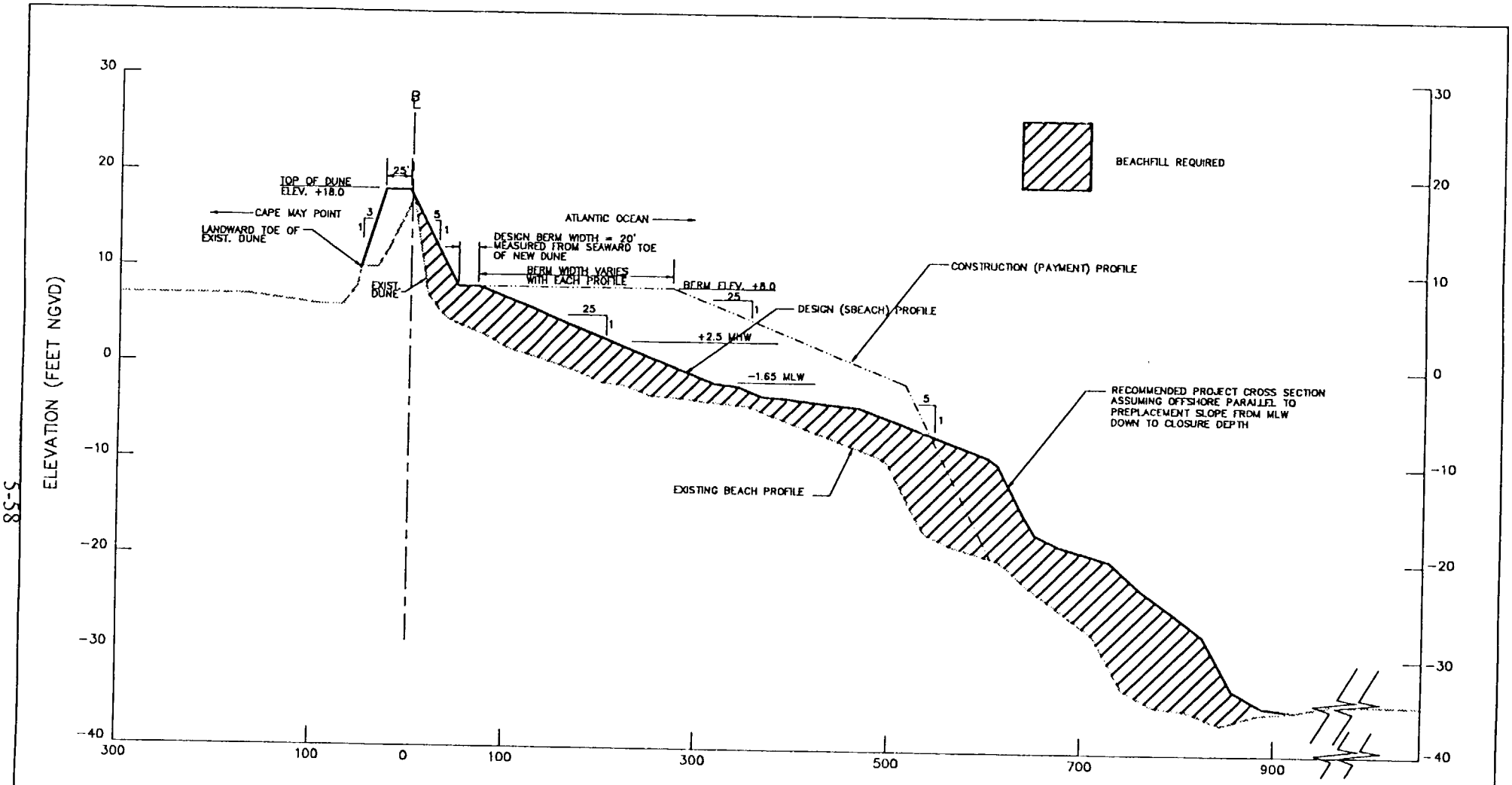
* compares costs and benefits found in Table 5.6.1.1-4



18' DUNE WITH 20' BERM

LOWER CAPE MAY MEADOWS – CAPE MAY POINT
FEASIBILITY STUDY
CAPE MAY MEADOWS
CYCLE 3 – SELECTED FILL DESIGN TEMPLATE
PROTECTIVE DUNE AND BERM
TYPICAL PROFILE (SURVEY LINE "C")
SCALE: 1"=150'

Figure 5.6.1.1-7

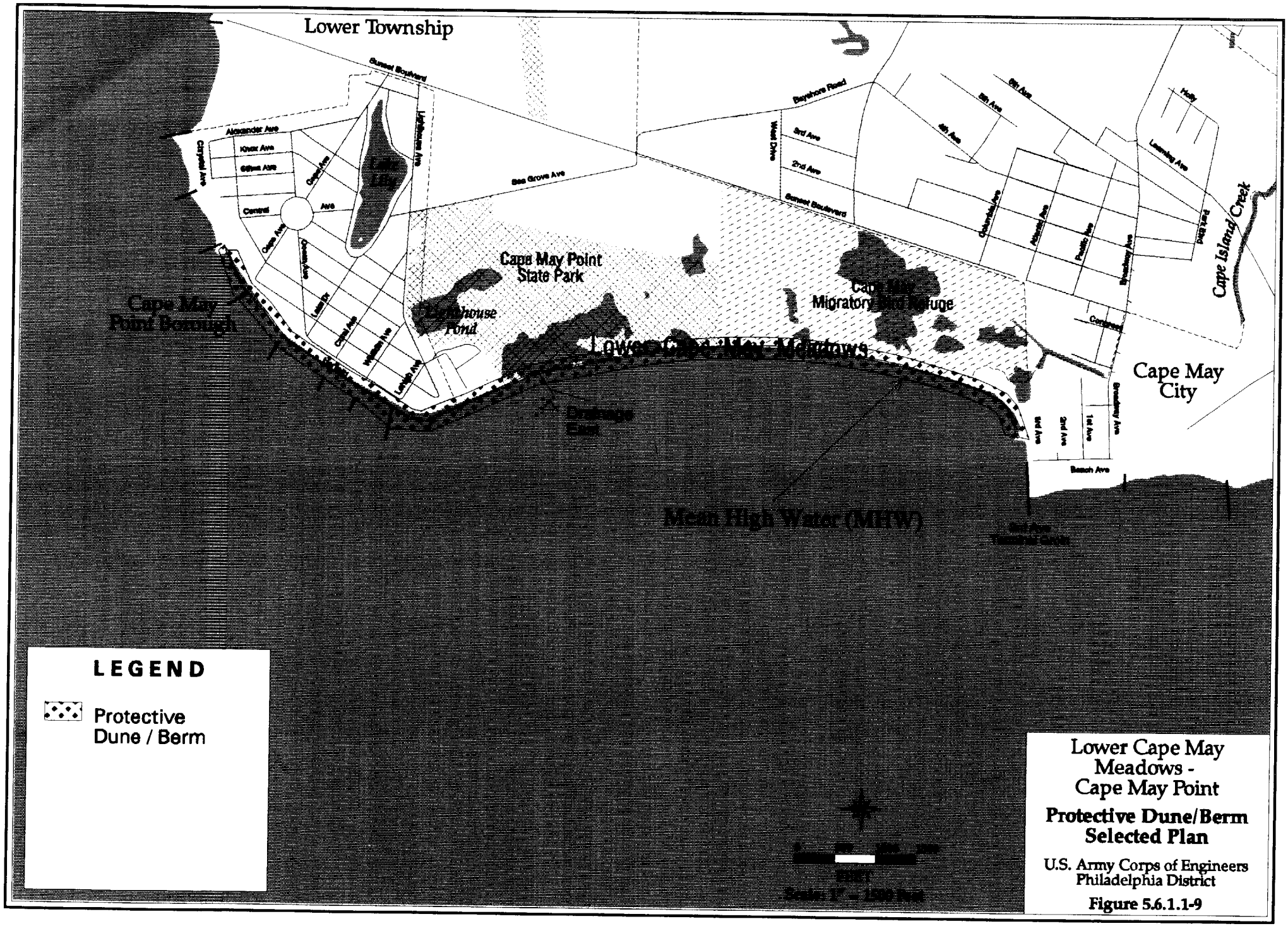


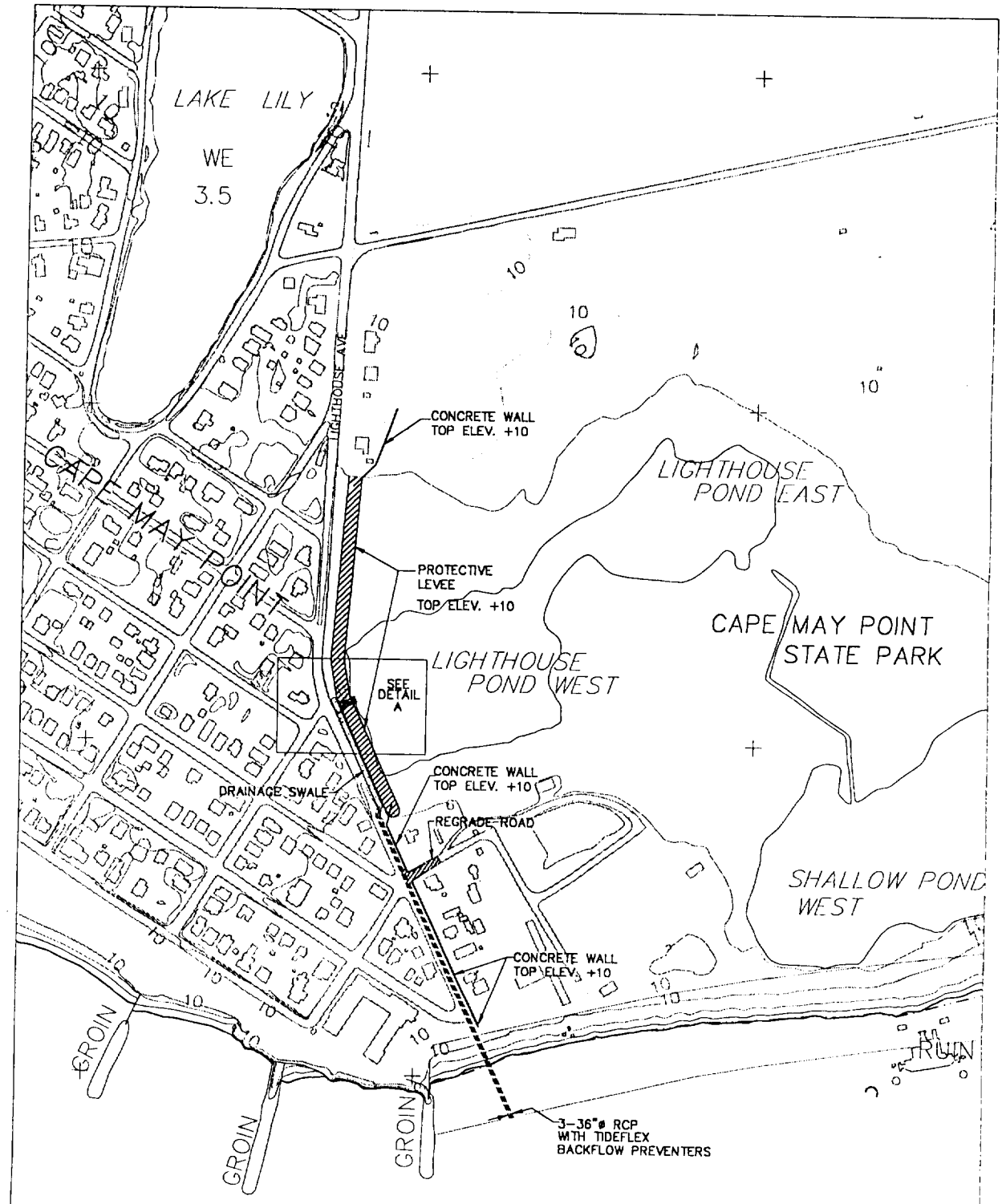
18' DUNE WITH 20' BERM

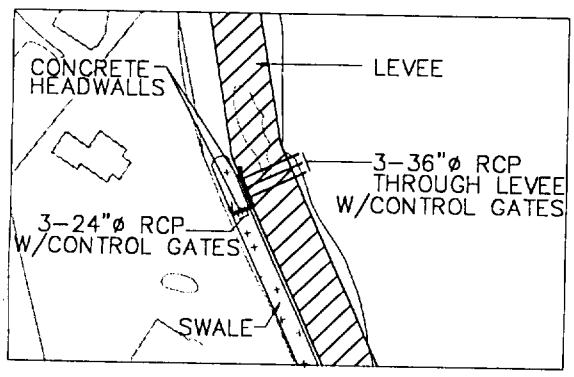
LOWER CAPE MAY MEADOWS –
CAPE MAY POINT
FEASIBILITY STUDY
CAPE MAY POINT
SELECTED PLAN
PROTECTIVE DUNE AND BERM
TYPICAL PROFILE (CELL 28)

SCALE: 1"=150'

FIGURE 5.6.1.1-8


Lower Township
Cape May Point State Park
Cape May Point Borough
Lighthouse Pond
Cape May City
Cape Island Creek
Mean High Water (MHW)
Sea Grove Ave
Beach Ave
LEGEND
Protective Dune / Berm
Lower Cape May Meadows - Cape May Point
Protective Dune/Berm Selected Plan
U.S. Army Corps of Engineers
Philadelphia District
Figure 5.6.1.1-9





DETAIL A

U.S. ARMY ENGINEER DISTRICT, PHILADELPHIA
CORPS OF ENGINEERS
PHILADELPHIA, PENNSYLVANIA

LOWER CAPE MAY MEADOWS
CAPE MAY POINT
FEASIBILITY STUDY

PROTECTIVE LEVEE AND
CONCRETE WALL

FIGURE 5.6.1.1-10

Solution #2: Protective Berm and Dune Restoration with Groin Field

Groins control the rate of longshore sediment transport through a project area and can reduce the rate of sediment lost to downdrift beaches. When designed properly, they are effective in stabilizing beaches and reducing nourishment rates where sediment is lost by alongshore movement. The reduction of nourishment rates would lessen or even eliminate long-term Federal commitment of funds, a current Administration priority. Concerns normally arise over the negative impacts to a downdrift beach, in this case Cape May Point, due to the reduced alongshore sand transport and subsequent downdrift erosion. However, since Cape May Point already has groins and presently doesn't receive any significant downdrift sand from The Meadows, placing groins along The Meadows might not have any measurable impact on Cape May Point. However, it should be noted that many agencies and organizations (most notably USFWS and The Nature Conservancy) are generally not supportive of placing hardened structures such as groins along the beach especially in an area such as The Meadows. Concerns exist regarding possible effects to species using beach habitat.

An analysis was performed by Offshore & Coastal Technologies, Inc. and Andrews, Miller, & Associates, Inc. to determine the impact of a groin field on the existing nourishment rate requirements. The expected reduction in costs associated with the reduced nourishment rates was compared to the costs associated with construction of the groin field to determine if the groins were economically justified.

Three alternative groin plans were considered:

Alternative 1	8 groins, 400 L.F. each, spaced 800 feet apart extending along The Meadows' shoreline
Alternative 2	4 groins, 400 L.F. each, spaced 1,500 feet apart along The Meadows' shoreline
Alternative 3	4 groins, 400 L.F. each, spaced 800 feet apart along the east end of The Meadows' shoreline

The groins would be similar in construction to those in Cape May Point having a top elevation of +3.4 NGVD. Based on this design and current unit prices, the estimated cost of groin construction (including contingencies, E&D, S&A) is $2,500 per linear foot. Due to the predicted tidal velocities in area of The Meadows, the periodic placement of stone along the toe of the groin head sections for scour protection is anticipated every 8 years at an estimated cost of $100,000 per groin. A further assumption is that even with periodic placement of stone scour protection, total rehabilitation of the proposed groins along the western portion of The Meadows' shoreline will be required during the project life. This is estimated at $4,000,000.

The results of the modeling predict that the addition of Alternative #1 to the proposed protective

18-20 dune/berm combination (under Solution #1) would be the most effective, reducing periodic nourishment quantities by about 60%. However, using a present worth cost analysis and converting to average annual costs, the large initial costs associated with the groins make this alternative not cost-effective. The average annual cost for the 18-20 plan (Meadows shoreline only, without groins) is $1,383,400 while the addition of the groins increases the average annual cost to $1,591,600.

In addition, as mentioned previously, among others, USFWS is currently opposed to the placement of groins along The Meadows' shorefront.

Solution #2 Summary

The groin configurations analyzed were not shown to be cost-effective nor would their construction currently be supported by USFWS and other agencies. Therefore this alternative will not be considered further.

Solution #3: Berm and Dune Restoration with Additional Structural Reinforcement

Consideration was given to the use of structural reinforcement of the dune such as geotextile tubes and other erosion control or protection devices to possibly provide a cost-effective, increased level of protection when compared with Solution #1 (berm and dune restoration only) . Currently, the dune at The Meadows consists of I-5 core (course aggregate). Tensar Mattresses have been placed at the shorefront border of The Meadows and Cape May Point to provide protection at an especially vulnerable location. The I-5 provides minor additional protection while the effectiveness of Tensar mattresses at this location is still being evaluated.

Due to the high ecological significance of The Meadows (especially the piping plover population), any reinforcement structure should only cause minimal disturbance to the natural beach habitat. Structures that would cover beach habitat may be inappropriate. In fact, it is highly unlikely that USFWS would support the further placement of exposed structures along the beach area. The presence of these unnatural structures may deter certain species from utilizing available habitat, especially if deterioration of materials occurs through exposure to the elements. However, structures (e.g. geotextile tubes) placed inside, at the center of the dune could be acceptable to the environment. Geotextile tubes provide protection in certain shoreline applications and are relatively inexpensive. Other types of dune reinforcement have not been widely used locally with success and therefore were not considered.

Geotextile tubes which are used in oceanfront applications are sand filled structures constructed of permeable geosynthetic material. The size of geotextile tube varies depending on the application, but those constructed parallel to the shoreline as protection from erosion due to wave attack need to be large, in order to adequately resist wave forces.

The configuration of geotextile tubes typically includes a primary tube, an anchor tube, and a scour apron. Geotextile tubes are constructed by pumping a sand/seawater slurry into prefabricated tubes. The tubes are laid empty on top of the scour apron. The slurry is pumped through the top of the tube through special openings to accommodate the pump. The water component of the slurry drains through the permeable tube material, leaving the sand inside. The scour apron is used to direct the water excreted from the tube away so during construction, the sand at the base of the tube is not eroded; this scour apron remains after the tubes are filled. The anchor tube is smaller and is placed in front of the primary tube. It is constructed in the same manner as the primary tube. Its function, along with the scour apron, is to prevent erosion of sand beneath the primary geotextile tube so that it remains stable.

As a final step, the geotextile tubes should be covered with sand and maintained for sacrificial purposes and for aesthetic appearance. Erosion of sand fronting geotextile tubes typically occurs in a vertical scarp on the seaward side of the tubes (unless an adequate beach exists). This will result in the scour apron "digging in" at the base of the dunes providing a non-erodible permeable base over which sand will come and go. If left exposed to sunlight, the geosynthetic material that geotextile tubes are constructed of becomes damaged from long-term exposure to ultraviolet light. The sand could be lost from the tube at which point the geosynthetic and plastic material become more susceptible to the forces of wind and water and can shred. Therefore, in order to maintain geotextile tubes properly, at some point replacement of sand cover becomes necessary. This can pose a maintenance problem if beach nourishment cycles are too far apart. If left exposed, they are aesthetically unpleasing in a shore environment such as exists in The Meadows.

The benefits which accrue from the placement of geotextile tubes are structural damage reduction and reduction of major rehabilitation costs since theoretically the geotextile tubes should maintain more of the design template than unconfined sand. Examination of the SBEACH output indicates that for Alternative 16 (design 18-20) the 50-year storm is the first storm event which substantially impacts the dune. With the geotextile tubes assumed to be placed inside at the center of the dune, The Meadows' dune will not be eroded and hence there will be a reduction in the overtopping volume of the 50 and 100 year event. This translates to a small reduction in the 50 and 100 year interior water surface and hence structural damage. However, the annualized reduction in structural damage from a reduction in interior water levels is negligible. In addition, unless increased protection is also added to Cape May Point, overtopping will continue unabated from the Cape May Point cells. There would be no reduction of the 200 to 500 year water surface elevation since the Cape May Point cells would continue to breach.

A geotextile core in the dune will provide a cost savings through the elimination of dune reconstruction after a major storm event. The 50-year storm event is the first which seriously erodes the dune. The dune erodes from elevation +18 NGVD to an average elevation of about +12 feet NGVD for the 500-year event. Looking at a worst case scenario, during a 500-year storm event, the approximate eroded area of the dune is 280 square feet, which corresponds to 76,700 cubic yards (assuming that the erosion applies to the 7,400 ft cell length of The

Meadows). Conservatively applying this volume to the 50 year event and annualizing, the volume of sand displaced is 1,530 cubic yards per year. Assuming a cost of $3.50 a cubic yard to replace the sand, average annual costs equal about $5,355. In comparison, assuming geotextile tube installation along the entire 7,400 ft length of The Meadows at a cost of $100 per linear foot (including installation), calculates to an average annual cost of $56,176. From this analysis, the cost of replacing sand after a major event (i.e. 50 year or greater) would be less than the installation of 7400 feet of geotextile tubes. Geotextile tubes may be useful as "insurance" for maintaining a specified dune crest under severe storm conditions but such a use cannot currently be economically justified.

Solution #4: Berm and Dune Restoration Using Structural Reinforcement With Groin Field

This alternative is a combination of previous alternatives. Since neither groin construction nor structural reinforcement were determined cost-effective, this alternative is not applicable.

5.6.1.2 *Goal #2) Restore Previously Eroded and Overwashed Habitat*

Since 1911, The Meadows has lost many acres of valuable habitat due to erosion. Seaward portions of freshwater habitat immediately behind the landward toe of the dune has also been covered with sand due to overwash from storm events. Addressing these problems was considered.

Solution #1: Remove Sand Overwash

Overwashed sand covering portions of The Meadows could be removed to increase the quality of the habitat, the total acreage, and habitat units. This can be accomplished relatively inexpensively by simply using heavy equipment to excavate the overwashed sand and return this sand to the beach area. About 3 feet of sand presently covers approximately 17 acres of previously existing wetland habitat (Figure 5.6.4-1). Within the Nature Conservancy property, there is one large area of overwashed sand which could be removed to benefit wildlife. If this sand is removed (approximately 52,000 cu yds) and pushed forward onto the dune, approximately 7 acres would return back to emergent wetland habitat. Estimated average annual cost equals $19,000 ($250,000 first cost) to modify the 7 acres. This cost includes the moving of the excess sand, adding organic substrate and planting wetland vegetation. The vegetation to be planted will include species such as narrow leaved cattail, bullrush, sedges and wild millet. Incidentally, using this existing material would slightly reduce the amount (quantity) of sand that would need to be obtained from an offshore source for the dune and berm restoration.

Solution #1 plan selection. This solution will be evaluated as part of the incremental analysis found in Section 6 of this report.

Solution #2: Create Freshwater Wetland Habitat

This solution was considered to restore some of the valuable freshwater wetland habitat that has eroded over the years. It would entail relocating the protective 18-20 dune/berm position seaward and creating freshwater wetlands behind the landward toe of the dune. The restored wetlands would be planted with a variety of native herbaceous emergent wetland plants. The plantings would include species such as smartweeds, widgeongrass, sedges, wild millet, and rushes. These plants would provide wildlife benefits and would also serve to help control the invasion and spread of common reed (*Phragmites*) into these areas. However, moving the 18-20 protective dune/berm seaward would increase the required sand quantities due to the steeper offshore profile.

Three plans for wetland restoration were developed; a small, medium, and a maximum plan (Figure 5.6.1.2-1). All three plans would involve the placement of organic substrate and planting of native herbaceous species behind the new location of the protective 18-20 dune/berm. Table 5.6.1.2-1 shows the additional (over the 18-20 dune/berm) benefits and costs for the 3

potential plans.

Table 5.6.1.2-1
Freshwater Habitat Restoration
Costs and Benefits

Plan	Add. Sand Costs *	Organic Substrate, Plant Material & Planting Costs	Avg Annual Costs	Wetland Acres Gained	Habitat Units
Small	$1,127,800	$873,500	$157,000	35	492
Medium	$2,457,400	$1,495,100	$310,000	60	538
Maximum**	$6,313,700	N/A	N/A	95	N/A

* additional sand needed for protective 18-20 dune/berm due to steeper offshore profile

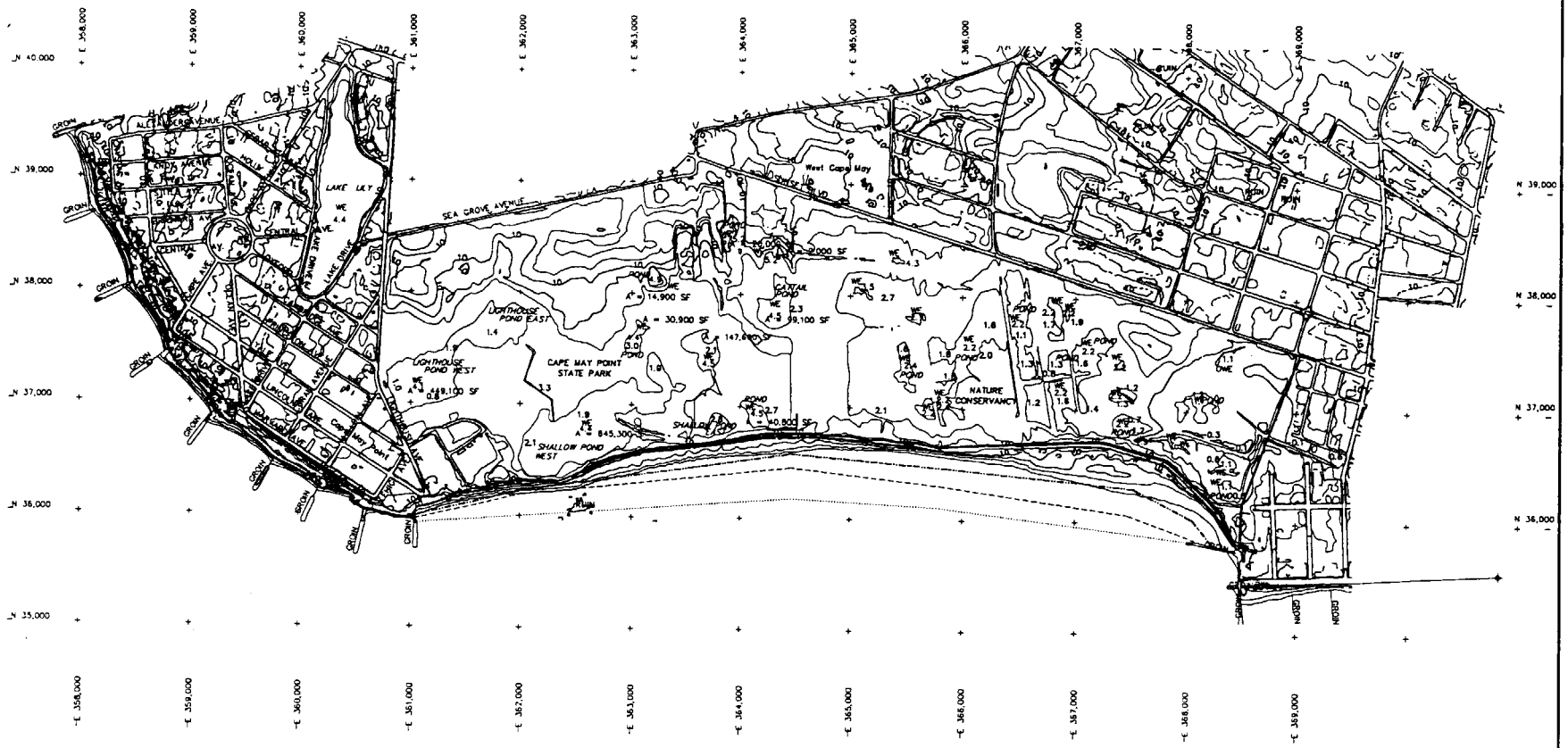
** since additional sand costs were relatively high, it was expected that this alternative would not be cost-effective, therefore additional costs were not developed

This seaward expansion of the wetlands will increase the available acreage and the habitat units of The Meadows as well as incidentally reducing storm inundation damages to Cape May Point and West Cape May due to the increased buffer. Table 5.6.1.2-2 shows the comparison between the increased incidental benefits (both EQ and NED) and costs when compared with the 18-20 dune/berm protection alternative.

Table 5.6.1.2-2
Freshwater Habitat Restoration
Costs and Incidental Benefits

Exterior Design	Average Annual Cost	Average Annual Acres Not Inundated (EQ)	Average Annual NED Benefits*
Protective dune/berm (18-20)	$1,775,700	320	$921,000
Minimum	$1,932,700	353	$924,200
Medium	$2,085,700	377	$926,000
Maximum	N/A	411	$927,500

* includes local costs foregone of $210,600



200 100 0 200 400

SCALE: 1" = 200'
CONTOUR INTERVAL: 2'
DATE OF PHOTOGRAPHY: 3-7-83
N.J. STATE PLANE NAD 83

MINIMUM PLAN (LANDWARD TOE OF NEW DUNE)

MEDIUM PLAN (LANDWARD TOE OF NEW DUNE)

MAXIMUM PLAN (LANDWARD TOE OF NEW DUNE)

U.S. ARMY ENGINEER DISTRICT, PHILADELPHIA
CORPS OF ENGINEERS
PHILADELPHIA, PENNSYLVANIA

LOWER CAPE MAY MEADOWS
CAPE MAY POINT
FEASIBILITY STUDY

HABITAT AREA CREATED BY
EXTENDING EXISTING SHORELINE FORWARD
CAPE MAY MEADOWS

FIGURE 5.6.1.2-1

Solution #2 plan selection. The small and medium configurations will be evaluated as part of the incremental analysis found in Section 6 of this report

5.6.2 *IB). Objective: Improve Internal Water Quality*

Due to the unique freshwater wetlands located at The Meadows, alternatives were examined to improve the current water quality of these wetlands.

5.6.2.1 *Goal #1: Reduce Saltwater Intrusion Due to Storm Activity*

Obviously a freshwater ecosystem needs to be mostly freshwater. Reduction of saltwater intrusion into the freshwater ecosystem will help to reduce the salinity levels which currently exist within this freshwater habitat. The dune/berm protection alternative selected as part of Objective IA, Goal #1, (Section 5.6.1.1) will address this problem. There is no need for additional measures if that alternative is implemented

5.6.2.2 *Goal #2: Reduce Organic Loading from Lake Lily*

Lake Lily is located in Cape May Point and is hydraulically connected to Lighthouse pond in The Meadows. Therefore, water quality at Lake Lily can contribute to freshwater quality at The Meadows. If water quality improvement is desired for The Meadows, various sources of potential detriments to the system should be examined. Local officials from Cape May Point have complained about the amount of avian waste deposited in Lake Lily by the numerous swans and ducks that reside there. A short-term solution would be a one-time dredging of Lake Lily to remove material.

Solution #1: Remove material (dredge) from bottom of Lake Lily

In 1997, sediment and water quality sampling was conducted in Lake Lily and several points within The Meadows. While the results of the sampling showed elevated levels of some parameters, it does not appear that Lake Lily currently has a significant impact on the water quality of The Meadows. For this reason, this alternative will not be evaluated further.

5.6.2.3 *Goal #3: Increase Water Movement Through Meadows*

Due to both storm damage and erosion over the years, natural drainage channels that existed in The Meadows have been lost. This has hydrologically isolated many of the ponds, creating area of stagnant water and low water flow, which has negatively impacted the area. A potential

improvement to the existing freshwater marshes would be to physically connect some of the isolated ponds to the main ponds by restoring natural channels between them. Increasing the freshwater inputs into these isolated ponds will improve the water quality within the ponds and promote the desired maintenance as a freshwater marsh. It is anticipated that the restoration of flow will also decrease the spread of the nuisance plant species Phragmites australis. The existing Drainage East project would have to be modified so that freshwater is not "lost" from The Meadows. A drainage gate on the inlet structure should be sufficient. This gate could be temporarily opened, if needed, to allow drainage from a severe storm event. The cost of this gate (installed) is estimated at $5,200.

Solution #1: (Re)establish drainage between ponds

This solution would involve the deepening or clearing out of several existing channels. In other areas, this will involve removing adverse slopes which exist in some of the ponds and drainage ditches and which hamper the flow of water from one area to another. Location of these areas can be found in Figure 5.6.4-1. Average annual cost equals $2,000 ($29,200 total cost). Costs were calculated assuming work would be accomplished by Cape May County Mosquito Commission.

5.6.3 *IC). Objective: Eliminate/control nuisance plant species (Phragmites australis)*

An important aspect of improving the habitat value of The Meadows is the development of a wetland vegetation management plan. Due in-part to the impacts of storm events, large sections of The Meadows are currently overgrown with monotypic stands of common reed (Phragmites australis), a nuisance plant species known to be of poor habitat value to wildlife, and in some cases, a fire hazard. Due to its adaptivity to areas with anthropogenic disturbances, its tolerance of a wide variety of environmental conditions, and its ability to propagate either vegetatively (as individual plants fall over, they can send out new propagules and roots from nodes along the stem) or by seed, removal of common reed can be very difficult. To succeed, common reed removal projects must be approached systematically and with persistence. Therefore, a comprehensive plan needs to be developed to control and reduce the population of common reed and to establish and maintain wetland vegetation of higher value to wildlife. This plan also needs to be consistent with the State Park and Nature Conservancy's management activities. The Nature Conservancy's management currently includes small-scale Phragmites australiscontrol through periodic application of herbicides.

Solution #1: Herbicidal spraying and burning

This solution would involve the aerial application of the herbicide Rodeo, most likely from a helicopter, which allows the application to be done quickly and with relative precision (compared to an airplane). During the spraying, threatened and endangered plant species will be protected

from coming into contact with the herbicide. Also, buffer areas near forested and emergent wetland areas will not be sprayed during the aerial application. Spraying will take place during the fall and will be done 2 consecutive years to ensure minimal survival of *Phragmites*. Average annual cost equals $18,000 (total cost $229,600).

Solution #2: Water level management/Conversion to Saltwater Marsh

This solution would involve the installation of 2 water control structures, the excavation of existing drainage ditches in order to re-connect hydrologically separated ponds, and converting a portion of The Nature Conservancy property to saltwater marsh.

Water level Management

This solution would allow some management of the water levels within The Meadows. It is hoped that during periods of low water, it will be possible to pond water to either drown out some of the Phragmites australis or at least keep enough water present around the edges of the pond to discourage its spread. It was determined that this solution alone would not be sufficient to control either the growth or spread of Phragmites autralis. This is because there is not enough freshwater present at the site to be able to pond water deep enough, for a long enough period to kill the Phragmites australis by drowning it. However, this solution will help to keep the Phragmites australis under control after it is killed by another method. In addition, this solution would also be applicable for improving the water movement and water quality within The Meadows.

Conversion to Saltwater Marsh

This solution would involve converting the current freshwater/brackish water system back into a tidal saltwater marsh. Prior to the tide gate installation in 1927, Cape Island Creek was a source of daily tidal flow into the site. While some tidal flow has been able to bypass the tide gate, the site has been converted to freshwater due to the absence of consistent tidal inundation. Since daily tidal inundation is an extremely effective means of killing Phragmites australis, this solution was considered for The Meadows. In addition, the existence of a saltwater marsh in such close proximity to a freshwater marsh is considered a favorable habitat situation due to the added diversity and was encouraged by The Nature Conservancy.

The possibility of converting a small portion of The Meadows was examined. Despite the fact that this alternative would require the construction of a small berm to limit the extent of the saltwater marsh and the replacement of the existing flap gate to a self-regulating tide gate , it may be a cost-effective solution when compared to the previous solutions. Vegetation would not have to be planted because the tide would be instrumental in supplying a seed source, therefore

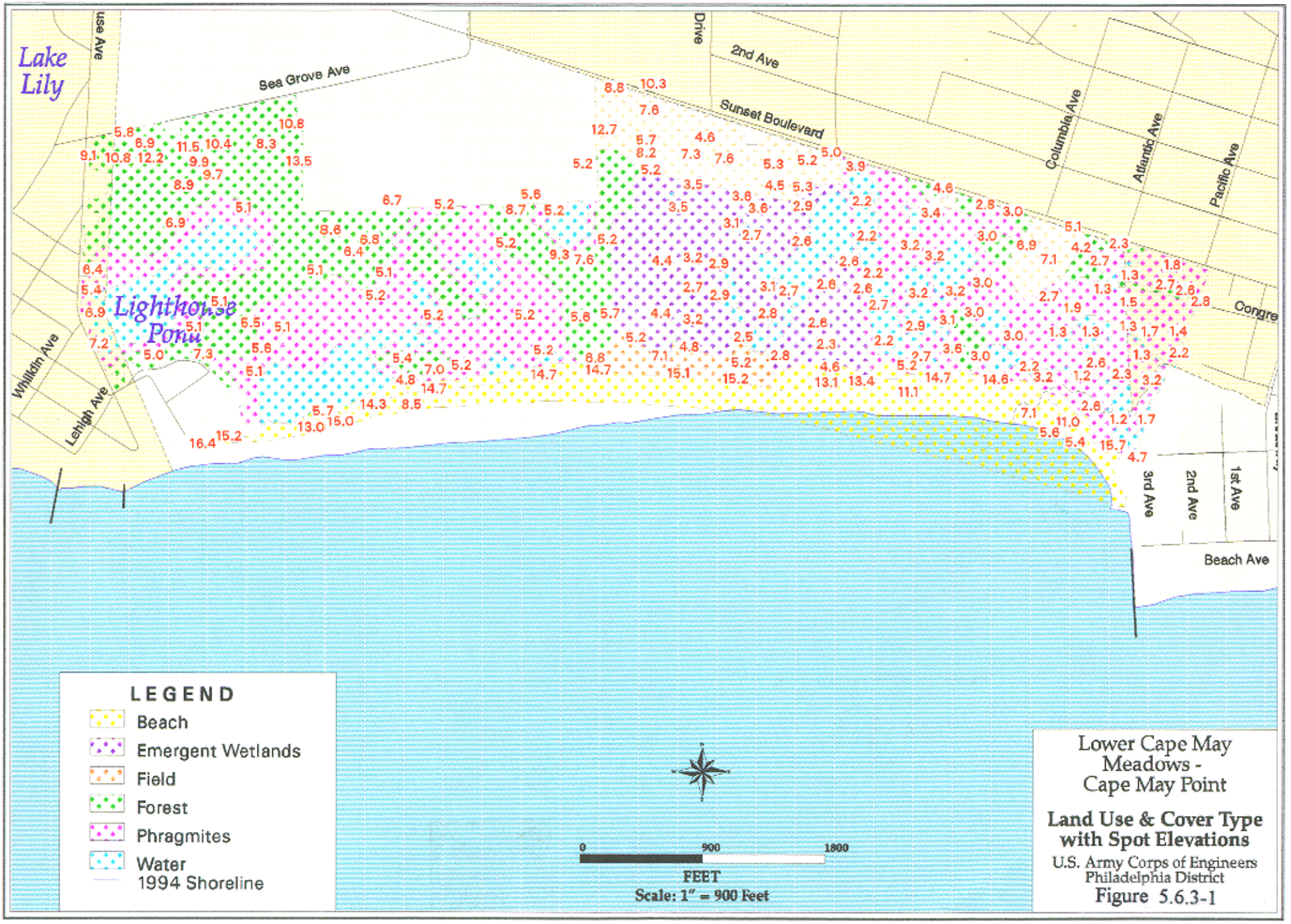
vegetating the site. In addition, a cost savings would probably be realized by reduced Phragmites australis control during the monitoring portion of the project as well as a cost savings to the Cape May County Mosquito Commission since the tidal action would eliminate the need for them to spray the area. Based on the above reasons, the conversion of 25 acres of existing Phragmites australis into a saltmarsh was evaluated. The location of this alternative can be found in Figure 5.6.4-1. Average annual cost equals $21,000 (total cost $254,400).

Solution #3: Planting of desirable plant species

This solution would be done in conjunction with either spraying and burning, excavation, or both. Once the Phragmites australis is removed by one of these methods, emergent wetland plants with value to wildlife can be planted. Once these plants are planted and established in the area, they will help to keep the Phragmites australis at bay, and may even be able to out-compete them for growing area. Different vegetation would be planted, depending upon elevations, adjoining habitat, and water levels. Immediately around the open water areas, species such as wild rice, smartweeds, bulrush, and cattails would be planted. In the palustrine emergent habitat beyond this area, species such as sedges, rice cutgrass, smartweeds, spike rush, and widgeon grass would be planted. In adjacent uplands and transition areas, species such as bayberry, wax myrtle, marsh elder, and marsh goldenrod would be planted. Average annual costs equal $53,000 (total cost $688,900).

Solution #4: Excavation

This solution would include the excavation of material to lower the existing ground elevation in order to provide a habitat less suitable for the growth of Phragmites australis. This would generally be done in conjunction with the application of herbicide to kill the vegetation before the area is excavated. Upon further investigation, it was determined that this would not be the most cost effective or most efficient solution for this area. Excavation in a wetland environment such as this is very expensive due to the wet site conditions, limited access, and disposal costs. In additions to the cost factors, based on topographical surveys, it does not appear that the elevation of the area plays a critical role in the invasion of the Phragmites australis. Figure 5.6.3-1 shows recent spot elevations recorded during the topographical surveys. It can be seen from this figure that the elevations are higher on the western side of the project and gradually decrease as you head east towards Cape May City. This change in elevation follows the natural drainage patterns of The Meadows. It can also be seen in this figure (especially within the Nature Conservancy) that there is no clear elevation change between the Phragmites australis and the emergent wetlands. In fact, in much of the eastern section of the Nature Conservancy, the elevation of the Phragmites australis is actually lower than that of the emergent wetlands. Something that is not illustrated in this figure but was identified in the original surveys is that despite the fact that the western section has the highest elevations when compared to the rest of the site, these elevations are closely linked to the existing water surface elevations in the ponds. Based on these factors, it was determined that this solution would not be utilized for this project.



Lower Cape May Meadows - Cape May Point

Land Use & Cover Type with Spot Elevations

U.S. Army Corps of Engineers
Philadelphia District

Figure 5.6.3-1

5.6.4 *ID). Objective: Restore Freshwater Ponding Areas*

As mentioned earlier, hydrologic alterations caused by storm events have resulted in the isolation of many of The Meadows' ponds. This causes many of the isolated ponds to become completely dry during periods of low water. When this happens, it can kill the fish living in the ponds, it can increase mosquito breeding, and can have a detrimental effect on species which rely on The Meadows as a source of food and water. Alternatives that prevent or lessen the occurrence of this problem were analyzed. These alternatives are also related to those found under Objective IB, Goal #3. In addition, restoration of ponding areas should prevent colonization by common reed.

Solution #1: Create water reservoirs within ponds

This solution would involve the construction of 6 deep water fish reservoirs within ponds at The Meadows. The reservoirs would be approximately 3 feet deep and gradually slope back into the existing ground elevation. The reservoirs would each be approximately 0.25 acres in size. The purpose of the fish reservoirs would be to provide a constant source of water, even during periods of low rain fall. Constant water will allow the continued survival of fish living within the ponds and the birds that feed on them. Also, the reservoirs will prevent a situation in which an area is covered by a small layer of stagnant water, which is the perfect breeding ground for mosquitoes. A reduction in the number of mosquitoes will lead to a reduction of mosquito ditching and spraying, both of which tend to have negative impacts on other species. The location of this alternative can be found in Figure 5.6.4-1. Average annual costs equal $4,000 (total cost $53,300). Costs were calculated assuming the work would be performed by the Cape May County Mosquito Commission.

Solution #2: Reconnect hydrologic units in combination with water control structures

Solution #2 for Objective 1C (Section 5.6.3) will achieve similar results. See Figure 5.6.4-1. Therefore this solution will not be considered further.

LEGEND

AREAS EXCAVATED TO PROVIDE FISH RESERVOIR

AREAS EXCAVATED TO IMPROVE DRAINAGE

WEIR (FLOW CONTROL STRUCTURE)

AREAS OF SAND OVERWASH TO BE RECLAIMED

DATE OF PHOTOGRAPHY: 3-7-93
N.J. STATE PLANE NAD 83
VERTICAL DATUM NGVD 29

U.S. ARMY ENGINEER DISTRICT, PHILADELPHIA
CORPS OF ENGINEERS
PHILADELPHIA, PENNSYLVANIA

LOWER CAPE MAY MEADOWS
CAPE MAY POINT
FEASIBILITY STUDY

CAPE MAY MEADOWS
INTERIOR RESTORATION

FIGURE 5.6.4-1

II. Problem: Oceanwater Inundation via The Meadows to the Towns of Cape May Point and West Cape May

5.6.5 ***A.) <u>Objective:</u> Reduce oceanwater storm inundation to Cape May Point and West Cape May***

Solution #1: See solutions listed under Problem I, Objective IA

As mentioned previously, the protection measures provided for The Meadows will incidentally address the inundation problems at Cape May Point and West Cape May. An identification of NED benefits for these areas can be found in that section of the report.

Solution #2: Dike(s) along with possible drainage structures (if needed) located along Cape May Point and West Cape May.

Since more than 75% of the damages at Cape May Point and 60% of the damages at West Cape May will be incidentally reduced by the protective dune/berm selected for The Meadows in Section 5.6.1.1, it was only examined whether any <u>additional</u> inundation protection provided to Cape May Point and West Cape May would be cost-effective. This could be accomplished by providing a dike or levee along Lighthouse Avenue in Cape May Point and another similar structure along Sunset Boulevard in West Cape May. The maximum realizable incremental average annual benefits (to protect against a 500-year frequncy event) for Cape May Point and West Cape May are approximately $181,600 and $84,500 respectively.

It is possible to construct a levee along Lighthouse Avenue with a crest elevation of +8.0 feet NGVD which would provide protection at between a 50-year and a 100-year frequency storm event. However, the additional average annual storm damage reduction in negligible ($2,000 for Cape May Point and $7,000 for West Cape May. It is highly improbable that the incermental costs to construct two dike/levee would be less than or equal to the incremental annual benefit.

Examining the potential benefits, a cost-effective solution protecting against a 100-year frequency level storm would have to have a first cost of less than $15,600 for Cape May Point and $50,300 for West Cape May. To protect against the 200 year level frequency event first costs would have to be less than $58,700 for Cape May Point and $186,800 for West Cape May. Experience indicates that it is highly unlikely that a dike or levee type structure could be constructed for those costs. Therefore, this alternative was not analyzed further.

5.6.6 *B.) Objective: Reduce storm damage vulnerability along Cape May Point Oceanfront*

Solution #1: Berm and dune restoration

It was demonstrated in Section 5.6.1.1 of this report that the protective dune/berm for The Meadows was needed to extend along the Cape May Point frontage up to the Central Avenue groin. This is because all of the cells at Cape May Point, with the exception of cell F (Central Avenue groin to Alexander Avenue groin), hydrologically drain to and therefore affect The Meadows. Not extending the project along the Cape May Point oceanfront would potentially undermine any potential project for The Meadows. Any extension of a project north of the Central Avenue groin would have to be justified on storm damage reduction (NED) benefits only.

An analysis of the potential benefits to this area shows $63,000. The relatively low magnitude of this number precludes the cost-effectiveness of extending the protective dune/berm placement this area.

Solution #2: Berm and due restoration using structural reinforcement

As in the previous analysis this solution would also not be cost-effective.

6. EVALUATION OF "WITH-PROJECT" HABITATS AND INCREMENTAL COST ANALYSIS

6.1 Alternatives

In order to develop viable alternatives for the ecosystem restoration, which could be carried through the HEP and incremental cost analysis, alternatives were evaluated through cycle 1, 2 and 3 screening. This process, for most alternatives, was similar to the standard alternative screening done for recent, similar CENAP studies. The alternative screening procedure to choose the selected berm and dune profile however, was different. The berm and dune design were selected using 2 criteria to measure benefits. The first criteria was the average annual acres not inundated by saltwater. This number was vital to the project design because the saltwater inundation which has been occurring at the site is one of the main causes of the degradation to the water quality and vegetative community. The second design criteria for the beachfill was the size of the beach from the seaward toe of the dune to Mean High Water (MHW). It was determined, through coordination with the USFWS, that the beach should be a minimum of approximately 150 feet wide from the toe of the dune to MHW. This beach width was chosen in order to accommodate beach nesting birds such as the Federally threatened piping plover, and the state endangered least tern. While both of these species currently nest at The Meadows, their nests are primarily confined to the section of The Nature Conservancy property where a wider beach exists. Since this nesting habitat is in short supply in the state of New Jersey, it was imperative that this habitat not be negatively impacted in any way. Also, since the project is designed to improve wildlife habitat, it was decided to design the berm to accommodate these nesting species. A complete discussion of the alternative screening process can be found in Section 5 of this report.

The results of this screening produces several alternatives which met the goals of the study, which were: to reduce coastal erosion, reduce storm associated saltwater intrusion, restore lost habitat, restore internal hydrology, and control invasive plant species (Phragmites australis). These alternatives included: a beachfill with an +18 ft NGVD dune and 20 ft berm profile with periodic nourishment, the same beachfill profile without periodic nourishment, restoring 7 acres of wetlands which have been buried by sand that was washed over the dune due to overtopping during storms, moving the existing dune line seaward to restore 35 acres of wetland habitat, moving the existing dune line seaward to restore 60 acres of wetland habitat, spray and burn 95 acres of Phragmites australis and plant with freshwater emergent vegetation, spray and burn 95 acres of Phragmites australis and plant 70 acres with freshwater emergent vegetation and convert 25 acres into a saltwater marsh, create 6 deep water fish reservoirs, and restore the hydrologic connections through channel excavation and install of 2 water control structures.

In order to analyze these plans for inclusion in the HEP and incremental cost analysis, it was

assumed that all plans were dependent upon the protective dune/berm portion of the project. The reason for this is that without the storm protection afforded by the beachfill, the interior habitat would continue to be degraded and more existing habitat would be lost. Since in the current situation, overtopping and breaching are occurring at a frequency of a 2 year and 10 year storm, respectively, it would not be environmentally beneficial or cost effective to spend any money improving that habitat behind the dune until this situation is improved.

In addition to this assumption, during the course of estimating past, future with project, and future without project conditions (and HU's) for the study it was necessary to make other assumptions regarding site conditions and wildlife use. Assumptions and recommendations were also necessary to design project features. These assumptions and recommendations are as follows:

- Saltwater inundation from a 5-year frequency storm event is enough to change the composition of the vegetation. For example, it is believed that the forested areas would begin to die and would be converted into Phragmites australis dominated habitat.

-The locations from which habitat variables were sampled adequately represented habitat variables throughout the cover type area.

- When dune breaches occur, the state will continue to do minimal repair, as it has done in the past. This repair generally involves the dune being moved further landward as the dune is usually repaired in the location it is left after the storm. This means the repairs do not "hold the line".

- In cover types where a particular life requisite was absent or low, the HEP team evaluated that variable in an adjacent cover type. However, all cover types had at least one life requisite.

- Temporary construction impacts were not factored into the HEP analysis.

- The past HEP numbers were based on photo interpretation from a 1955 aerial photo. No field work was done. HSI's and acreages were determined by this method.

- The existing offshore shallow water habitat will not be lost with the project, it will simply be moved to the edge of the project. With or without project, shallow water habitat will be the same.

- Environmental conditions will remain unchanged except for forces of nature (i.e. - no building etc.), and natural succession will occur (i.e.- vegetation growth and expansion etc.).

- The proposed plan included vegetating the dunes.

- Beach acreage (with project) remains constant due to re-nourishment.

- The selected plan includes planting vegetation such as wax myrtle and bayberry to form a buffer area (approximately 20 feet wide) at the landward toe of the dune to avoid the dune being undermined by the restored emergent wetlands.

- Alternative A1 (with nourishment) and A2 (without nourishment) will be run against each other for the initial incremental cost analysis. The plan selected during this analysis will then be combined with the other alternatives to pick a final selected plan.

- The saltmarsh alternative assumes that approximately 25 acres of wetlands will be converted to saltmarsh.

- In order to reconnect the hydrologically disconnected ponds, approximately 1 acre of emergent wetlands will be converted to open water habitat.

- Alternative B2 (the small move the shoreline alternative) includes the creation of 4 acres of open water within the 35 acres of restored wetlands. Alternative B3 (medium move the shoreline alternative) includes the creation of 7 acres of open water within the 60 acres of restored wetlands. The created ponds and ditches will be approximately 12" deep or less with one or two deep pockets. The open water area will be spread between more than one pond.

- Organic substrate will be placed during the creation of the restored wetlands for alternatives B1 (restore 7 acres of overwash), B2, and B3. For the purposes of the HEP, this substrate will be classified as "muddy".

- While the HEP results show a loss of habitat units for Phragmites australis, this does not represent true conditions. In reality, this habitat is not being lost but is being converted into emergent wetlands. The muskrat and marsh wren, as well as other species that utilize the Phragmites australis habitat will use the emergent wetland habitat.

- A beachfill with nourishment will reduce the saltwater intrusion and the number of snails and submerged aquatic vegetation will increase.

- All HSI numbers were calculated based on the implementation of alternative A1.

- Overwash areas will remain emergent wetlands after reclamation due to site maintenance performed by The Nature Conservancy (ie - area will not convert to Phragmites australis).

- The berm associated with the saltmarsh alternative will be planted with woody vegetation to prevent the invasion of Phragmites australis.

- Phragmites australis is expected to spread approximately 0.5 acres per year for the beachfill, B1, B2, and B3 alternatives. The rate of spread will be 1 acre per year without the project and will not spread with the water level control alternative.

- Alternative C1 (Phragmites australis removal, all freshwater) will convert the Phragmites australis habitat into emergent habitat with some scrub shrub. Alternative C2 includes 25 acres of Spartina marsh.

- Alternatives C1 and C2 include 2 aerial applications of the herbicide Rodeo.

- The Nature Conservancy will continue to periodically mow (maintain) the old field habitat which would keep the habitat at a value similar to what it is now.

6.2 Incremental Cost Analysis

In accordance with ER 1105-2-100 (U.S. Army Corps of Engineers, 1990), an incremental cost analysis was completed for the ecosystem restoration portion of this project. The planning guidance in ER 1105-2-100 requires:

"An incremental cost analysis shall be performed for all recommended mitigation plans. The purpose of incremental cost analysis is to discover and display variation in cost, and to identify and describe the least cost plan" (paragraph 7-35h).

In 1991, the U.S. Army Corps of Engineers Policy Guidance Letter #24 extended this requirement to the restoration of fish and wildlife habitat resources; and current program and budget guidance accords high priority to "the restoration and protection of environmental resources, including fish and wildlife habitat, i.e. inland and coastal wetlands, other aquatic and riparian habitat, and upland habitat" (U.S. Army Corps of Engineers, 1994).

For the purposes of this project, the incremental cost analysis was completed using the U.S. Army Corps of Engineers publication "Cost Effectiveness Analysis for Environmental Planning: Nine EASY Steps" and the software program "Automated Procedures for Conducting Cost Effectiveness and Incremental Cost Analysis (Beta Version 2.0)".

The Nine EASY Steps presented in the above document are as follows:

Step 1 - Display outputs and costs.

Step 2 - Identify combinable management measures.

Step 3 - Calculate outputs and costs of combinations.

Step 4 - Eliminate economically inefficient solutions.

Step 5 - Eliminate economically ineffective solutions.

Step 6 - Calculate average costs.

Step 7 - Recalculate average costs for additional output.

Step 8 - Calculate incremental costs.

Step 9 - Compare successive outputs and incremental costs.

These steps were completed through the use of the above referenced computer program. Steps 1 - 3 are summarized in Table 6-1 which shows each combination of management measures, as well as the associated cost and output (in HU's). The list of management measures, and their corresponding "code", is found on Table 6-2.

The management measures were grouped according to the objective being met with the proposed alternative. The 4 groupings were: erosion control/inundation reduction (A), reclaiming wetland acreage (B), controlling Phragmites australis (C), and water level control/reconnection (D). Groups A, B and C were broken down further to represent the alternatives associated with each objective.

Table 6-1

LOWER CAPE MAY MEADOWS
Combinations Sorted by Cost & Output

	Management Measures	Cost	Output
1	A0 B0 C0 D0	0.00	0.00
2	A1 B1 C0 D0	10438118.00	254.40
3	A1 B0 C0 D0	10188963.00	257.50
4	A1 B1 C0 D1	10544641.00	285.00
5	A1 B0 C0 D1	10295486.00	287.40
6	A1 B2 C0 D0	12190323.00	313.40
7	A1 B1 C1 D0	11356547.00	334.90
8	A1 B0 C1 D0	11107392.00	337.30
9	A1 B1 C2 D0	11302084.00	340.40
10	A1 B0 C2 D0	11052929.00	342.80
11	A1 B2 C0 D1	12296846.00	343.30
12	A1 B3 C0 D0	14141511.00	359.70
13	A1 B1 C1 D1	11463070.00	364.80
14	A1 B0 C1 D1	11213915.00	367.20
15	A1 B1 C2 D1	11408607.00	370.30
16	A1 B0 C2 D1	11159452.00	372.70
17	A1 B3 C0 D1	14248034.00	389.60
18	A1 B2 C1 D0	13108752.00	393.20
19	A1 B2 C2 D0	13182703.00	398.70
20	A1 B2 C1 D1	13215275.00	423.10
21	A1 B2 C2 D1	13289226.00	428.60
22	A1 B3 C1 D0	15059940.00	439.50
23	A1 B3 C2 D0	15262305.00	445.00
24	A1 B3 C1 D1	15166463.00	469.40
25	A1 B3 C2 D1	15368828.00	474.90

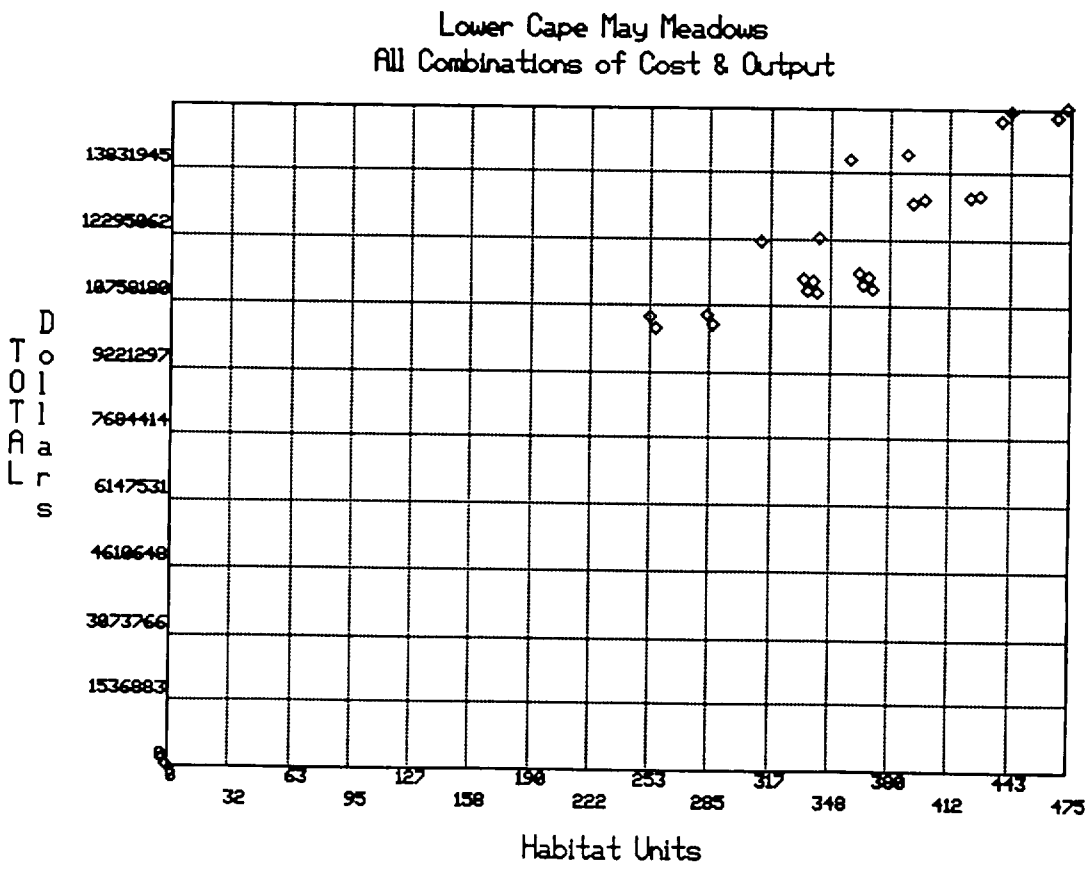


Table 6-2
Lower Cape May Meadows
Environmental Restoration Alternatives

Erosion Control (A)

A0 - No Action

A1 - 18-20 Berm and Dune, Meadows and the Point, With Nourishment

A2 - 18-20 Berm and Dune, Meadows and the Point, Without Nourishment

Reclaiming Wetland Acreage (B)

B0 - No Action

B1 - Restore 7 Acres of Sand Overwash Areas

B2 - Move the Shoreline, Restoring 35 Acres of Wetlands (Small)

B3 - Move the Shoreline, Restoring 60 Acres of Wetlands (Medium)

Phragmites australis Control (C)

C0 - No Action

C1 - Spray and Burn Phragmites australis, Plant Emergent Vegetation (All Freshwater)

C2 - Spray and Burn Phragmites australis, Plant Emergent Vegetation, (Fresh and Saltwater),

Water Level Control (D)

D0 - No Action

D1 - Create 6 Deep Water Fish Reservoirs, Reconnect Hydrologic Units, Improve Drainage, and Install 2 Water Level Control Structures

NOTE: All plans are dependent upon alternative A. The Selected Plan will be some combination of the above alternatives.

In order to simplify the HEP and incremental cost analysis, alternatives A1 and A2 (beachfill with and without periodic nourishment) were analyzed separately to determine if periodic nourishment should be part of the selected plan. Alternatives A1 and A2 were assigned new management codes and evaluated through the use of the incremental cost analysis. Management code B represented the beachfill and management code N represented the periodic nourishment. Therefore, the combination B1 N1 represents the beachfill with periodic nourishment. Table 6-3 shows the 2 possible combinations of these management measures, along with the outputs, incremental cost, incremental output, incremental average cost, and the graph associated with the combinations. From this table it can be noted that, with nourishment, the beachfill plan provides an additional 257.5 HU's, at an average incremental cost of $68,939 per HU, over the baseline conditions for the year 2050. In contrast, without nourishment, the beachfill plan provides only and additional 58.11 HU's, at an average incremental cost of $175,339 per HU, over the baseline conditions for the year 2050. Based on these numbers, Table 6-4 shows the results of the final incremental analysis, which chooses the beachfill with periodic nourishment (B1 N1) as the selected beachfill plan. This selected beachfill plan was then combined with the rest of the management measures for the remainder of the analysis in order to select the best overall plan to restore the habitat at The Meadows. It should be noted however that only the initial construction cost for the beachfill was used for the remainder of the incremental analysis. This had to be done because of a problem with the computer software. When the additional $13,745,800 for the nourishment component was added into the analysis, all alternatives except for alternative A1 B3 C2 D1 were dropped from the analysis. This did not make sense since the same amount of money was added to all proposed plans and therefore should not have changed the results of the analysis. Tables 6-5 and 6-6 show that the incremental costs and outputs for the 2 analyses are virtually the same. The only difference is in the incremental cost of the initial increment which goes from the no-action alternative to alternative A1 B0 C0 D0. In order to clearly illustrate the fact that the analysis using the nourishment costs would give you the same 4 plans illustrated in Table 6-11, another program was used for the final incremental analysis for the nourishment costs. This analysis is shown on Table 6-7.

Table 6-1 showed all the possible combinations of management measures when those management measures are dependent upon the previously selected beachfill with periodic nourishment alternative. Tables 6-8 to 6-10 show the process by which the management measure combinations were sorted according to cost and output and how combinations with high costs and low outputs were dropped from the analysis in order to get a list of the most cost-effective least-cost alternatives. From this point, several iterations were done which continued to remove those measures which had a higher cost than others for the same (or less) output. These iterations produced a list of 4 viable combinations for the final incremental analysis (Table 6-11). These combinations were: no action; the beachfill (with nourishment), Phragmites australis removal with 25 acres of salt marsh, and reconnect the hydrologic units; the beachfill (with nourishment), move the shoreline to restore 35 acres of wetlands, Phragmites australis removal with 25 acres of salt marsh, and reconnect the hydrologic units; the beachfill (with nourishment), move the shoreline to restore 60 acres of wetlands, Phragmites australis removal with 25 acres of

salt marsh, and reconnect the hydrologic units. The graph associated with Table 6-11 compares the output (in HU's) to the incremental dollars associated with the plan. While all of these plans, except the no action, would accomplish the desired goals and protect and restore the wildlife habitat at The Meadows, the selected plan (A1 B2 C2 D1 - the beachfill (with nourishment), move the shoreline to restore 35 acres of wetlands, Phragmites australis removal with 25 acres of salt marsh, and reconnect the hydrologic units) was considered to be the most cost effective plan based on the environmental benefits gained. The selected plan results in a gain of 429 HU's by the year 2050 when compared to the baseline conditions. This represents a gain of 56 habitat units over the plan below it (A1 B0 C2 D1) which does not include the restoration of previously eroded wetlands. The additional cost for these habitat units is a total of $2,129,774, giving it an incremental cost of $38,099 per habitat unit for the additional gains. Due to the fact that this plan would begin to replace some of the over 124 acres of habitat that has been lost due to erosion, and the fact that, in reality, the restoration of this area will be much more valuable to wildlife than the HEP can express, it was decided that the extra $2.1 million cost was worth the benefits gained. For this reason, this plan was chosen as the selected plan for the project area.

Table 6-3

LOWER CAPE MAY MEADOWS
Cost-Effective Least-Cost with Incremental Analysis

Management Measures	Cost	Output	Incremental Cost	Incremental Output	Incremental Average Cost
B0 N0	0.00	0.00	0.00	0.00	0.00
B1 N0	10188963.00	58.11	10188963.00	58.11	175339.24
B1 N1	23934763.00	257.50	13745800.00	199.39	68939.26

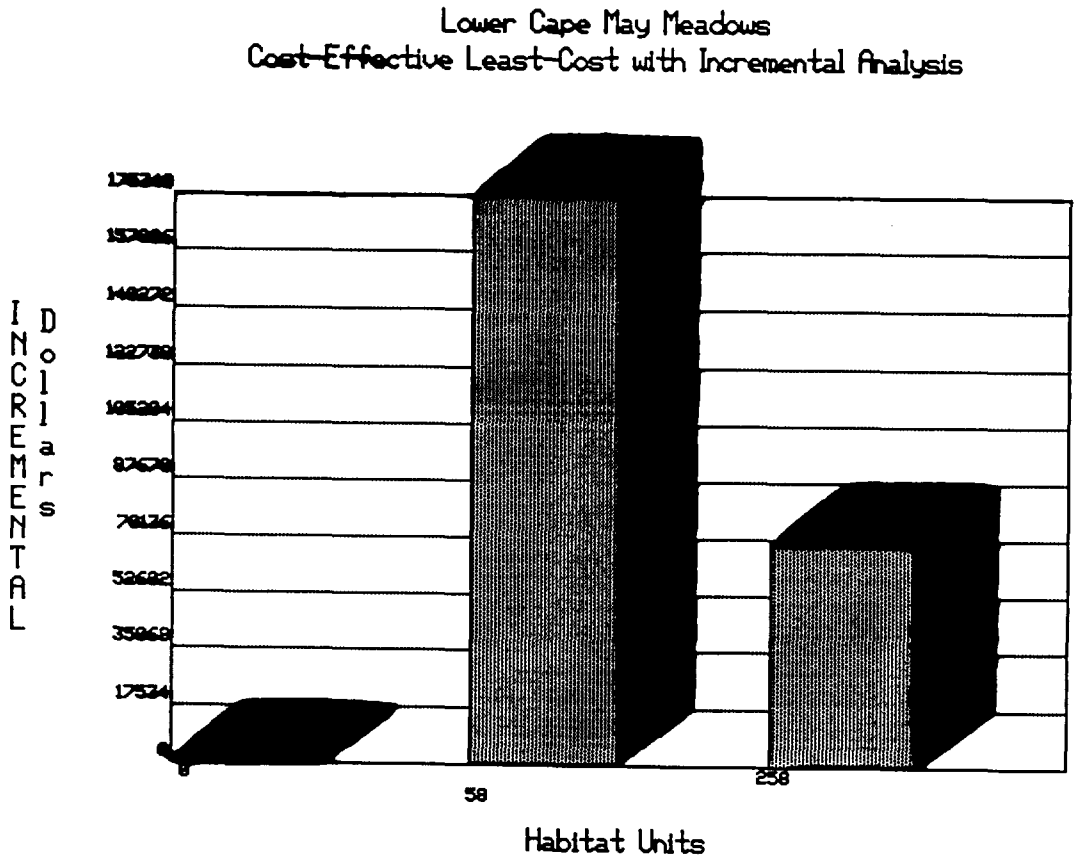


Table 6-4

LOWER CAPE MAY MEADOWS
Combinations for Final Incremental Analysis

Management Measures	Cost	Output	Incremental Cost	Incremental Output	Incremental Average Cost
B0 N0	0.00	0.00	0.00	0.00	0.00
B1 N1	23934763.00	257.50	23934763.00	257.50	92950.54

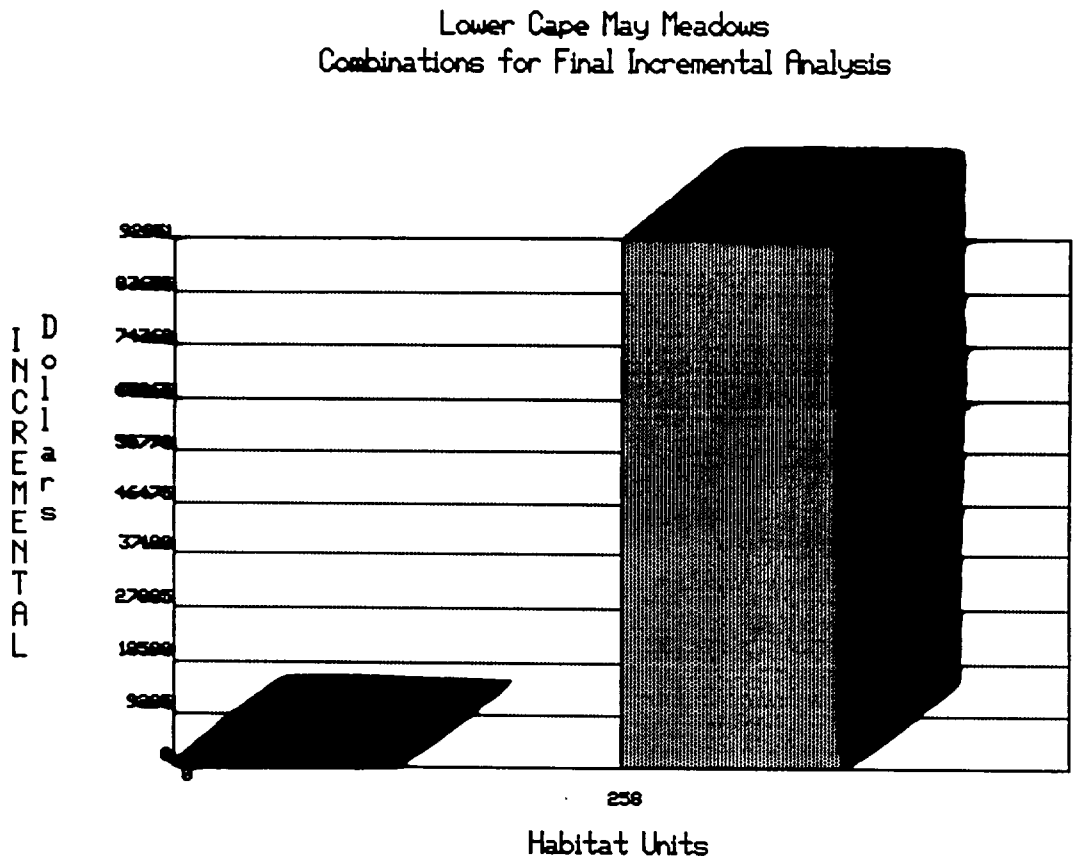


Table 6-5

LOWER CAPE MAY MEADOWS

Cost-Effective Least-Cost with Incremental Analysis

Management Measures	Cost	Output	Incremental Cost	Incremental Output	Incremental Average Cost
A0 B0 C0 D0	0.00	0.00	0.00	0.00	0.00
A1 B0 C0 D0	10188963.00	257.50	10188963.00	257.50	39568.79
A1 B0 C0 D1	10295486.00	287.40	106523.00	29.90	3562.64
A1 B0 C2 D0	11052929.00	342.80	757443.00	55.40	13672.26
A1 B0 C2 D1	11159452.00	372.70	106523.00	29.90	3562.64
A1 B2 C1 D0	13108752.00	393.20	1949300.00	20.50	95087.80
A1 B2 C2 D0	13182703.00	398.70	73951.00	5.50	13445.64
A1 B2 C1 D1	13215275.00	423.10	32572.00	24.40	1334.92
A1 B2 C2 D1	13289226.00	428.60	73951.00	5.50	13445.64
A1 B3 C1 D0	15059940.00	439.50	1770714.00	10.90	162450.83
A1 B3 C1 D1	15166463.00	469.40	106523.00	29.90	3562.64
A1 B3 C2 D1	15368828.00	474.90	202365.00	5.50	36793.64

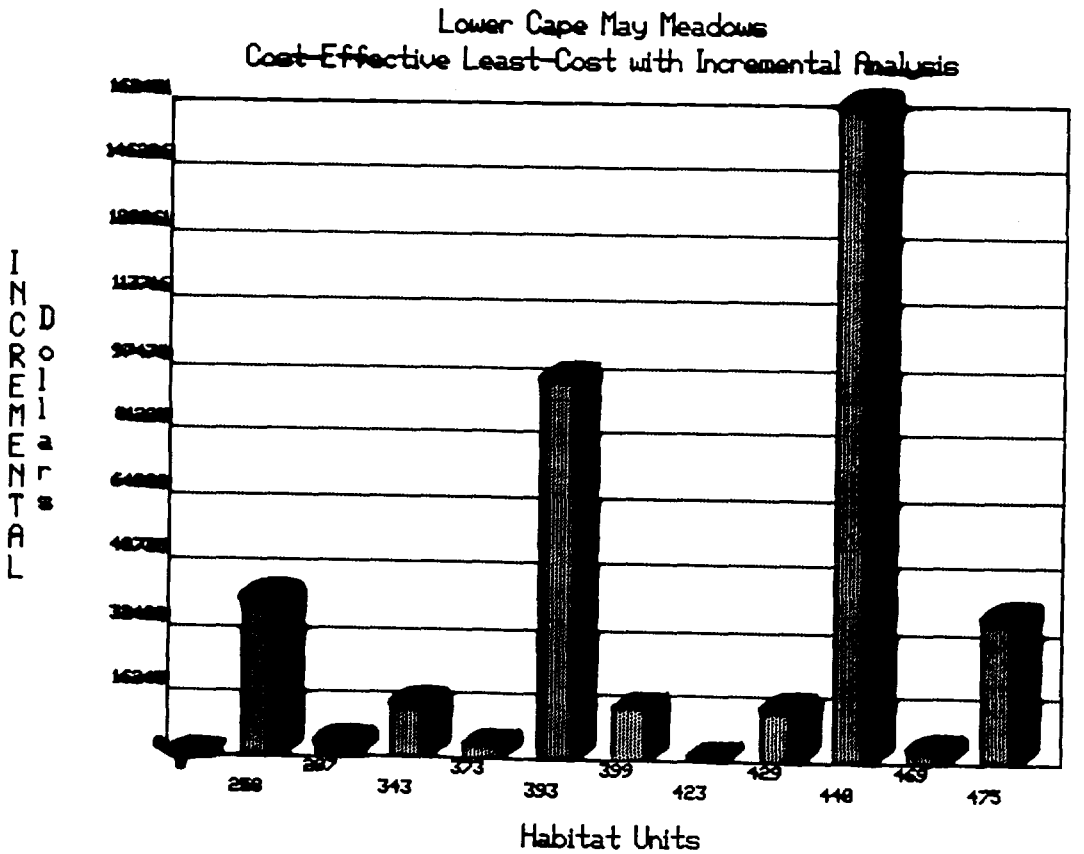


Table 6-6

LOWER CAPE MAY MEADOWS
Cost-Effective Least-Cost with Incremental Analysis

Management Measures	Cost	Output	Incremental Cost	Incremental Output	Incremental Average Cost
A0 B0 C0 D0	0.00	0.00	0.00	0.00	0.00
A1 B0 C0 D0	23934763.00	257.50	23934763.00	257.50	92950.54
A1 B0 C0 D1	24041286.00	287.40	106523.00	29.90	3562.64
A1 B0 C2 D0	24798729.00	342.80	757443.00	55.40	13672.26
A1 B0 C2 D1	24905252.00	372.70	106523.00	29.90	3562.64
A1 B2 C1 D0	26854552.00	393.20	1949300.00	20.50	95087.80
A1 B2 C2 D0	26928503.00	398.70	73951.00	5.50	13445.64
A1 B2 C1 D1	26961075.00	423.10	32572.00	24.40	1334.92
A1 B2 C2 D1	27035026.00	428.60	73951.00	5.50	13445.64
A1 B3 C1 D0	28805740.00	439.50	1770714.00	10.90	162450.83
A1 B3 C1 D1	28912263.00	469.40	106523.00	29.90	3562.64
A1 B3 C2 D1	29114628.00	474.90	202365.00	5.50	36793.64

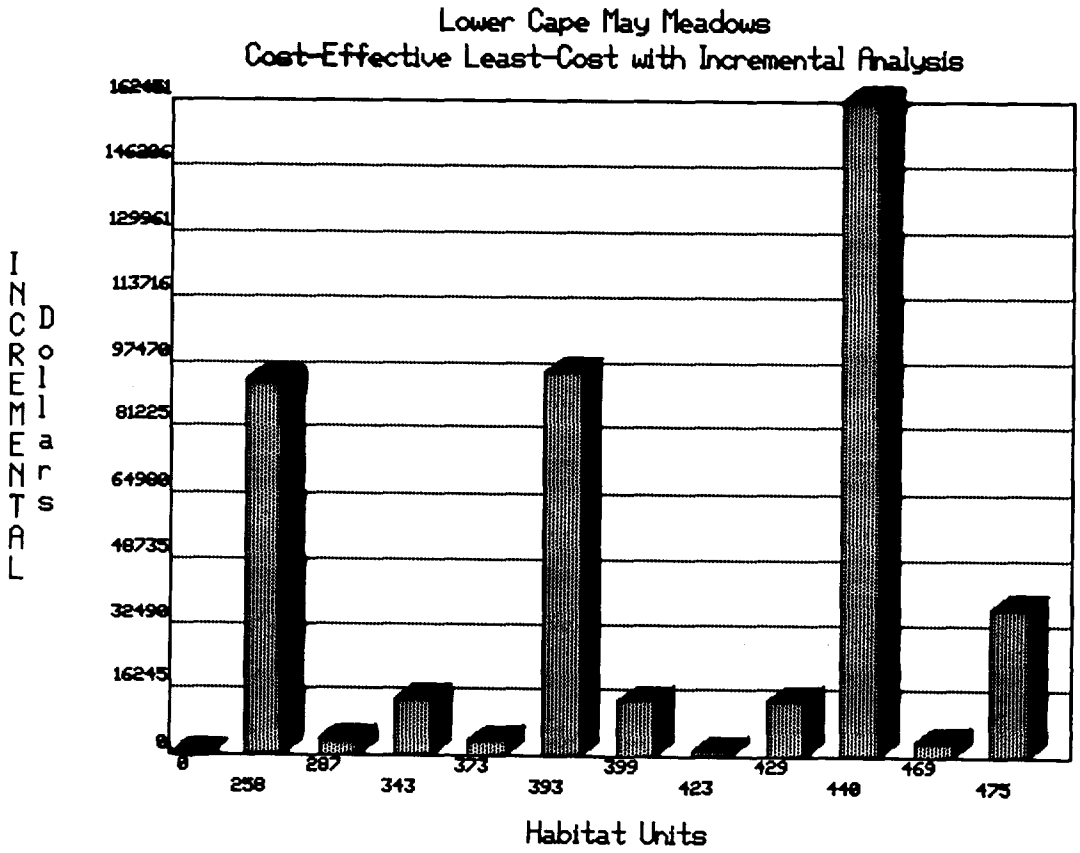


Table 6-7

Alternative Incremental Analysis for Plans with Nourishment Costs

ITERATION #1							
Plan	**Management**			**Incremental**	**Incremental**	**Incremental**	
No.	**Measures**	**Cost**	**Output**	**Cost**	**Output**	**Average Cost**	
1	A0 B0 C0 D0	0	0.00	0	0.00	0	*
2	A1 B0 C0 D0	$23,934,763	257.50	$23,934,763	257.50	92,950.54	x
3	A1 B0 C0 D1	$24,041,286	287.40	$24,041,286	287.40	83,650.96	x
4	A1 B0 C2 D0	$24,798,729	342.80	$24,798,729	342.80	72,341.68	x
5	A1 B0 C2 D1	$24,905,252	372.70	$24,905,252	372.70	66,823.86	*
6	A1 B2 C1 D0	$26,854,552	393.20	$26,854,552	393.20	68,297.44	
7	A1 B2 C2 D0	$26,928,503	398.70	$26,928,503	398.70	67,540.76	
8	A1 B2 C1 D1	$26,961,075	423.10	$26,961,075	423.10	63,722.70	
9	A1 B2 C2 D1	$27,035,026	428.60	$27,035,026	428.60	63,077.52	
10	A1 B3 C1 D0	$28,805,740	439.50	$28,805,740	439.50	65,542.07	
11	A1 B3 C1 D1	$28,912,263	469.40	$28,912,263	469.40	61,594.08	
12	A1 B3 C2 D1	$29,114,628	474.90	$29,114,628	474.90	61,306.86	
ITERATION #2							
Plan	**Management**			**Incremental**	**Incremental**	**Incremental**	
No.	**Measures**	**Cost**	**Output**	**Cost**	**Output**	**Average Cost**	
1	A0 B0 C0 D0	0	0.00	0	0.00	0	*
2	A1 B0 C2 D1	$24,905,252	372.70	$24,905,252	372.70	66,823.86	*
3	A1 B2 C1 D0	$26,854,552	393.20	$1,949,300	20.50	95,087.80	x
4	A1 B2 C2 D0	$26,928,503	398.70	$2,023,251	26.00	77,817.35	x
5	A1 B2 C1 D1	$26,961,075	423.10	$2,055,823	50.40	40,790.14	x
6	A1 B2 C2 D1	$27,035,026	428.60	$2,129,774	55.90	38,099.71	*
7	A1 B3 C1 D0	$28,805,740	439.50	$3,900,488	66.80	58,390.54	
8	A1 B3 C1 D1	$28,912,263	469.40	$4,007,011	96.70	41,437.55	
9	A1 B3 C2 D1	$29,114,628	474.90	$4,209,376	102.20	41,187.63	
ITERATION #3							
Plan	**Management**			**Incremental**	**Incremental**	**Incremental**	
No.	**Measures**	**Cost**	**Output**	**Cost**	**Output**	**Average Cost**	
1	A0 B0 C0 D0	0	0.00	0	0.00	0	*
2	A1 B0 C2 D1	$24,905,252	372.70	$24,905,252	372.70	66,823.86	*
3	A1 B2 C2 D1	$27,035,026	428.60	$2,129,774	55.90	38,099.71	*
4	A1 B3 C1 D0	$28,805,740	439.50	$1,770,714	10.90	162,450.83	x
5	A1 B3 C1 D1	$28,912,263	469.40	$1,877,237	40.80	46,010.71	x
6	A1 B3 C2 D1	$29,114,628	474.90	$2,079,602	46.30	44,915.81	*

Table 6-8

LOWER CAPE MAY MEADOWS
Least-Cost Combinations for each Level of Output

	Management Measures	Cost	Output
1	A0 B0 C0 D0	0.00	0.00
2	A1 B1 C0 D0	10438118.00	254.40
3	A1 B0 C0 D0	10188963.00	257.50
4	A1 B1 C0 D1	10544641.00	285.00
5	A1 B0 C0 D1	10295486.00	287.40
6	A1 B2 C0 D0	12190323.00	313.40
7	A1 B1 C1 D0	11356547.00	334.90
8	A1 B0 C1 D0	11107392.00	337.30
9	A1 B1 C2 D0	11302084.00	340.40
10	A1 B0 C2 D0	11052929.00	342.80
11	A1 B2 C0 D1	12296846.00	343.30
12	A1 B3 C0 D0	14141511.00	359.70
13	A1 B1 C1 D1	11463070.00	364.80
14	A1 B0 C1 D1	11213915.00	367.20
15	A1 B1 C2 D1	11408607.00	370.30
16	A1 B0 C2 D1	11159452.00	372.70
17	A1 B3 C0 D1	14248034.00	389.60
18	A1 B2 C1 D0	13108752.00	393.20
19	A1 B2 C2 D0	13182703.00	398.70
20	A1 B2 C1 D1	13215275.00	423.10
21	A1 B2 C2 D1	13289226.00	428.60
22	A1 B3 C1 D0	15059940.00	439.50
23	A1 B3 C2 D0	15262305.00	445.00
24	A1 B3 C1 D1	15166463.00	469.40
25	A1 B3 C2 D1	15368828.00	474.90

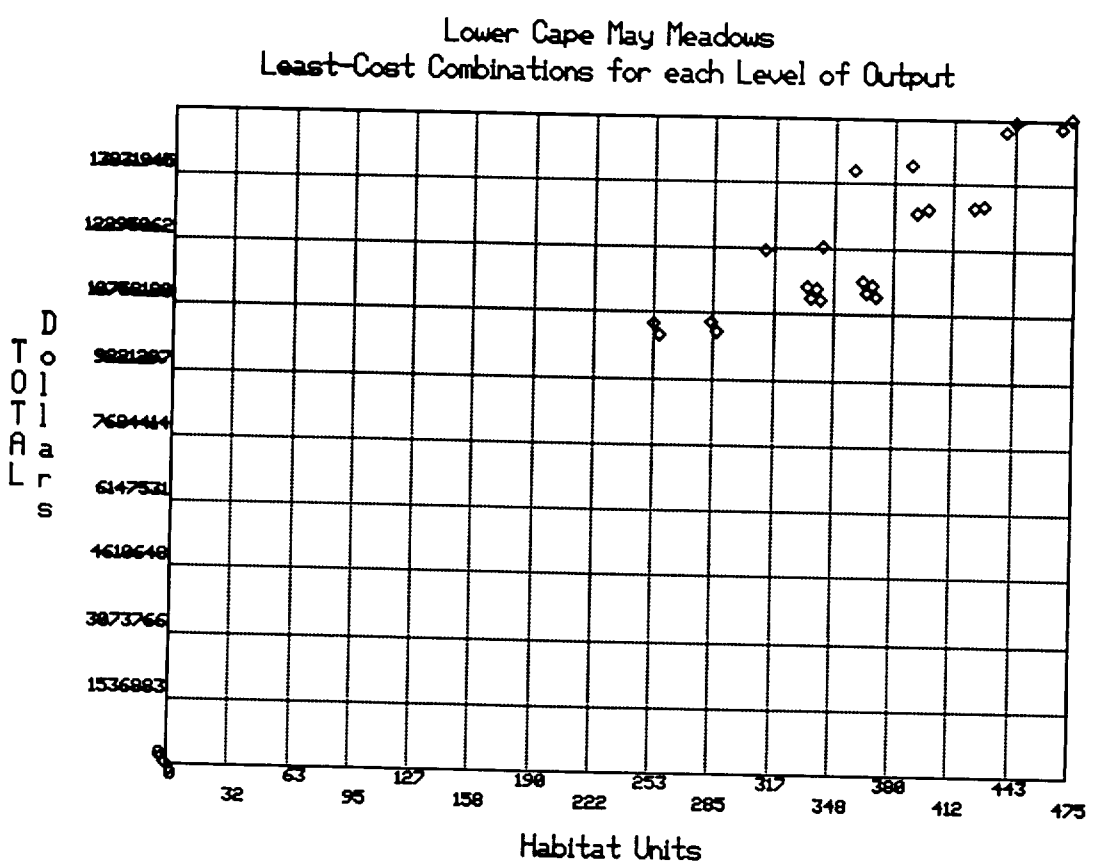


Table 6-9

LOWER CAPE MAY MEADOWS
Cost-Effective Least-Cost Combinations

	Management Measures	Cost	Output
1	A0 B0 C0 D0	0.00	0.00
2	A1 B0 C0 D0	10188963.00	257.50
3	A1 B0 C0 D1	10295486.00	287.40
4	A1 B0 C2 D0	11052929.00	342.80
5	A1 B0 C2 D1	11159452.00	372.70
6	A1 B2 C1 D0	13108752.00	393.20
7	A1 B2 C2 D0	13182703.00	398.70
8	A1 B2 C1 D1	13215275.00	423.10
9	A1 B2 C2 D1	13289226.00	428.60
10	A1 B3 C1 D0	15059940.00	439.50
11	A1 B3 C1 D1	15166463.00	469.40
12	A1 B3 C2 D1	15368828.00	474.90

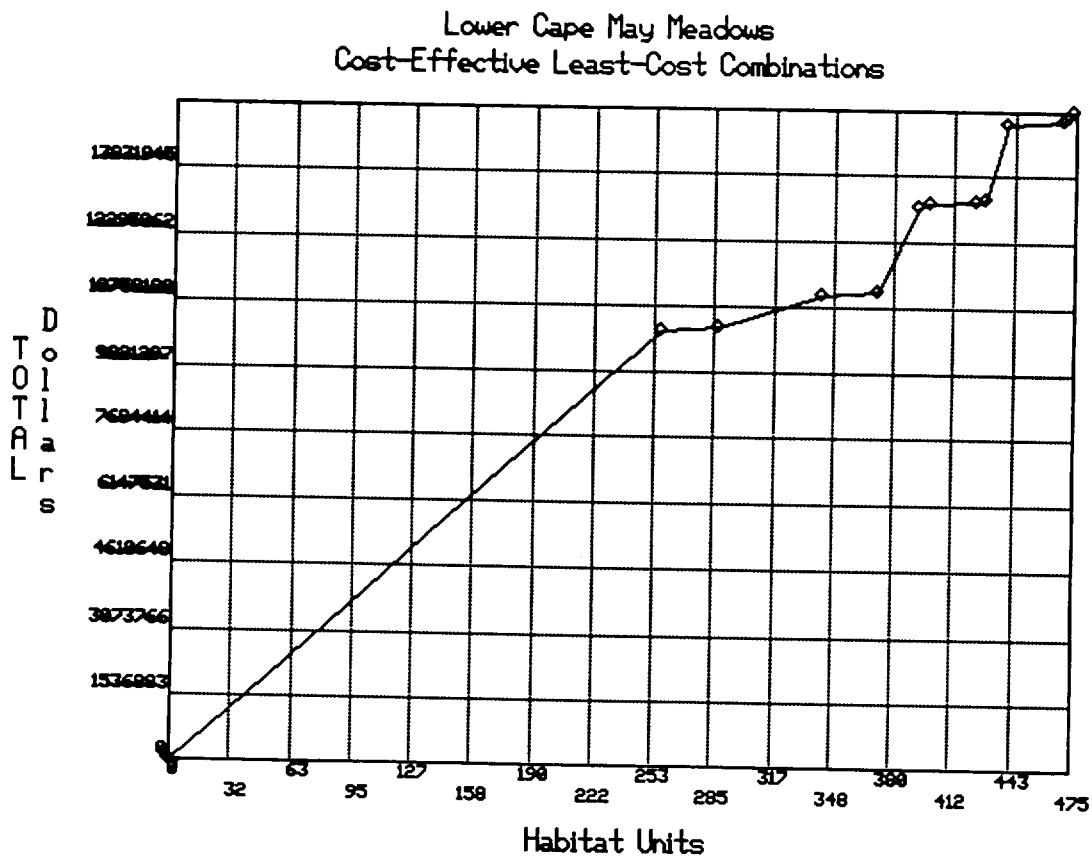


Table 6-10

LOWER CAPE MAY MEADOWS
Cost-Effective Least-Cost with Incremental Analysis

Management Measures	Cost	Output	Incremental Cost	Incremental Output	Incremental Average Cost
A0 B0 C0 D0	0.00	0.00	0.00	0.00	0.00
A1 B0 C0 D0	10188963.00	257.50	10188963.00	257.50	39568.79
A1 B0 C0 D1	10295486.00	287.40	106523.00	29.90	3562.64
A1 B0 C2 D0	11052929.00	342.80	757443.00	55.40	13672.26
A1 B0 C2 D1	11159452.00	372.70	106523.00	29.90	3562.64
A1 B2 C1 D0	13108752.00	393.20	1949300.00	20.50	95087.80
A1 B2 C2 D0	13182703.00	398.70	73951.00	5.50	13445.64
A1 B2 C1 D1	13215275.00	423.10	32572.00	24.40	1334.92
A1 B2 C2 D1	13289226.00	428.60	73951.00	5.50	13445.64
A1 B3 C1 D0	15059940.00	439.50	1770714.00	10.90	162450.83
A1 B3 C1 D1	15166463.00	469.40	106523.00	29.90	3562.64
A1 B3 C2 D1	15368828.00	474.90	202365.00	5.50	36793.64

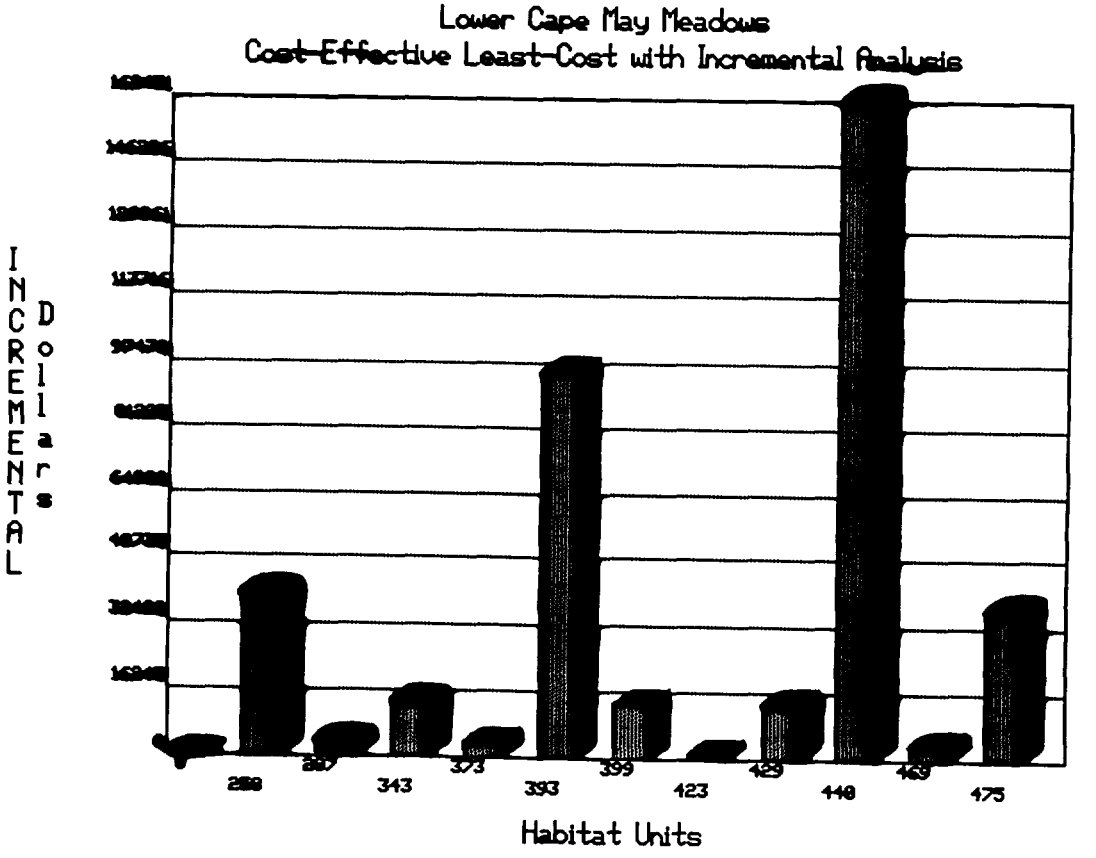
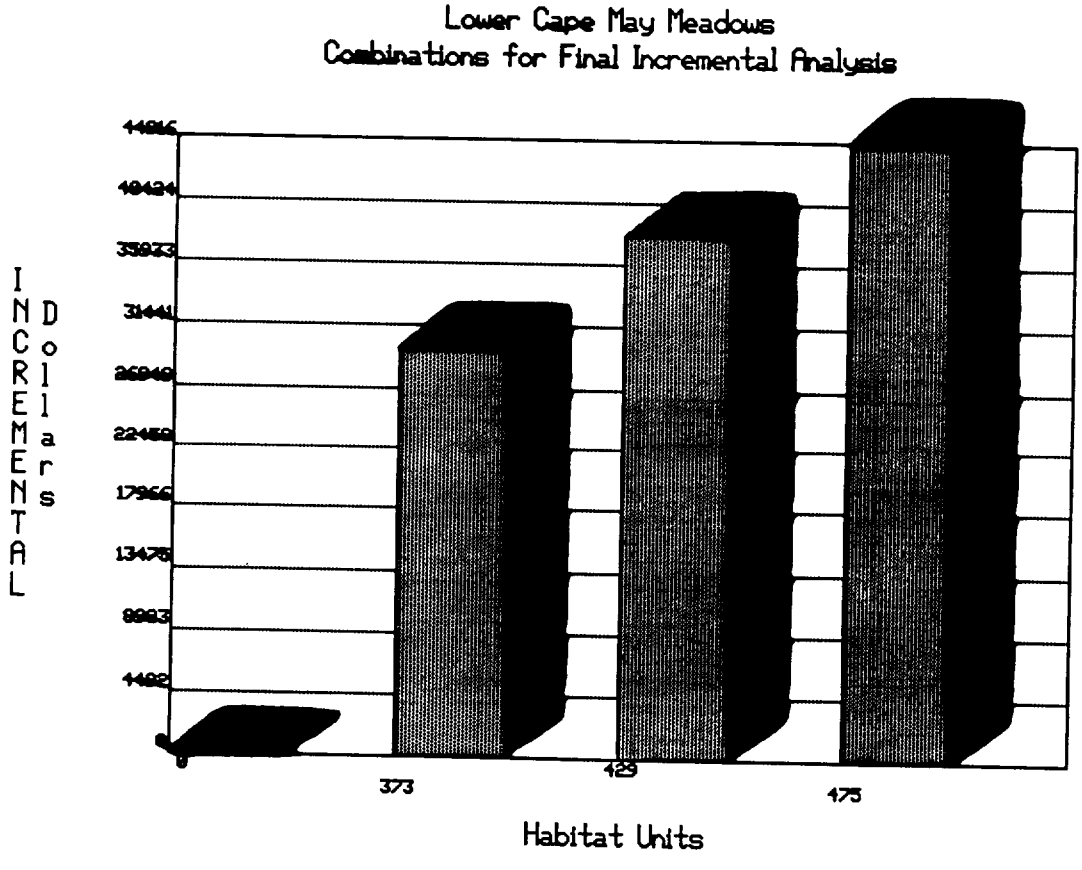


Table 6-11

LOWER CAPE MAY MEADOWS
Combinations for Final Incremental Analysis

Management Measures	Cost	Output	Incremental Cost	Incremental Output	Incremental Average Cost
A0 B0 C0 D0	0.00	0.00	0.00	0.00	0.00
A1 B0 C2 D1	11159452.00	372.70	11159452.00	372.70	29942.18
A1 B2 C2 D1	13289226.00	428.60	2129774.00	55.90	38099.71
A1 B3 C2 D1	15368828.00	474.90	2079602.00	46.30	44915.81



6.3 Selected Plan

In order to reduce the erosion, saltwater intrusion, and dune breaching which is impacting The Meadows, the Corps is proposing to place approximately 2,312,000 cubic yards of sand on the existing beach and dune system. The placement of sand will consist of a dune with a top elevation of +18.0 ft NGVD (+16.7 ft NAVD88), a top width of 25 feet, and sideslopes of 1:5. Also included in the design is a berm constructed to an elevation of +8.0 ft NGVD to Mean Low Water (MLW), with a width of 20 feet and a foreshore slope of 1:25. The beach width, measured from the seaward toe of the dune to Mean High Water (MHW) extends 157 feet. The implementation of this proposed plan will help to increase the value of this area for wildlife in several ways. First, the placement of this sand will increase the number of acres of beach habitat, therefore increasing the total number of HU's for the project area and for the species utilizing the beach for breeding and feeding. In addition, the proposed project is anticipated to stabilize the existing shoreline, stopping the further erosion of the habitats which currently exist beyond the dune. While doing this, the more stable dune and berm will also serve to lower the frequency of the saltwater intrusion which results from breaching and overtopping. The reduction of the amount of saltwater inundating The Meadows will improve the water quality for freshwater plants and fish species and will allow interior restoration efforts to be done.

The remainder of the selected plan consists of the removal of 95 acres of Phragmites australis through herbicide application and burning, replanting 70 of these reclaimed acres with emergent vegetation and converting the remaining 25 to a tidal salt marsh, moving the existing shoreline seaward to create (restore) 35 acres of emergent wetlands, reconnect hydrologically isolated ponds through the excavation of existing drainage ditches, installing 2 water control structures, and creating 6 deep water fish reservoirs throughout the site. The implementation of these features will greatly increase the value of the habitat currently existing within The Meadows. The replacement of Phragmites australis with vegetation of greater value to wildlife will have a tremendous impact on the project area. The change in vegetation will benefit all species which currently utilize the emergent wetlands as well as any species currently utilizing the Phragmites australis. The removal of the Phragmites australis will also more than double the amount of area available for hunting by raptors which migrate through the site. The installation of the water control structures, creation of fish reservoirs and reconnection of isolated ponds will allow the site to be better managed for wildlife and will help to insure that there is permanent water on the site for use by fish and wildlife species, even during drought conditions. All aspects of the selected plan are shown in Section 7 of this report.

Table 6-12 shows the total number of HU's available for wildlife use based on "with project" conditions for the year 2050. This table also compares the values for the years 2000 and 2050 without the project. Based on the future conditions expected with implementation of the proposed plan, an estimated 567 HU's will be available in the year 2050. This number represents 58 HU's for the sharp-shinned hawk, 36 HU's for the wood thrush, 18 HU's for the American

kestrel, 14 HU's for the field sparrow, 102 HU's for the green heron, 147 HU's for the clapper rail, 59 HU's for the sanderling, 74 HU for the least tern, 41 HU's for the black duck, and 18 HU's for the spring peeper. While the HEP shows no HU's for the marsh wren and muskrat since the number of acres of Phragmites australis equals zero, in reality, these species would utilize the newly created emergent wetlands, making the actual number of HU's available higher than the numbers represented by the HEP.

Table 6-12 also shows that the proposed project will maintain approximately 138 acres of habitat which would be lost due to erosion without the proposed plan, plus adds an additional 35 acres which has already been lost. In addition, when compared to "without project" conditions, a total of 388 more HU's will be available in the year 2050 with implementation of the proposed plan.

Note: During the incremental analysis, the costs for both the self-regulating tide gate ($95,700) needed for alternative C2 and the drainage gate ($5,200) for alternative D1 were inadvertently not included in the analysis. The addition of these costs should not change the plan selection.

Table 6 - 12
HEP RESULTS
Comparison of W/ and W/out Project Conditions

	2000 with out			2050 with out			2050 with project		
	Acres	HSI	HU's	Acres	HSI	HU's	Acres	HSI	HU's
Forest									
Sharp Shinned Hawk	72	0.6	43.2	38	0.1	3.8	72	0.8	57.6
Wood Thrush	72	0.5	36	38	0.3	11.4	72	0.5	36
Field									
American Kestrel	23	0.8	18.4	15	0.7	10.5	23	0.8	18.4
Field Sparrow	23	0.6	13.8	15	0.6	9	23	0.6	13.8
Emergent Wetlands									
Green Heron	38	0.6	22.8	2	0.5	1	* 138 25	0.6 0.8	82.2 20
Clapper Rail	38	0.8	30.4	2	0.4	0.8	163	0.9	147
Beach									
Sanderling	64	0.8	51.2	48	0.7	33.6	74	0.8	59.2
Least Tern	64	1.0	64	48	1.0	48	74	1.0	74
Phragmites									
Marsh Wren	95	0.4	38	95	0.3	28.5	** 0	0.0	0.0
Muskrat	95	0.3	28.5	95	0.3	28.5	** 0	0.0	0.0
Open Water									
Black Duck	41	0.7	28.7	7	0.5	3.5	46	0.9	41.4
Spring Peeper	41	0.0	0.0	7	0.0	0.0	* 21 25	0.0 0.7	0.0 17.5
Totals	333			205			378		

*Note: For the Year 2050, with the project, 2 different HSI Values are shown for the Green Heron and the Spring Peeper. This is to represent the different conditions between the fresh water habitat and the tidal saltwater habitat.

**Note: In reality, the Marsh Wren and Muskrat would utilize the newly created emergent wetlands and would therefore have a higher HSI Value then w/out project conditions.

7. SELECTED PLAN

7.1 Identification of the Selected Plan

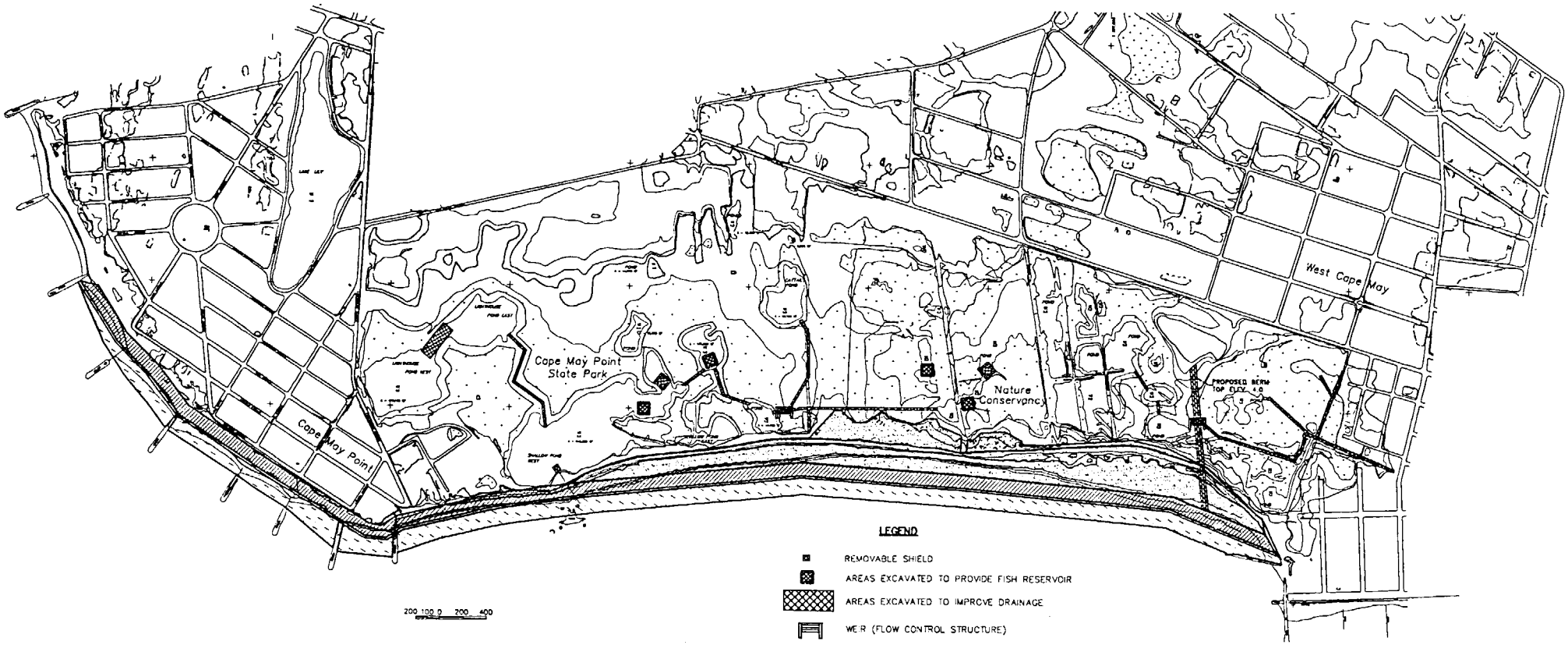
The selected plan maximizes Environmental Quality (EQ) and NED benefits to the study area. Specific benefits were expressed in either Habitat Units (HU), average annual acres not inundated by saltwater (dune/berm optimization) or dollars. As per EC 1105-2-210, an incremental analysis was performed and shown in Section 6 of this report.

The plan consists of the following components:

- Dune/berm construction with a berm width of 20 feet at elevation +8.0 ft NGVD (+6.7 ft NAVD88) and a dune elevation of +18.0 ft NGVD (+16.7 ft NAVD88). This plan includes planting of 18 acres of dune vegetation.
- Seaward restoration of 35 acres of previously eroded emergent wetland. This will move the MHW line seaward a maximum distance of 280 feet.
- Elimination of 95 acres of Phragmites australis through herbicidal spraying and burning
- Planting of 105 acres of emergent wetland vegetation.
- Excavation to restore flow within existing drainage ditches.
- Creation of drainage ditches, linking hydrological segments of the project area.
- Installation of 2 weir flow control structures.
- Creation of a total of 6 fish deep water reservoirs within existing ponds.
- Construction of a shallow earthen water retaining structure and a self-regulating tide gate to allow for the creation of approximately 25 acres of tidal marsh.

7.2. Description of the Selected Plan

The design of the selected plan is complete and consistent with Corps criteria as described in the Shore Protection Manual, CETNs and accepted engineering practice. Because design of the selected plan is not technically complex and is essentially complete, additional design work (i.e. Design Memorandum) is not needed except for plans and specifications. The following sections describe the selected plan. Graphical details of the selected plan are shown in Figures 7.2.-1 to 7.2-3.



DATE OF PHOTOGRAPHY: 3-7-93
N.J. STATE PLANE NAD 83
VERTICAL DATUM NGVD 29

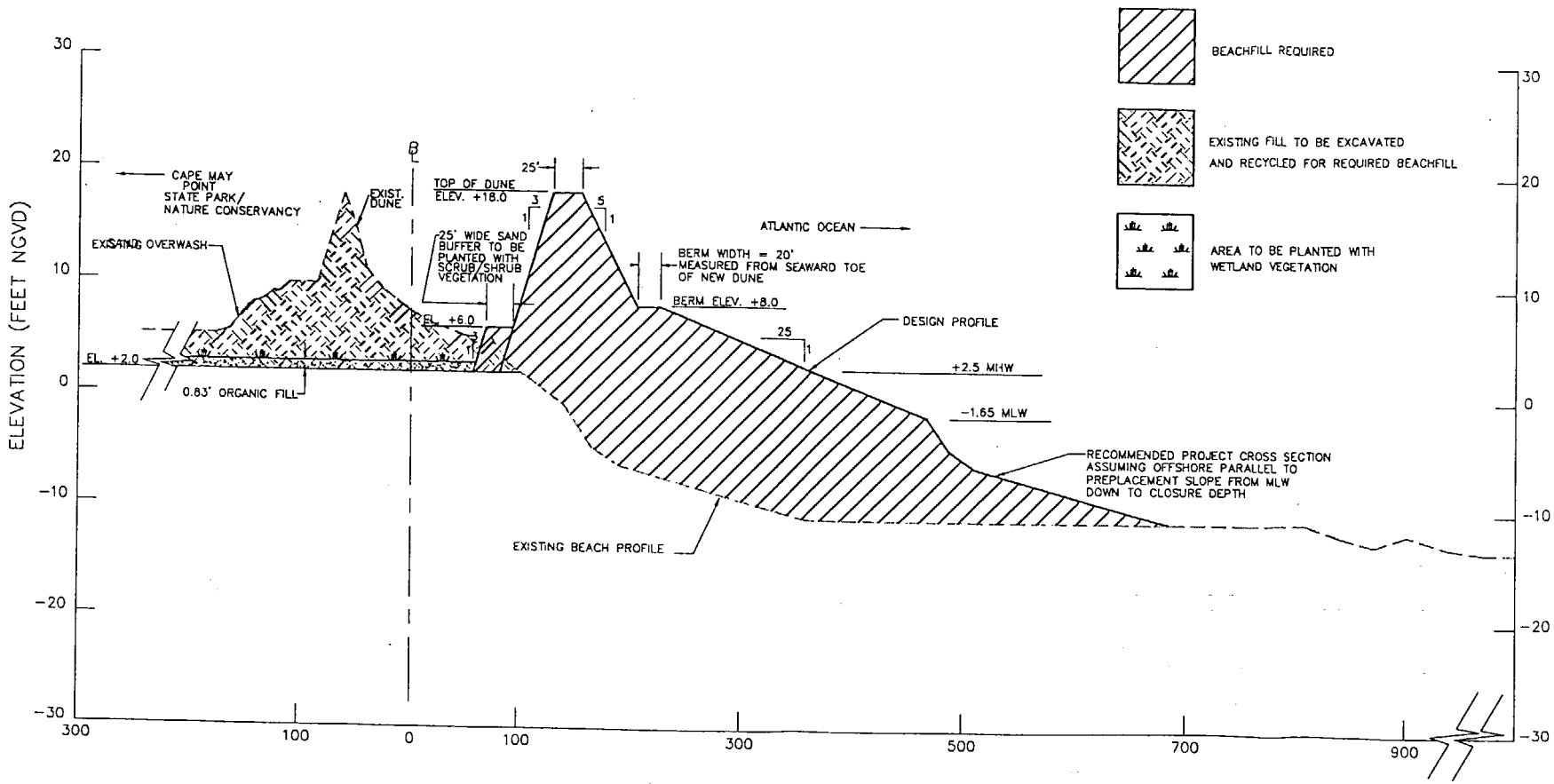
LEGEND

- REMOVABLE SHIELD
- AREAS EXCAVATED TO PROVIDE FISH RESERVOIR
- AREAS EXCAVATED TO IMPROVE DRAINAGE
- WEIR (FLOW CONTROL STRUCTURE)
- HABITAT AREA TO BE RECLAIMED/RESTORED
- LIMITS OF PROPOSED DUNE
- LIMITS OF PROPOSED BERM INCLUDING SLOPED PORTION DOWN TO MHW

U.S. ARMY ENGINEER DISTRICT, PHILADELPHIA
CORPS OF ENGINEERS
PHILADELPHIA, PENNSYLVANIA

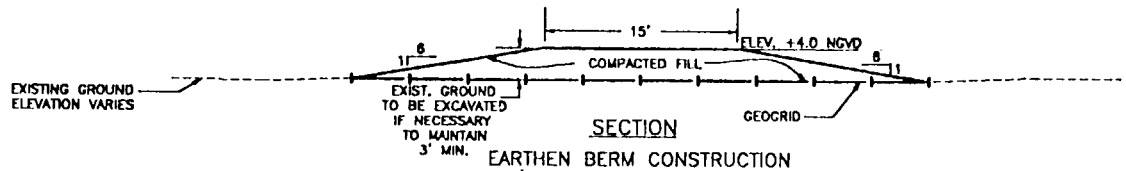
LOWER CAPE MAY MEADOWS
CAPE MAY POINT
FEASIBILITY STUDY
CAPE MAY MEADOWS
SELECTED PLAN
INTERIOR RESTORATION AND
PROTECTIVE DUNE AND BERM

FIGURE 7.2-1



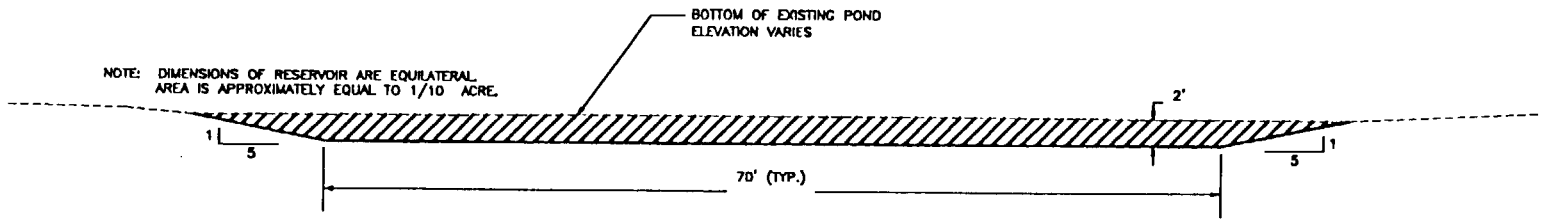
18' DUNE WITH 20' BERM

LOWER CAPE MAY MEADOWS – CAPE MAY POINT
FEASIBILITY STUDY
CAPE MAY MEADOWS
SELECTED PLAN
EXTEND SHORELINE SEAWARD
PROTECTIVE DUNE AND BERM
TYPICAL PROFILE (SURVEY LINE "C")
SCALE: 1"=150'
FIGURE 7.2-2



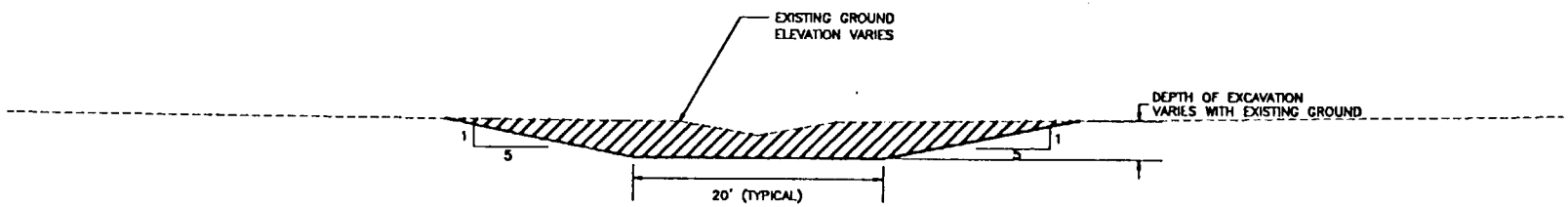
SECTION

EARTHEN BERM CONSTRUCTION
(NATURE CONSERVANCY)



SECTION

FISH RESERVOIR



SECTION

TYPICAL CHANNEL EXCAVATION

HORIZONTAL SCALE: 1"=160'
VERTICAL SCALE: 1"=15'

LOWER CAPE MAY MEADOWS –
CAPE MAY POINT
FEASIBILITY STUDY

CAPE MAY MEADOWS
INTERIOR DRAINAGE IMPROVEMENTS
SELECTED PLAN TYPICAL SECTIONS

FIGURE 7.2-3

7.2.1 Protective Dune and Berm Restoration

- The selected plan includes protective dune/berm restoration. The dune crest has a top elevation of +18.0 ft NGVD (+16.7 ft NAVD88), a top width of 25 feet, and slopes of 1V:3H and 1V:5H on the landward and seaward side slopes, respectively. The total width of this dune from toe to toe is 105 feet.

- The dune will be planted with 18 acres of vegetation and stabilized with 15,000 linear feet of sand fence. Vegetation will consist of approximately 11 acres of beachgrass (70%) and coastal panicgrass (30%) which will be planted on the newly constructed dune. In addition, approximately 7 acres along the landward toe of the dune will be planted with a combination of bayberry, wax myrtle, beach plum, and shore juniper. These plantings will help to stabilize the dune, in addition to being a benefit to wildlife species.

- "Walkovers" for piping plovers will be located along the dune to allow access to back water feeding habitat. The walkovers will be approximately 100 feet wide and be positioned along the length of the project approximately every 600 feet. The "walkovers" will be sparsely vegetated and most likely enclosed by sand fencing to discourage public usage.

- The berm will extend from the seaward toe of the dune for a distance of 20 feet (at elevation +8.0 ft NGVD) before sloping down at 1V:25H to elevation -1.65 ft NGVD (MLW). The remainder of the fill assumes the offshore fill required is parallel to the existing preplacement slope out to the closure depth for each survey profile (CETN-II-5, 10/81). The total width of the berm from the seaward toe of dune to MHW is equal to 157 feet.

- The dune/berm will extend from the 3rd Avenue terminal groin in Cape May City to the Central Avenue groin in Cape May Point at which point the fill translates to tie into the existing beach and dune. The total length of fill is 10,050 linear feet (1.9 miles).

- Initial sand quantity is 2,372,000 cy, which includes initial design fill (1,722,000 cy) plus advanced nourishment (650,000 cy). Periodic nourishment of 650,000 cy is scheduled to occur every 4 years. Material would be taken from borrow areas P1 and P2 (Figure 2.6.1). *Note: In July 1998, NJDEP-Land Use Regulation requested that borrow area P2 not be used and that P1 be reconfigured in an effort to minimize impacts to surf clams and prime fishing areas. During the Preconstruction Engineering and Design phase, the Corps will be investigating the possibility of using other borrow areas, as well as the possibility of using sand from Cape May Inlet for nourishment activities to further reduce the potential impact to marine species. Any permanent changes to the borrow areas will be coordinated with the appropriate agencies.*

7.2.1.1 Beachfill and Transition Tapers. The beachfill will transition and taper into the existing beach and dune at the Central Avenue terminal groin.

7.2.1.2 Outfall Extensions. The Drainage East outfall pipe does not extend past the construction template and will need to be extended 112 feet seaward to remain functional. Costs are given in detail in Appendix E. The total cost is $41,555.

7.2.1.3 Major Rehabilitation. Major rehabilitation of the dune/berm project template is expected due to episodic storm erosion. This quantity is included in the periodic nourishment quantity listed above and is discussed in Section 5.6.1.1 of this report.

7.2.1.4 Overfill factor. The overfill factor has been included in the periodic nourishment quantities. As shown in Table 2.6.1, this factor is 1.0.

Questions regarding the overfill factor used when estimating dune/berm material have surfaced following recent higher authority review of Philadelphia District studies. This topic is addressed as follows:

The winnowing out of the finer portion of the beachfill material as a result of wave action is a continually ongoing process that can best be described as "erosional losses." Similar, yet separate from "erosional losses" are "pumping losses." "Pumping losses" occur as a result of placement of the material during construction. Sand is pumped as a slurry and the finer portion of this material is washed away as the water from the slurry drains into the ocean. A "pumping losses" factor is included in the estimation of the initial fill quantity. The pumping losses factor used in the cost estimate is 29%. This is an overly conservative estimate since experience shows that the actual percentage of losses that occur are often significantly less. "Erosional losses" are offset by the inclusion of an overfill factor which is used to estimate the number of volumetric units of borrow material required to produce the equivalent of one volumetric unit of native beach material after natural processes have adjusted the constructed beach to the equilibrium profile. It should be noted that the overfill factor should be used with caution when borrow materials are well sorted, as is the case with the designated borrow site. James (1975) indicates that when the borrow area is better sorted than the beach, there is insufficient material in the grain size distribution, hence, consideration of sorting losses is not required.

It is not necessary to include the overfill factor in addition to the "pumping loss" factor when calculating the initial construction quantity for the proposed project. Due to the inclusion of advance nourishment, the material contained within the "design template," as distinct from the larger "construction template," is effectively isolated from the long term erosion impacts which sort and transport sediment on the exposed face of the active profile. Hence, only the "pumping loss" factor, and not the overfill factor need be applied to the "design template." The Philadelphia District however, maintains the more conservative approach of applying both the overfill factor and the "pumping losses" factor to the periodic nourishment quantity because it is this material that will be subjected to long term erosion losses since it lies in the active wave

zone.

The initial construction quantity is based on the cross-section required to construct the "design" profile plus a comparable or larger quantity required to advance the entire active profile out to the "depth of closure." The native beach composite grain size distribution, such as was computed for the study area, includes samples from the sub-aerial beach as well as the submerged portion of the active profile out to closure depth. The initial construction volume, because it is based on the quantity required to advance the entire active profile out to depth of closure, in effect already includes the fraction which is calculated with the overfill factor procedures. In addition, the performance characteristics of the proposed beachfill design takes into account the differences in grain size between the material in the borrow area and the material on the native beach.

7.2.2 Internal Restoration Components

- The proposed selected plan layout for the dune/berm restoration in Cape May Meadows also includes a plan for extending the location of the dune and berm in a seaward direction to restore 35 acres of emergent wetlands that have been eroded. The restoration of habitat area will be constructed by excavating the existing dune material down to elevation +2.0 ft NGVD and placing the material seaward to reduce the amount of fill required by this option. This material to be excavated will also include some areas of sand overwash behind the existing dunes. The exception to this will be an area in the State Park frontage where the proposed dune will be placed on the existing dune in order to provide sand cover over the existing Tensar stone mattress. The dune and berm would then be constructed by normal beachfilling operations in the proposed location. A 25 ft wide sand buffer will be constructed directly behind the landward toe of the proposed dune with a top berm elevation of +6.0 ft NGVD. This buffer will be planted with scrub/brush vegetation. The area behind the buffer zone will then be filled to a depth of 10 inches (0.83 ft) with organic material obtained from other excavations required within The Meadows as part of the selected plan. This organic material will then be planted with wetland vegetation. See Figure 7.2-2 for a typical profile of this plan.

- Elimination of 95 acres of Phragmites australis through herbicidal spraying and burning. The proposed project involves 2 aerial applications of the herbicide Rodeo followed by a controlled burn of all of the Phragmites australis dominated areas.

- Planting of 105 acres of emergent wetland vegetation.

- Excavation to restore flow within existing drainage ditches. Ditches to be excavated will be configured with a bottom width of 20 ft and 1V:5H side slopes. Depth of excavation ranges from a maximum of 4 feet (in the State Park) to a minimum of 0.5 ft. (in The Nature Conservancy property), and vary with existing ground elevations.

- Creation of two new drainage ditches between hydrologic segments. These will have the same channel configurations as previous, but are regulated with weir flow control structures. The weirs consist of removable 10 ft wide timber flash boards which are supported by small concrete gravity walls that will be designed to resist saturated earth pressures. The bottom width of the channels narrow from 20 feet to 10 feet at each weir structure. Graded riprap will be placed at the bottom of the channel at the entrance and exit of the weirs to provide scour protection. The side slopes of the channel in the transition between 20 and 10 feet bottom widths will be stabilized with geoweb, the compartments of which will be filled with low slump concrete. The geoweb will only be placed on those areas of the side slopes that result in slopes greater than 1V:3H as the channel narrows but bottom elevations remains essentially the same.

- Construction of a berm to allow for approximately 25 acres of tidal marsh in the northeast corner of The Nature Conservancy property. The water retaining structure (berm) will extend from the landward side of the proposed dune to high ground to the north for a distance of approximately 1000 feet. The berm will be constructed of materials excavated in other locations in The Meadows. The berm will have a top elevation of +4.0 ft NGVD and will tie in to the existing +4 ft NGVD contour on the north end. Side slopes are set at 1V:6H and will be planted with woody vegetation to discourage growth of Phragmites australis. The crest width of the berm will be 15 ft and the total width of this berm will be 45 feet from toe to toe. The base of the berm will be supported by geogrid to strengthen the underlying soil. For design purposes a constant minimum cross section of 3 feet from top of berm to final grade at the bottom of the structure was assumed. In addition, the existing tide gate at Cape Island Creek will be replaced with a self-regulating tide gate to allow for tidal flow into this potion of the Meadows.

- Creation of fish reservoirs. The fish reservoirs to be excavated are located within existing ponds in The Meadows. Depth of the ponds is equal to 3 feet below existing bottom of the ponds. Each pond will be approximately 70 sq feet with side slopes of 1V:5H.

- The installation of a removable (in case of emergency) drainage gate or shield on the existing inlet structure at Drainage East to keep more freshwater in the Meadows' hydrologic/hydrualic system.

7.3 Project Costs[1]

7.3.1 Real Estate. Real estate requirements include fill easements, temporary and permanent access easements (see Real Estate Plan, Appendix F). The project will require the acquisition of temporary and/or perpetual easements for 52 parcels with 16 ownerships. There are 4 public ownerships with 19 parcels and 12 private ownerships with 33 parcels. The temporary easement area will be approximately 25 acres and the perpetual easement area is approximately 131 acres. Additionally, an agreement between the non-Federal sponsor (NJDEP) and The Nature Conservancy will be required to insure future access. The borrow area easements will be provided at no cost by the State of New Jersey. Fill easement costs, temporary and permanent easements for construction access and public storage are also zero. Total administrative costs are estimated to be $145,000. The extension of the Drainage East outfall is considered and item of relocation and is the responsibility of the local sponsor.

7.3.2 Operation, Maintenance, Repair, Replacement, and Rehabilitation (OMRR&R). The annual operation and maintenance of the project includes maintaining the dunes (including sand fence) and beach surveys. Beach surveys are to be conducted annually along 8 survey lines located within the project. Beach profile information will then be used to determine the project conditions. Other operation and maintenance costs pertain to the water control structures, vegetation (both Phragmites australis removal and plantings), drainage channels, fish reservoirs and other project features. Average annual costs equal $56,000.

7.3.3 Interest During Construction. Table 7.3.3-1 displays the calculations for interest during construction. It is assumed the construction costs would be evenly distributed over the construction period. The duration of initial construction for the project is estimated at twelve months. The preconstruction engineering and design (PED) phase of study will begin approximately one year prior to the start of construction. Therefore, in accordance with ER1105-2-100, paragraph 6-153, interest during construction was based on twenty-four months. It is assumed that the construction costs would be evenly distributed over this period.

7.3.4 First Costs. The estimated first cost for the selected plan described above is $15,548,000 (October 1997 price level) which includes real estate acquisition costs (including administrative costs), engineering and design (E&D), construction management (CM) and associated contingencies (Table 7.3.4-1). E&D costs include preparation of plans and specifications, project management, environmental coordination (which consists of surfclam, benthic, and cultural resources surveys) value engineering, execution of the Project Cooperation Agreement (PCA), and monitoring during construction (see 7.3.6).

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[1] Costs for the selected plan have been updated from those shown in Sections 5 and 6 of this report.

7.3.5 Periodic Nourishment. Periodic nourishment is expected to occur at 4 year intervals subsequent to the completion of initial construction (year 0) of the dune/berm component of the project. Based on a volume of 650,000 cy for each nourishment cycle, the cost per cycle is $4,740,000 (Oct 1997 price level) for construction years 4, 12, 20, 36, and 44; $4,793,000 (Oct 1997 price level) for construction years 8, 16, 24, 32, 40, and 48; $4,826,000 for constuction year 28. (The reason for this variation is due to varying engineering and design (E&D) costs, specifically geotechnical investigations). Costs also include engineering and design (E&D), construction management (CM) and associated contingencies. E&D costs include preparation of plans and specifications, project management, and environmental coordination and monitoring during construction. Over the 50-year project life, the total periodic nourishment cost is estimated to be $58,023,000 (Oct 1997 price level) and includes E&D monitoring during construction.

7.3.6 Project Monitoring (as part of Engineering and Design). The project monitoring plan will document the performance of the various project components and also determine conditions (geotechnical, environmental, cultural) within the sand borrow areas. This proposed monitoring program will begin at the initiation of preconstruction engineering, and design (PED) and continue throughout the project life.

Project monitoring will occur during Engineering and Design (E&D), and specifically includes surfclam, benthic, and cultural resources surveys, aerial photography, beach profiles, plover monitoring, sea turtle monitoring (if hopper dredge is used), cultural resources monitoring, wetland monitoring, and geotechical surveys.

The program to monitor the performance of the protective dune/berm was developed in accordance with EM-1110-2-1004, ER-1110-2-1407, CETN-II-26 and the draft CETN dated 3/13/95 entitled "Recommended Base-level Physical Monitoring of Beach Fills." The pre- and post-construction dune/berm monitoring plan includes beach profile surveys and aerial photography. Geotechnical surveys includes hydrographic surveys and sediment sampling of the beach and borrow areas.

Environmental monitoring will consist of detailed benthic monitoring to determine current benthic community populations and densities and to chart changes to this community between nourishment cycles. Monitoring of piping plovers will be accomplished and turtle monitoring will be conducted if a hopper dredge is used. Cultural resources surveys will also be conducted.

Other project monitoring items include wetland monitoring. The field data collection will be followed up by lab and data analyses. Monitoring of the internal wetland restoration will be conducted by the Corps for 5 years following the completion of initial construction. This time frame appears sufficient to measure the success of the project and allow comparisons with predicted habitat units and acres. Adopting the goals of "Adaptive Management" per EC 1105-2-210 dated June 1995, the ecological monitoring program may result in adaptive measures being taken. Adaptive management allows feedback and an improved knowledge base regarding the

performance of the individual project as well as future projects. Future relatively minor adjustments to the project may be warranted and these costs are included in the monitoring costs.

Specific aspects of the wetland monitoring include: evaluating the growth and survival of all newly planted vegetation and replacing it as necessary, documenting any growth or spread of Phragmites australis and removing it as necessary, monitoring internal water levels and the performance of the water control structures and modifying as necessary, and evaluating the wildlife usage of the site. Input from USFWS, NJDEP, The Nature Conservancy, Cape May Point State Park, and other applicable groups or agencies will be used to further refine the monitoring plan.

The Corps recommends that a water management plan be developed for use by The Nature Conservancy and Cape May Point State Park. The management plan should discuss the management goals of each party, especially in relation to the amount of freshwater required to meet these goals. This will be imperative to the success of the site since each party will have control of one water level control structure and will have the power to negatively impact the other party. The management plan should also discuss how disputes will be resolved or what course of action will be taken if management goals of the two parties do not always coincide. While the management plan should be developed prior to the completion of the project, the results of the Corps 5-year monitoring program may be helpful in modifying the management plan if necessary.

Aerial photography, beach profiles, piping plover, sea turtle monitoring (if hopper dredge is used), cultural resources monitoring, and wetland monitoring are estimated to cost $2,207,000 (Oct 1997 price level) through the 50-year project life or $79,000 on an average annual basis.

Surfclam, benthic, and cultural resources surveys would accur prior to each sand placement and are estimated to cost $1,443,000 (Oct 1997 price level) through the 50-year project life.

Table 7.3.3-1
Interest During Construction

Discount Rate:		7.125%	
Use Date:		Feb-2000	
Start Date:		Feb-2001	
	Monthly	Interest	Total
MONTH	Costs	Factor	Cost
1	$162,999	1.147577	$187,054
2	$162,999	1.141013	$185,984
3	$162,999	1.134488	$184,921
4	$162,999	1.128000	$183,863
5	$162,999	1.121549	$182,811
6	$162,999	1.115134	$181,766
7	$162,999	1.108757	$180,726
8	$162,999	1.102416	$179,693
9	$162,999	1.096111	$178,665
10	$162,999	1.089842	$177,643
11	$162,999	1.083609	$176,627
12	$162,999	1.077412	$175,617
13	$1,132,643	1.071250	$1,213,344
14	$1,132,643	1.065123	$1,206,405
15	$1,132,643	1.059032	$1,199,505
16	$1,132,643	1.052975	$1,192,645
17	$1,132,643	1.046953	$1,185,824
18	$1,132,643	1.040965	$1,179,043
19	$1,132,643	1.035012	$1,172,299
20	$1,132,643	1.029093	$1,165,595
21	$1,132,643	1.023207	$1,158,929
22	$1,132,643	1.017355	$1,152,301
23	$1,132,643	1.011537	$1,145,711
24	$1,132,643	1.005752	$1,139,158
Total First Cost:	$15,547,709		
	Total Investment Cost:		$16,286,131
	Minus First Cost:		15,547,709
	IDC (rounded):		$738,000

Table 7.3.4-1
Total First Cost Summary
October 1997 Price Levels

Description of Item	Qty	Unit	Unit Price	Est. Amount	Contingency	Total Amount
Lands and Damages						
Post Authorization Planning	0	0	0	$0	$0	$0
Required Easements Including Surveys Appraisal and Administration	0	Job	LS	$125,722	$18,858	$144,580
Total Lands and Damages				$125,722	$18,858	$144,580
Protective Dune/Berm Restoration						
Mobilization, Demobilization and Preparatory Work (Lower Cape May Meadows		Job	LS	$415,438	$49,853	$465,291
Mobilization, Demobilization and Preparatory Work (Cape May Point		Job	LS	$226,920	$27,230	$254,150
Beachfill (Lower Cape May Meadows	1,724,400	CY	$3.57	$6,156,108	$923,416	$7,079,524
Beachfill (Lower Cape May Meadows	647,400	CY	$3.75	$2,427,750	$364,163	$2,791,913
Dune Grass	18	ACR	$28,138.56	$506,494	$75,974	$582,468
Sand Fence	15,000	LF	$4.14	$62,100	$9,315	$71,415
Outfall Extension		Job		$34,546	$6,909	$41,455
Total Berm/Dune Restoration				**$9,829,356**	**$1,456,860**	**$11,286,216**

Table 7.3.4-1
Total First Cost Summary
October 1997 Price Levels

Internal Ecosystem Restoration						
Phragmites removal and burning		Job	LS	$167,900	$38,580	$206,480
Plantings		Job	LS	$696,092	$139,218	$835,310
Organic Substrate		Job	LS	$380,000	$190,000	$570,000
Excavation for Fish Reservoirs		Job	LS	$7,028	$1,406	$8,434
Excavation for Drainage Channels		Job	LS	$13,986	$2,797	$16,783
Berm		Job	LS	$100,484	$20,097	$120,581
Misc Interior Site Work		Job	LS	$39,984	$7,997	$47,981
Weir Control Structures		Job	LS	$34,131	$5,120	$39,251
Tidegate		Job	LS	$79,748	$15,950	$95,698
Drainage Gate		Job	LS	$4,329	$866	$5,195
Total Internal Ecosystem Restoration				**$1,523,682**	**$422,031**	**$1,945,713**
Planning, Engineering, and Design (P,E&D)		Job	LS	$1,638,000	$245,700	$1,883,700
Construction Management (S&A)		Job	LS	$250,000	$37,500	$287,500
Project Total						
Total Project First Cost				$13,366,760	$2,180,949	$15,547,709
Total Project First Cost (rounded)				$13,367,000	$2,181,000	$15,548,000

7.3.7 Total Estimated Annualized Cost. The estimated total annualized cost of the selected plan is $2,386,000, which is based on an economic project life of 50 years and a discount rate of 7.375% . This cost includes the annualized first cost, interest during construction, annualized periodic nourishment costs, OMRR&R, and monitoring costs. This is shown in Table 7.3.7-1.

Table 7.3.7-1
Estimated Costs
(October 97 Price Levels)

Item	Costs
Initial Construction (includes E&D monitoring)	$15,403,000
Interest During Construction	$738,000
Real Estate	$145,000
Total Periodic Nourishment over 50 project life (includes E&D monitoring)	$58,023,000
Average Annual Construction Costs	$2,330,000
Average Annual OMRR&R	$56,000
Total Estimated Average Annual Cost (rounded)	**$2,386,000**

7.3.8 Engineering and Design, Construction Management and Contingency Costs. Engineering and design costs include preparation of plans and specifications, environmental, cultural, pre-construction and performance monitoring, value engineering, cost engineering, construction and supply contract award activities, project management, and the development and execution of the Project Cooperation Agreement (PCA). Construction management costs are a flat $250,000 and are based on the direct labor cost. The costs include contract administration, review of shop drawings, inspection, and quality assurance, project office litigations and project management.

Pertaining to contingencies:

15% was applied to the dune/berm work to account for larger required beachfill quantities at the time of construction due to future preconstruction erosion;

12% was applied to mobilization, demobilization and preparatory work to account for variances in the travel distance for a dredge plant

15% was applied to dune grass and sand fencing to account for variances in the beach profile at the dune location due to future preconstruction shifting and/or eroding beach conditions .

23% was applied to Phragmites australis removal and burning to account for ant additional burning that might be needed due to vegetation growth

20 % was applied to plantings to account for changes in the site conditions that would require additional plantings

50 % was applied to the organic substrate to account for variances in the availability of organic substrate and changes in the site conditions that would affect production

20 % was applied to miscellaneous site work to account for variances in the site design due to pre-construction erosion at the habitat locations

15% was applied to Planning, Engineering, and Design (P,E, and D)

7.3.9 Construction and Funding Schedule. An estimated schedule of expenditures by year is shown in the Project Management Plan (PMP), which is in a seperate volume of this document. The PMP describes activities leading to, through and after construction of the selected plan. Appendix D, Section 17 includes the schedule for design and construction.

7.4 Project Benefits

7.4.1 Environmental Quality (EQ) Benefits. The environmental quality benefits for the selected plan are:

Table 7.4.1-1
Environmental Quality (EQ) Benefits

AVERAGE ANNUAL ACRES IN MEADOWS NOT INUNDATED BY SALTWATER	175 acres
AVERAGE ANNUAL ACRES RESTORED	173 acres
AVERAGE ANNUAL HABITAT UNITS	388 HU

7.4.2 National Economic Development (NED) Benefits. The protective dune/berm component of the selected plan incidentally provides storm damage reduction to the Borough of Cape May Point and Borough of West Cape May. Compared to without-project conditions, damages would be reduced by 75% in Cape May Point and 60% in West Cape May. Average annual damage reduction totals $719,500 (not including local costs foregone).

7.4.2.1 Local Costs Foregone. As detailed in section 1.5 of this report, the State of New Jersey and Borough of Cape May Point have been active in providing storm damage protection. The protective dune/berm component of the selected plan would save $201,600 in average annual costs.

7.4.3 Unquantified Recreation Benefits. The Meadows, which contains Cape May Point State Park and the Cape May Migratory Bird Refuge, is one of the most popular bird watching areas in the world, drawing more than 100,000 birders each year. A recent study conducted by the New Jersey Audubon Society's Cape May Bird Observatory estimates that these birders contribute more than $31,000,000 to the local economy. Visitors to the State Park totaled 728,596 in 1995, an increase of 677% from 1977 totals. Since the selected plan would prevent further degradation of the ecosystem and restore birding habitat, it can be reasonably assumed that the bird population at The Meadows would increase (especially when compared to the without-project condition which shows elimination of most of the existing habitat). This may likely correlate in an increase in birdwatchers to some degree.

7.4.4 Benefits During Construction. The project will be constructed over twelve months, which includes an additional month before and after construction for mobilization and demobilization. Portions of the beach will be nourished early in the construction phase and will provide storm damage reduction benefits. This equals $23,700 on an average annual basis.

7.4.5 Benefit-Cost Summary. Table 7.4.5-1 shows the benefit-cost comparison for the selected plan. Table 7.4.5-2 shows the incremental benefit-cost comparison for the Cape May Point portion of the project as discussed in Section 5.6.1.1 of this report.

Table 7.4.5-1
Benefit-Cost Summary for the Selected Plan

DISCOUNT RATE	7.125%
PROJECT LIFE	50 years
PRICE LEVEL	October 1997
BASE YEAR	2000
AVERAGE ANNUAL BENEFITS	
ENVIRONMENTAL QUALITY (EQ)	
ACRES NOT INUNDATED BY SALTWATER	175 acres
ACRES NOT ERODED	173 acres
HABITAT UNITS	388 HU
NED	
STORM DAMAGE REDUCTION	$719,500
LOCAL COSTS FOREGONE	$201,600
BENEFITS DURING CONSTRUCTION	$23,700
AVERAGE ANNUAL COSTS	
CONSTRUCTION COSTS (includes monitoring)	$15,403,000
INTEREST DURING CONSTRUCTION	$738,000
REAL ESTATE	$145,000
OPERATION & MAINTENANCE	$56,000
TOTAL AVERAGE ANNUAL COSTS	**$2,386,000**

Table 7.4.5-2
Incremental (compared to Dike Termination Alternative) Benefit-Cost Comparison for the Cape May Point Portion of the Selected Plan

DISCOUNT RATE	7.375%
PROJECT LIFE	50 years
PRICE LEVEL	October 1997
BASE YEAR	2000
AVERAGE ANNUAL BENEFITS	
STORM DAMAGE REDUCTION	$378,100
LOCAL COSTS FOREGONE	$81,800
BENEFITS DURING CONSTRUCTION	$6,600
AVERAGE ANNUAL BENEFITS	**$466,500**
INCREMENTAL COSTS	
AVERAGE ANNUAL CONSTRUCTION COSTS	$323,000
AVERAGE ANNUAL OPERATION & MAINTENANCE	$9,600
AVERAGE ANNUAL COSTS	**$332,600**
BENEFIT-COST RATIO	**1.4**
NET BENEFITS	**$152,1000**

7.5 Project Impacts

7.5.1 Environmental Consequences

7.5.1.1 Comparative Effects of Alternatives. The no action alternative will allow continuation of existing conditions, as well as the existing processes which currently modify those conditions. The continuation of existing conditions would result in the continued degradation of the critical habitat at The Meadows. Breaching and overtopping would regularly inundate the freshwater habitat with saltwater, weakening emergent vegetation and fueling the growth and expansion of Phragmites australis. Consequently, the following discussion will focus on the impacts of the beach nourishment and interior improvements with impacts associated with the no action alternative discussed when appropriate.

7.5.1.2 Topography and Soils. Under the no action alternative, erosion would continue and more beach and dune acreage would be lost. Without further engineering efforts, the existing erosion control measures would be rendered ineffective and breaching will continue as the beach profile becomes steeper and the wave energy becomes harsher.

The beach nourishment alternative would result in topography changes in the proposed borrow areas. The dredging would increase the depth by approximately 10 feet in borrow area P1 and 6.5 feet in borrow area P2. Based on the quantities of material required and the depth of excavation, approximately 138 acres of borrow area P1 and 99 acres of borrow area P2 may need to be utilized. The resulting cross-sectional configuration would be designed to approximate natural ridge slopes, and therefore promote free exchange of water with the overlying and adjacent waters. The excavation would also be designed to ensure that all of the bottom substrate would not be removed, and therefore the bottom would retain its existing substrate character. In addition, due to the dynamic location of the borrow areas, it is anticipated that the sand source will be replenished fairly quickly. The intent of excavating a broad basin with depth, contours, and substrate consistent with the adjacent areas was to simulate the character of these nearby environments. More detailed information regarding the proposed borrow areas, and how they were selected for use for this project, can be found in section 2.6 of this report.

Regarding the beach, the berm restoration would result in a berm 157 feet wide from the landward toe of the dune down to MHW. The final berm elevation will be +8.0 feet NGVD. A dune with a top elevation of +18 feet NGVD and a top width of 25 feet will also be constructed. The grade of the foreshore and underwater slopes would essentially parallel the existing profile at a slope of 25:1. The increase in beach elevation would effectively widen the beach. The net result would be a larger buffer against the erosion from storm events, and also an increase in usable beach in the project area.

Internally, there will also be some minor changes to the topography of the site. Moving the

shoreline to restore 35 acres of emergent wetlands will account for the majority of the changes. This portion of the selected plan involves moving the berm, dune, and overwash areas from their present locations seaward a maximum distance of 280 feet. The area where these features were moved will be graded to approximately elevation +2.0 ft NGVD. All material moved from this location will be re-used for the new berm and dune. This action serves to restore the area to historical conditions. Topography changes will also result from the reconnection of the hydrologic units and the improvement of the internal drainage patterns. These changes will also serve to return these areas to historic conditions by removing material that has accumulated over time, including overwashed sand, Phragmites australis, and other plant biomass. All material excavated from these areas will be re-used as a source of organic substrate for the restored wetlands.

7.5.1.3 Water Quality. The dredging associated with the beach nourishment alternative would result in short-term adverse impacts to water quality in the immediate vicinity of the dredging and beach nourishment operations. Dredging in the proposed borrow areas will generate turbidity, resulting in sedimentation impacts within the immediate vicinity of the operations. Short-term increased turbidity can affect organisms in several ways. Primary production in phytoplankton and/or benthic algae may become inhibited from turbidity. Suspended particulate matter can clog gills and inhibit filter-feeding species. Reilly et.al. 1983 determined that high turbidity could inhibit recruitment by pelagic larval stocks. In addition, midwater nekton like finfish and mobile benthic invertebrates may migrate outside of the area where turbidity and deposition occur.

The amount of turbidity and its associated plume is mainly dependent on the grain size of the material. Generally, the larger the grain-size, the smaller the area of impact. The period of turbidity is also less with larger grain-sized materials. The proposed borrow locations contain medium to fine sands, which are coarser grained than silts and clays. Turbidity resulting from the resuspension of these sediments is expected to be localized and temporary in nature. Utilization of a hydraulic dredge with a pipeline delivery system will help minimize the impact, however, some disturbance will occur.

Similar water quality effects on aquatic organisms could likely be incurred from the deposition of borrow material on the beach. Increased turbidity resulting from the deposition of a slurry of sand will be temporary in nature and localized. This effect will not be significant as turbidity levels are naturally high in the high-energy surf zone. Organisms in the surf zone versus deep water areas will be less likely to suffer adverse effects from turbidity because they have already adapted to these conditions. Fine sediments sifted from the deposited material would be transported by waves and currents into the nearshore with varying environmental impacts from a few months to at least several years (Hurme and Pullen, 1988). Parr et al, 1978 determined that fine materials were rapidly sorted out and transported offshore after beach deposition. In their study, the dredged material had a much higher silt content than the beach, however, all of the silt was removed within 5 months. The selection of borrow material from a high energy

environment should minimize the fine particle content. Material taken from the proposed borrow areas will have low quantities of silt, therefore, high levels of turbid waters after deposition should not persist.

Based on the HTRW survey, the borrow material is not expected to be chemically contaminated. The use of beach nourishment quality sand from a high energy environment coupled with the absence of nearby dumping activities, industrial outfalls, or contaminated water infers the low probability that the borrow material would be contaminated by pollutants.

Minor temporary impacts will also be associated with the excavation to take place within the ponds and drainage ditches. These impacts will be temporary and minor and confined to the actual period of construction. In addition, it may be possible to minimize these impacts by doing construction during periods of low water when some of the ponds and drainage ditches are virtually free of water.

7.5.1.4 Terrestrial Ecology

7.5.1.4.1 Effects on Flora and Fauna of Upper Beach. Construction of the beach nourishment alternative would result in the initial placement of approximately 2,372,000 cubic yards of sand on the beach, with subsequent periodic nourishments of approximately 650,000 cubic yards every 4 years for a project life of 50 years. This construction will greatly disturb the impacted beach area, however, impacts to terrestrial species are expected to be minor and temporary. The existing species inhabiting the beach are generally capable of surviving adverse conditions, and most are capable of migrating out of the impacted area. Therefore, impacts are not expected to be significant. It would be reasonable to expect recolonization from adjacent areas shortly after the end of construction, and a rapid return to pre-construction conditions. Considering the current condition of the existing beach, the proposed project would actually create a minimum of 10 additional acres of beach habitat.

Following the construction, approximately 11 acres of beachgrass (70%) and coastal panicgrass (30%) will be planted on the newly constructed dune. In addition, approximately 7 acres along the landward toe of the dune will be planted with a combination of bayberry, wax myrtle, beach plum, and shore juniper. These plantings will help to stabilize the dune, in addition to being a benefit to wildlife species.

7.5.1.4.2 Effects on Flora and Fauna of Internal Habitat. The proposed project involves 2 aerial applications of the herbicide Rodeo followed by a controlled burn of all of the Phragmites australis dominated areas. The implementation of these steps has the potential to impact the surrounding vegetation, as well as irradicate the Phragmites australis from the site. These impacts will be temporary however, and proper measures will be taken during the spraying and burning to protect other existing vegetation to the maximum extent possible. Once the

Phragmites australis is removed from the site however, the area will be replanted with emergent wetland vegetation which has a much greater value to wildlife species which frequent The Meadows. In addition, the removal of the Phragmites australis is expected to have a beneficial effect on The Meadows' populations of threatened and endangered plants. Since in most cases, the habitats required for these plants are being overtaken by Phragmites australis, the removal of this invasive competition should help to re-establish healthy populations of these species.

The existing animal species inhabiting the site are generally capable of surviving adverse conditions, and most are capable of migrating out of the impacted area during the construction activities. It is expected that any species disturbed by the construction will return following the construction activities. In order to minimize any potential impacts to existing species, construction of the internal features can probably be timed to avoid migrating seasons when a greater number of species are present at the site.

7.5.1.5 Aquatic Ecology

7.5.1.5.1 Effects of Beachfill Placement on Benthos. The majority of the impacts of beachfill placement will be felt on organisms in the intertidal zone and nearshore zones. The nearshore and intertidal zone is highly dynamic, harsh, and is characterized by great variations in various abiotic factors. Fauna of the intertidal zone are highly mobile and respond to stress by displaying large diurnal, tidal, and seasonal fluctuations in population density (Reilly et al. 1983). Despite the resiliency of intertidal benthic fauna, the initial effect of beachfill deposition will be the smothering and mortality of existing benthic organisms within the shallow nearshore (littoral) zone on the oceanfront. This will initially reduce species diversity and number of animals. Burial of less mobile species such as amphipods and polychaete worms would result in losses, however, densities and biomasses of these organisms are relatively low on beaches. Beach nourishment may also inhibit the return of adult intertidal organisms from their nearshore-offshore overwintering refuges, cause reductions in organism densities on adjacent unnourished beaches, and inhibit pelagic larval recruitment efforts. Parr et al. 1978 notes that the nearshore community is highly resilient to this type of disturbance, however, the offshore community is more susceptible to damage by receiving high sediment loads from fines sorting-out from a beachfill. The ability of a nourished area to recover depends heavily on the grain size compatibilities of material pumped on the beach (Parr et al.,1978). Reilly et al. 1978 concludes that nourishment initially destroys existing macrofauna, however, recovery is usually rapid after pumping operations cease. Recovery of the macrofaunal component may occur within one or two seasons if borrow material grain sizes are compatible with the natural beach sediments. However, the benthic community may be somewhat different from the original community. Hurme et. al. 1988 caution, "Macrofauna recover quickly because of short life cycles, high reproductive potential, and planktonic recruitment from unaffected areas. However, the recolonization community may differ considerably from the original community. Recolonization depends on the availability of larvae, suitable conditions for settlement, and mortality. Once

established, it may be difficult for the original community species to displace the new colonizers." Benthic recovery on the beach/intertidal zone may become hampered by the four-year periodic nourishments. Based on the above mentioned studies, the benthic community may take 1-2 years to recover. With a four-year renourishment cycle, the benthic community may be in a higher than normal state of flux due to periodic disturbances from re-nourishment. It is conceivable that the benthic community may attain a recovered state for a period of 1-2 years before being disturbed again by a re-nourishment cycle. It should be noted however that the four-year nourishment cycle was developed purely for cost estimating purposes. In reality, nourishment activities will be based on current survey information and limited only to those areas where sand is needed, therefore minimizing nourishment activities and impacts.

Geomorphological studies on the sediments within the proposed borrow sites indicate that there will be relatively low levels of fine sediments placed on the beaches of The Meadows and Cape May Point. Parr et.al. 1978 recommend that to minimize biological impacts, the percentage of fine sediments (smaller than 125 micrometers) should be low to minimize siltation and consequent deposition offshore, which may create anoxic conditions in the sediment. The berm restoration would be conducted in a manner that approximates the existing beach profile. The approximate area of lost intertidal and shallow nearshore habitat resulting from the beachfill would be likewise created seaward. Therefore, no significant loss of intertidal or shallow nearshore habitat is expected.

7.5.1.5.2 Effects on Benthos at Borrow Sites. The primary ecological impact of dredging the sand borrow sites will be the complete removal of the existing benthic community through entrainment into the dredge. It is estimated that a total of approximately 237 acres of benthic habitat will be impacted by dredging during the proposed beachfill and ecosystem restoration. Dredging will primarily impact the benthic and epibenthic organisms. Mortality of these organisms will occur as they pass through the dredge device and/or as a result of being transplanted into an unsuitable habitat. A secondary disturbance would be the generation of turbidity and deposition of sediments on the benthic community adjacent to the dredging. Despite the initial effects of dredging on the benthic community, recolonization is anticipated to occur within one year. Saloman et al. 1982 determined that short-term effects of dredging lasted about one year resulting in minor sedimentological changes, and a small decline in diversity and abundance within the benthic community. The recovery of a borrow area is dependent upon abiotic factors such as the depth of the borrow pits, and the rate of sedimentation in the borrow pits following the dredging. Dredging a borrow pit can result in changes that affect circulation patterns resulting in pits where fine sediments can become deposited, which may lead to hypoxia or anoxia in the pit. Accumulations of fine sediment may also shift a benthic community from predominantly a filter-feeding community to a deposit-feeding community. It is important that for recovery, the bottom sediments are composed of the same grain sizes as the pre-dredge bottom. Cutler et al. (1982) investigated long-term effects of dredging on the benthic community and noted that faunal composition was different than the pre-dredge community, however, the difference was attributed more to normal seasonal and spatial variations. In this study, it was

determined that there were no significant differences in the benthic communities and sediment parameters between borrow sites and surrounding areas. Periodic disturbances from maintenance of the project may favor the development of benthic communities composed primarily of colonizers. Assuming that the same location within each borrow area is dredged every nourishment cycle, the secondary benthic community may be in a higher state of flux than the original community. This may, in effect, favor more r-selected (rapid reproduction, short life span) benthic species in the sand borrow impact areas over the 50-year project life. In addition, benthic organism abundances may be lower than normal. However, this may not be the case if subsequent dredging cycles are conducted at different locations within the borrow areas. This would allow disturbed areas from previous dredging disturbances to become recolonized. Depending upon the availability of sand within the borrow areas in the future, it may also be possible to limit all nourishment activities to one of the two borrow areas, thereby minimizing the number of acres impacted.

Benthic investigations in and around the selected borrow sites reveal benthic communities that are not unique or rare to the general project area. Recolonization of the benthic community may occur within 1-2 years following dredging, however, the effects of the four year periodic project maintenance over a 50 year project life may have more profound adverse effects if conducted at the same locations. Hurme et al. (1988) recommend that borrow materials be obtained from broad, shallow pits in nearshore waters with actively shifting bottoms, which would allow for a sufficient surficial layer of similar sediments for recolonization. Measures that would minimize the effects of dredging in the borrow areas include dredging in a manner as to avoid the creation of deep pits, alternating locations of periodic dredging, dredging during lowest biological activity, and the utilization of a hydraulic dredge with a pipeline delivery system to help minimize turbidity.

7.5.1.5.3 Impacts on Fisheries

7.5.1.5.3.1 Shellfish. The existing benthic community at the proposed sand borrow sites were sampled and analyzed by Versar, Inc. in September of 1996. These areas are designated Borrow Area P1 and Borrow Area P2. These areas are depicted in Figure 2.3-3. Only one species of commercial or recreational value was collected during the macroinvertebrate survey, the Atlantic surf clam (Spisula solidissima).

Atlantic surf clams were found within both Borrow Areas and at the reference sites. Mean abundance of this clam was 169 per square meter at Borrow Area P1, 275.3 per square meter at Borrow Area P2, and 170.5 per square meter at the reference sites. All of the Atlantic surf clams recovered in Borrow Area P2 were less than 2 cm in shell length and the biomass of this species was significantly lower at Borrow Area P2 than at P1. Approximately 39 percent of the clams were greater than 2 cm at Borrow Area P1, compared to 0.0 percent at Borrow Area P2, and 20 percent at the reference sites. These results indicate that although juvenile surf clams are settling

and surviving in Borrow Area P2, they may not be reaching older life stages (Versar, 1997).

As stated in Section 2.3.4.6.1, the Atlantic surf clam fishery supports the largest molluscan fishery in New Jersey. However, the coastal area below Absecon Island contains only 17 percent of the total standing stock, and comprised less than 5 percent of the total commercial use during the 1993-1994 season. In addition, based on sampling conducted by the NJDEP, Bureau of Shellfisheries in 1993, it was concluded that the surf clam resource below Great Egg Harbor Inlet remains noncontributory to the overall standing stock, and continues to provide no evidence of recruitment (N.J. Bureau of Shellfisheries, 1994). As such, the use of the proposed sand borrow areas for beach restoration and periodic renourishment is not expected to have any significant impact on the surf clam population or the commercial fishery along the New Jersey Coast.

Due to the quantity of sand available in borrow area P2, it is not possible to use this borrow area exclusively in order to minimize the impacts of the proposed project on the surf clam population. At this time, it is proposed that 1,724,000 cy of material be removed from 138 acres within borrow area P1 and 648,000 cy of material be removed from 99 acres of borrow area P2 to depths of 10 feet and 6.5 feet respectively. The mean biomass of surf clams within Borrow Area P1 was 9.15 grams per meter squared as opposed to Borrow Area P2 which had a mean biomass of only 0.07 grams per meter squared. Periodic monitoring of the benthic communities in the sites will provide information for selecting dredging locations within the borrow area that minimize surf clam impacts. Other possible measures may include trying to harvest clams prior to dredging, dredging a smaller area to greater depths, and only dredging in approved sections of the borrow areas. These and any other measures will be fully coordinated with appropriate state and local resource agencies.

In addition, as a result of coordination of the draft report, NJDEP-Land Use Regulation has requested that borrow area P2 not be used and that P1 be reconfigured in an effort to minimize impacts to surf clams and prime fishing areas. The Corps is currently investigating these changes to the borrow areas, as well as the possibility of using sand from Cape May Inlet for nourishment activities to further reduce the potential impact to marine species. Any permanent changes to the borrow areas will be coordinated with the appropriate agencies.

7.5.1.5.3.2 Finfish. With the exception of some small finfish, most bottom and pelagic fishes are highly mobile, and should be capable of avoiding entrainment into the dredging intake stream. It is anticipated that some finfish would avoid the turbidity plume while others may become attracted to the suspension of food materials in the water column. Little impact to fish eggs and larvae are expected because these life stages are widespread throughout the Middle Atlantic Bight, and not particularly concentrated in the borrow sites or surf zone of the project area (Grosslein and Azarovitz, 1982).

The primary impact to fisheries will be felt from the disturbance of benthic and epibenthic communities. The loss of benthos and epibenthos entrained or smothered during the project will

temporarily disrupt the food chain in the impact area. This effect is expected to be temporary as these areas become rapidly recolonized by pioneering benthic and epibenthic species.

Some minor and temporary impacts may also be associated with the construction to take place within The Meadows' interior. Most species currently found within the ponds and drainage ditches are highly mobile, and should be capable of avoiding the construction equipment. Since only minor, localized work will be done in the ponds and ditches, there should be plenty of undisturbed area for the fish to take refuge in during the construction activities.

7.5.1.6 Threatened and Endangered Species. The piping plover, which is State listed as endangered and Federally listed as threatened, is a frequent inhabitant of New Jersey's sandy beaches. Past nesting sites of this species in New Jersey have included the southern end of Brigantine, Ocean City, and several locations in Cape May, including The Nature Conservancy's section of the project area. If piping plover are still nesting within the project area prior to the commencement of the initial beach nourishment and periodic maintenance activities, the Corps will contact the New Jersey Department of Environmental Protection, Division of Fish, Game and Wildlife and the U.S. Fish and Wildlife Service to determine appropriate measures to protect the piping plovers from being disturbed. These measures may include establishing a buffer zone around the nest, and limiting construction to be conducted outside of the nesting period (1 April - 15 August).

From June through November, New Jersey's coastal waters may be inhabited by transient sea turtles, especially the loggerhead (Federally listed threatened) and the Kemp's ridley (Federally listed endangered). Sea turtles have been known to be adversely impacted during hopper dredging operations. Dredging encounters with sea turtles have been more prevalent along waters of the southern Atlantic and Gulf coasts, however, incidences of "taking" sea turtles have been increasing in waters of the middle Atlantic coast. Coordination with the National Marine Fisheries Service (NMFS) in accordance with Section 7 of the Endangered Species Act has been undertaken on all Philadelphia District Corps of Engineers dredging projects that may have impacts to Federally threatened or endangered marine species. A Biological Assessment that discusses Philadelphia District hopper dredging activities and potential effects on Federally threatened or endangered species of sea turtles has been prepared, and was formally submitted to the NMFS in accordance with Section 7 of the Endangered Species Act. A biological opinion was provided by the NMFS in November of 1996. As a term and condition of the incidental take statement included in this opinion, the NMFS is requiring monitoring of all hopper dredge operations in areas where sea turtles are present between June and November by trained endangered species observers. Adherence to the findings of the Biological Opinion will insure compliance with Section 7 of the Endangered Species Act. Recent projects that have utilized a hopper dredge between June and November have included NMFS approved sea turtle observers on the dredge to monitor for sea turtles during dredging. Observers inspect the hopper, skimmer, and draghead after each load looking for signs of interaction with endangered or threatened species. Other measures that may be taken to reduce the impact to sea turtles include the use of

rigid dragarm deflectors and pre-dredging trawling.

The Rare, Threatened and Endangered Plant Survey which was conducted in 1995 and 1996 confirmed the presence of four rare, imperiled or endangered species within the project site. Prior to any construction activities, an updated survey will be conducted to determine which (if any) populations still exist within the project area. This survey will allow any existing populations to be precisely mapped so that all efforts can be made to avoid negatively impacting the species.

7.5.1.7 Impacts on Noise and Air Quality. Minor short-term impacts to air quality and noise levels would result from the construction phases of the beach nourishment alternative. Dredging activities and grading equipment use would produce noise levels in the 70 to 90 dBA (50 feet from the source) range, but these would be restricted to the beach area. These noises would be masked by the high background levels of the surf or dissipated by distance. Ambient air quality would also be temporarily degraded, but emission controls and limited duration aid in minimizing the effects. In the case of equipment use associated with the periodic nourishment efforts, conducting the work in the off-season would further minimize the impact.

Noise and air quality impacts would be restricted to site construction preparation (generally beginning two weeks prior to dredging) and the actual dredging and placement operation. Noise is limited to the utilization of heavy equipment such as bulldozers to manipulate the material during placement. Additional noise may be caused by a pumpout station, if necessary. Depending on future circumstances, the construction may be conducted overnight to meet construction schedules. Air quality impacts would similarly be limited to emissions from the heavy equipment and pumpout station (if used). No long-term significant impacts to the local air quality are anticipated.

Minor short-term impacts to air quality and noise levels are also anticipated to result from the construction activities to take place within The Meadows. As stated above, these impacts will primarily be associated with construction equipment such as bulldozers and small dredges. Minor air quality impacts will also be associated with the burning of the Phragmites australis. This impact will be temporary in nature and will only occur once throughout the project. The burning will be strictly controlled with fire breaks and is not anticipated to have any long-term significant impacts.

The draft Feasibility Report and Environmental Impact Statement was coordinated with the State of New Jersey to document compliance with the State Implementation Plan. The U.S. Environmental Protection Agency reviewed the draft report and had no adverse comments relative to air quality impacts, pursuant to Section 309 of the Clean Air Act. A statement of conformity with the State Implementation Plan is provided in Section 11 of this document.

7.5.1.8 Recreation. The proposed project as a secondary benefit, may improve

opportunities for recreational use for both the beach and interior areas. Recreational shore and surf fishing will be temporarily affected by the project, since the public and fishermen will not be permitted to enter the actual work segments. However, since the project will be constructed in sections, only those sections actually under construction will be closed to the public. Impacts to shore and surf fishing access will be localized and relatively short-lived. Recreational bird watching activities may also be temporarily impacted by the project. Construction noise and activities will most likely cause many bird species to hide or simply avoid the site during construction activities. As stated previously however, all attempts will be made to schedule construction activities during times when migrating species will be impacted the least. All birds are expected to return to the site following construction.

7.5.1.9 Aesthetics. Beach nourishment is a more natural and soft structural solution to reducing storm damages at The Meadows. With the exception of short-term impacts during construction, overall aesthetics of the beach and interior areas would be improved as a result. A natural-looking beach and dune would be more aesthetically pleasing and attractive to residents and tourists. In addition, the removal of the Phragmites australis will greatly improve the aesthetics of the whole Meadows area. Presently, little of the site can be seen from any of the paths or observation areas due to the height of the Phragmites australis. In some areas, the height reaches over 7 to 8 feet, obscuring views of all habitat around it. Once the Phragmites australis have been removed, visitors will be able to see many different habitats and wildlife species from any given vantage point.

7.5.1.10 Unavoidable Adverse Impacts. The long-term adverse impact of the no action alternative would be to the natural environment and the critical habitat it provides to the numerous resident and migratory species which frequent The Meadows. Beach habitat would continue to be lost, jeopardizing the piping plovers and other beach nesters which require this habitat for their continued survival. This loss of beach habitat also puts the dunes, and the habitat behind them at risk. As the beach continues to get smaller, the dunes become more vulnerable to breaching and overtopping during storm events. This in turn increases the risk of saltwater intrusion into The Meadows. Past saltwater inundation has resulted in fish killings, the death of emergent wetlands and the replacement with Phragmites australis dominated wetlands, the loss of water movement through the site, and the degradation of the habitat in terms of wildlife usage.

The long-term adverse impact of the beach nourishment alternative would be decreased benthic community standing stocks, which would be affected during each dredging operation.

7.5.1.11 Short-term Uses of the Environment and Long-term Productivity. The no action alternative does not involve short-term uses but would affect the long-term environmental quality of the project area as previously indicated. On the other hand, the selected plan would enhance the environmental quality by storm damage reduction, reduction of saltwater intrusion, and improvement of the interior habitats as well as by providing traditional incidental storm

damage reduction to the town of Cape May Point.

Again, the beachfill portion of the plan would reduce the long-term productivity of the sand borrow sites, but would increase shorebird nesting habitat in areas which presently have minimal beach and dune area.

7.5.1.12 Irreversible and Irretrievable Commitments of Resources. The no action alternative does not involve a commitment of resources. The selected plan would involve the utilization of time and fossil fuels which are irreversible and irretrievable. Impacts to the benthic community would not be irreversible as benthic communities would redevelop with cessation of all dredging activity.

7.5.1.13 Cumulative Effects. Cumulative Impact as defined in CEQ regulations is the "impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time."

Projects using beach nourishment from offshore borrow sites are becoming increasingly common in coastal areas as these areas become susceptible to the erosive forces present. Numerous beach nourishment projects have been conducted along the Atlantic Coast since the 1950's by local, state and Federal agencies, as well as private interests. Depending on circumstances such as the methods being utilized to alleviate the coastal erosion and ensuing storm damages and the existing ecological and socio-economic conditions, it is difficult to gauge the net cumulative effects of these actions. The scientific literature generally supports that beach nourishment projects, if planned properly, have short-term and minor ecological effects, however, we are not aware of any studies that consider regional or national cumulative impacts of these projects on resources of concern. It is our position that since this project was designed to minimize adverse environmental effects of all types and actually has net environmental benefits, this project should not culminate in adverse cumulative impacts on ecological and socio-economic resources, or if it does, to the minimum extent possible.

7.5.1.14 Mitigation Measures. Mitigation measures are utilized to minimize or mitigate for project impacts to environmental resources within the project area. The appropriate application of mitigation is to formulate a project that avoids or minimizes adverse impacts first, and compensates for impacts only as a final alternative. Several measures can be adopted to avoid or minimize project impacts on effected resources such as: benthic resources, fisheries, endangered species, vegetation, cultural resources, recreation, and noise.

Mitigation measures are either institutional in that environmental mitigation is inherent in project alternative selection, or as measures incorporated into the construction and operation and maintenance of the project. Several institutional measures have already been adopted to

minimize the impacts on these resources. These measures include the selection of the beach nourishment alternative. This alternative offers a more naturalistic and softer approach for storm damage reduction. Selection of this alternative is based on its relatively low ecological impacts, environmental benefits, and its cost effectiveness. Another institutional measure is the utilization of offshore sand borrow areas. These areas are characterized by high energy and shifting sands resulting in a benthic community of lower abundance and diversity as compared to more stable benthic environments. Therefore, biological impacts are expected to be lower. Another measure is the selected use of suitable sand grain sizes for beach nourishment. The selection of borrow areas is based on compatibility studies for sand grain sizes. The selection of coarser beach nourishment quality material will minimize impacts on water quality at the dredging site and discharge (placement) site.

As discussed in the preceding paragraphs, the beach nourishment alternative does include unavoidable impacts to several environmental resources of concern. These impacts can be minimized by implementing several measures during construction and operation and maintenance of the project. Mitigation measures recommended for construction and operation and maintenance of the project involve minimizing impacts to: benthic resources, fisheries, endangered species, recreation, noise and cultural resources. The following measures are recommended, however, their implementation is dependent upon the circumstances that may be encountered at the time of project construction or periodic maintenance.

7.5.1.14.1 Benthic Resources. The majority of unavoidable impacts are likely to be incurred on the benthic communities within the study area. Measures to minimize the effects of dredging in the borrow areas will include dredging in a manner as to avoid the creation of deep pits, alternating locations of periodic dredging, conducting dredging during months of lowest biological activity (when possible), and the utilization of a pipeline delivery system to help minimize turbidity. Implementation of a benthic monitoring program concurrent with periodic maintenance activities would document project impacts and aid in avoiding impacts to sensitive areas during the periodic maintenance activities.

7.5.1.14.2 Fisheries. Adverse impacts to the surf clam population will be minimized by what ever means possible. Since borrow area P2 has a slightly larger number of small juvenile clams but the lowest numbers of surf clams greater than 2 cm, indicating that these juveniles may not be reaching harvestable size, it may be possible to minimize impacts by conducting nourishment activities in this borrow area alone. This decision will be made based on sand quantities available prior to nourishment cycles. Prior to any dredging activities, updated benthic surveys will be obtained to determine current populations. If viable populations exist within the borrow areas, measures will be taken to minimize impacts to the clams. These measures may include relocation of the borrow area(s), the commercial harvest of clams prior to dredging, dredging a smaller area to greater depths, and only disturbing a portion of the site. All measures will be fully coordinated with the appropriate Federal, State and local agencies.

7.5.1.14.3 Threatened and Endangered Species. Currently, piping plovers nest along a portion of the project area. If piping plovers are still nesting within the project area prior to the commencement of the initial beach nourishment and periodic maintenance activities, the Corps will contact the New Jersey Department of Environmental Protection, Division of Fish, Game and Wildlife and the U.S. Fish and Wildlife Service to determine appropriate measures to protect the piping plovers from being disturbed. These measures may include establishing a buffer zone around the nest, and limiting construction in these areas to periods outside of the nesting season (1 April - 15 August).

Depending on the timing of the dredging and the type of dredge to be used, it may be necessary to implement mitigative measures to avoid adversely impacting threatened or endangered sea turtles. If a hopper dredge is used the NMFS requires the use of NMFS approved turtle monitors on the dredge in order to document any impacts. Other mitigative measures could include utilizing specially modified hopper dredges, and use of trawlers that can intercept and transport turtles away from the dredging impact area. It may not be necessary to implement these measures if dredging is conducted within the winter months when turtle activity is lowest in this area.

The spraying and burning of the Phragmites australis, as well as other construction activities has the potential to negatively impact rare, threatened or endangered plant species which are present within the project area. In order to minimize these impacts, an updated plant survey will be conducted prior to any construction activities. Once any existing populations are located, necessary precautions will be taken to protect the species during construction. The threatened or endangered species will be covered or protected in some other way during the application of the herbicide. Likewise, all efforts will be made to protect them during the burning phase of the project

7.5.1.14.4 Recreation. Beachfill operations typically occur within isolated segments, subsequently moving as the work progresses. As each work segment is completed, it can be opened for recreational use. This would allow access for recreation in all areas outside of the segment under construction. The same would hold true for the work to be completed within The Meadows as well.

7.5.1.14.5 Air Quality and Noise. Air quality and noise impacts can be reduced by utilizing heavy machinery fitted with approved muffling apparatus that reduces noise, vibration, and emissions.

Air quality impacts may also be reduced by the proper management and execution of the controlled burn needed to remove the dead Phragmites australis. Trained professionals will be responsible for this aspect of the study and all effort will be made to minimize impacts to the surrounding community.

7.5.2 Impacts on Cultural Resources. Construction of the selected plan has the potential to impact cultural resources in four specific project locations. These areas are 1) the shoreline, 2) the underwater near-shore area, 3) the offshore borrow areas, and 4) the fresh water marsh area. Impacts to cultural resources could occur as a result of: drainage ditch and fish reservoir excavation and weir construction in the fresh water marsh area; the placement, grading and compaction of beach and near-shore sands during berm and dune construction; the excavation of pier foundations for outfall pipe extension; and the removal of sand from the offshore borrow areas. Selected portions of the project area were investigated for cultural resources by Dolan Research, Inc. and Hunter Research, Inc. in 1997.

7.5.2.1 The Shoreline Area. A pedestrian low-tide surface inspection and hand carried magnetometer survey was conducted along the project's shoreline between the Lighthouse Avenue groin in Cape May Point and the Third Avenue terminal groin in Cape May City. Stone and brick rubble believed to be associated with the second Cape May lighthouse, constructed in 1847, was located within the tidal zone of the beach. The remains of World War II-era fortifications, Battery #'s 223 and 26, were also identified within the tidal zone. Researchers believe both the lighthouse site and fortifications are potentially eligible for listing in the National Register of Historic Places. Proposed sand placement and outfall pipe extension has the potential to impact these two sites. No structural evidence of Cape May South or the historic corduroy road were identified. Magnetometer survey found no indication of significant buried shoreline material.

7.5.2.2 The Underwater Near-Shore Area. An underwater remote sensing investigation was conducted in the 200 acre near-shore project area. One remote sensing target was identified. Researchers believe this target location (#12:666) could possibly represent an old jetty or structural remnant once associated with the adjacent military battery installation. This target is not considered to be historically significant and no further work is recommended at this location. Although no evidence of Coastal Defense Battery #7 was observed in the field, historic map research indicates its location just east of the bunker in the near-shore area. Proposed sand placement may impact this probable site location.

7.5.2.3 The Offshore Borrow Areas. The remote sensing investigation of offshore Borrow Areas P1 and P2 identified eight low probability targets. Researchers concluded that these targets represent relatively modern debris that do not exhibit significant cultural resource characteristics. No further work is recommended at these target locations.

7.5.2.4 The Fresh Water Marsh Area. The fresh water marsh area was not investigated for cultural resources. Proposed construction in this area is restricted to submerged locations and wetland areas, which include existing drainage ditches and ponds. The potential for significant cultural resources in these locations is considered extremely low.

7.5.2.5 Section 106 Coordination. As a result of our review of the information

provided in the above referenced report, the District has found that implementation of the selected plan, as detailed in the feasibility report, has the potential to impact significant cultural resources that are potentially eligible for listing in the National Register of Historic Places. These cultural resources are 1) the second Cape May Lighthouse site, 2) the Delaware Harbor Defense Batteries #223 and 26 and 3), the reported location of Delaware Harbor Defense Battery #7. However, it is the District's position that the impacts can be avoided and/or minimized and that measures can be taken to ensure that the project will have no adverse effect on these potentially significant cultural resources.

In accordance with the specific recommendations provided by Dolan Research and Hunter Research in their 1997 report, the District plans to implement the following measures. First, the District will conduct a program of controlled, periodic archaeological monitoring of the shoreline during and immediately following sand placement activities to check for archaeological materials originating from the offshore borrow areas.

Second, some additional fieldwork will be conducted at the 1847 Cape May Lighthouse site to document the exact extent and location of associated surface debris. The site will then be clearly delineated and carefully monitored during the placement of sand over the site. Researchers believe that sand placement, if done carefully at this location, will have a preservation enhancing effect on any buried remains. No additional Phase II studies were recommended at this location.

Third, the District will conduct a HABS/HAER level documentation program of Delaware Harbor Defense Batteries #223 and #26. These structures will also be carefully monitored during sand placement and outfall extension construction to ensure that no project related impacts will occur to these structures.

Fourth, an underwater diving operation will be conducted at the reported location of Delaware Harbor Defense Battery #7. If this investigation determines that sufficient structural integrity is present, additional HABS/HAER documentation will be conducted. This site will then be carefully monitored during sand placement activities to minimize impacts.

As mentioned previously, two selected portions of the project area were not investigated because the likelihood for cultural resources was considered extremely minimal. These two areas are 1) the Cape May Point portion of the project area, which includes the shoreline and near-shore area between the Central Avenue groin and the Lighthouse Avenue groin and 2), the freshwater marsh area.

The Cape May Point portion of the project area, including both the shoreline and near-shore area, has been historically subjected to several episodes of erosion and subsequent filling following the construction of several stone groins. The potential for shipwrecks and other submerged cultural resources within this area is extremely low. Proposed sand placement will be within the groin field and will not extend seaward. Proposed construction in the freshwater marsh is limited to

the excavation of existing drainage ditches and ponds that are located in submerged and/or wetland areas. The likelihood for cultural resources within these previously disturbed locations is also considered extremely low.

Section 106 coordination for this project is continuing and will be concluded prior to any project activities.

7.6 Local Cooperation

7.6.1 Cost Apportionment. Section 111 of the Rivers and Harbors Act of 1968 (Public Law 90-483) as amended by Section 940 of the Water Resources Development Act of 1986 (Public Law 99-662), and Section 10lc of WRDA 86 (Public Law 99-662) provides authority to "...investigate, study, plan, and implement structural and nonstructural measures for the prevention or migation of shore damages attributable to Federal navigation works." This is subject to the requirement that the non-Federal sponsor agree to operate and maintain the measures. The existing Federal beachfill project at Cape May City is cost-shared 90% Federal, 10% Non-Federal using Section 111 authority. This beachfill project was originally to extend along The Meadows' shoreline but this project feature was removed in the *Cape May Inlet to Lower Township Phase I GDM* dated August 1980 due to the limited economic benefits of protecting The Meadows.

The costs for implementing measures under Section 111 authority are cost-shared by the non-Federal sponsor in the same proportion as the costs for the project causing the shore damage were so shared (Cape May Inlet jetties - 90% Federal, 10% Non-Federal). In this case of a navigation project comprised of a number of authorized modifications, costs for Section 111 measures are cost shared in accordance with the cost sharing for the specific modification or modifications to which the cause of shore damage can be traced. When adopted, the plan for Section 111 measures is considered to constitute a modification to the related navigation project(s).

The degree of the mitigation is typically the reduction of erosion or accretion to the level which would prevail without the influence of navigation works at the time these works were accepted as a Federal responsibility. It is not intended that shorelines be restored to historic dimensions, but only to lessen the existing shore damage or prevent subsequent damages by action based on sound engineering and economic principles when equitable and in the public interest.

To determine the cost allocation and apportionment under this authority, it is necessary to evaluate the degree to which erosion problems at the study area are attributable to the Federal navigation project, in this case the jetties at Cape May Inlet. A technical analysis was conducted to asses the impacts of the Cape May Inlet jetties and is presented in the following section.

7.6.1.1 Section 111 Technical Analysis. A Section 111 analysis was conducted to assess the impacts of the Cape May Inlet (formerly Cold Spring Inlet) Federal navigation project on the Lower Cape May Meadows - Cape May Point study area. This analysis indicates that the navigation project has resulted in measurable adverse impacts on the study area shorelines. The following sections of this analysis present an overview of historical developments at and in the vicinity of Cape May Inlet, a review of the historic shoreline behavior adjacent to the Inlet (with emphasis on Cape May City, Lower Cape May Meadows, and Cape May Point) and finally a quantitative interpretation of the impacts of the navigation project on the Lower Cape May Meadows - Cape May Point study area.

7.6.1.1.1 Historic Overview of Navigation Project. The Cape May Inlet navigation project was authorized in 1907, and included a recommendation for parallel stone jetties approximately 4,500 feet long, spaced 850 feet apart on center, and extending to the 25 foot (MLW) depth contour in the Atlantic Ocean. The navigation channel was authorized at 25 feet deep and 400 feet wide. The jetties were constructed between 1908 and 1911, and the entrance channel dredging was completed in 1913. The completion of construction on this project stabilized the previously natural but unstable tidal inlet historically referred to as Cold Spring Inlet, after the village of the same name located about two miles north of Cape May City. The purpose of the inlet was to provide a permanent, stable connection between the ocean and the man-made harbor then being developed just inside and west of the inlet.

The navigation project was modified in 1945 to include a 20 foot deep by 300 foot wide channel from the inner end of the jetties into Cape May Harbor. Jetty rehabilitation was performed between 1963 and 1966. In the period since initial channel construction in 1913, the project has required maintenance dredging at intervals ranging from one to five years, depending upon channel shoaling and the changing draft requirements of navigation. Recent O&M dredging practice at Cape May Inlet has been to maintain a 15 X 400 foot channel using a Government sidecasting dredge. The presently maintained channel dimensions are consistent with draft requirements of vessels using Cape May Harbor and the adjacent portions of the NJIWW.

7.6.1.1.2 Overview of Adjacent Shoreline Response and Shore Protection Structures. The completion of the Cape May Inlet jetties in 1911 initiated a series of immediate and significant shoreline changes on both the updrift (to the east) and downdrift (to the west) sides of the inlet. The impacts to the adjacent shorelines were caused by the interaction of the Cape May Inlet jetties with the ambient longshore sediment transport regime. The predominant regional longshore transport direction along this portion of the New Jersey coastline is toward the southwest. Thus the updrift beach of Two Mile Island (now Wildwood Crest and Wildwood) experienced dramatic accretion, due to interception of predominantly westward longshore transport by the east jetty. In contrast, the downdrift beaches experienced a sediment deficit that was initially manifest in the shoreline reach between the west jetty of Cape May Inlet and Cape May City, an area presently under the jurisdiction of the US Coast Guard. Subsequently, the sediment deficit induced by the Cape May Inlet jetties led to beach erosion impacts which

progressed in the downdrift, westward direction. These impacts were sequentially experienced in Cape May City, Lower Cape May Meadows, and at Cape May Point.

Cape May City. Cape May City was one of the nation's preeminent coastal destinations as long ago as the mid-1800's. However, as a result of progressive erosion following the 1911 completion of the Cape May Inlet jetties, the earliest of a series of protective works was required along the easternmost portion of Cape May City in 1914, three years after completion of the inlet jetties. These works consisted of 3,500 lineal feet of stone-filled timber cribs to protect upland development, supplemented in 1930 by the addition of a steel sheet pile bulkhead landward of the original cribbing. The first groins were constructed at Cape May City between 1924 and 1929. Of a total of 24 groins, 19 were constructed of timber and the remainder were built with steel sheet pile. An additional eight groins were constructed between 1939 and 1941. Beginning in 1946, Cape May City initiated a program to replace seven of the older timber and steel groins with massive stone groins, backed by a continuous stone seawall. The final two groins constructed in Cape May City were completed in 1952 at the western end of the city shoreline, consistent with recommendations contained in H.D. 83-206. These structures were located at Patterson and Third Avenues. The Third Avenue groin is the longest and westernmost structure in Cape May City, at the updrift (east) end of the Lower Cape May Meadows study area shoreline. Following the March 1962 storm, a combination of local, State and Federal funds were used for construction (and reconstruction) of shore protection works along the Cape May City shorefront. Upon completion of this work, the entire frontage of the City was protected by a combination of shore-parallel structures, including timber and steel bulkheads and stone seawall, segmented by a total of nine stone groins.

The most recent improvements at Cape May City consist of the construction of the authorized Federal beach erosion control project between 1988 and 1991. This project included groin modifications at Baltimore and Trenton Avenues (at the eastern end of Cape May City) and beachfill with periodic nourishment along the USCG and Cape May City shorefront.

Lower Cape May Meadows and Cape May Point. In the period between 1930 and 1942, Cape May Point constructed a series of steel, and later, stone groins along its developed Atlantic Ocean and Delaware Bay frontage. A timber and steel bulkhead was constructed at the eastern end of the Cape May Point shoreline in 1934, and largely replaced with a stone seawall in 1954. No structural modifications were made in this period in the Lower Cape May Meadows reach, between Cape May City on the east and Cape May Point on the west, due to the low level of development along this 7,500 foot section of beachfront. As a result, the protective works constructed at Cape May City and at Cape May Point were able to prevent further loss of upland within those communities, while the unprotected shoreline of Lower Cape May Meadows experienced a continuous process of sediment deficit and accompanying shoreline retreat.

7.6.1.1.3 Assessment of Shoreline Changes, Sediment Transport, and Cape May Inlet Impacts

Data Sources. A number of sources of data exist which are pertinent to the assessment of the role of the Cape May Inlet navigation project on the downdrift shorelines of Cape May City, Lower Cape May Meadows, and Cape May Point. Historic shoreline mapping was performed by the US Coast Survey, its successor, the US Coast and Geodetic Survey, and the Army Corps of Engineers, for dates including the following: 1842, 1879-80, 1899, 1927, 1948, and 1955. The most recent compilation of historic shoreline data for the study area was performed by the University of Maryland, Laboratory for Coastal Research, for the State of New Jersey Department of Environmental Protection. This effort involved the digital compilation of available historic shoreline maps and surveys, and shoreline positions obtained from aerial photography up to 1986. The University of Maryland mapping included data from several dates not listed above. Aerial photography of the study area has been obtained at intervals of from one to five years from 1949 to the present. Hydrographic surveys of the nearshore and offshore zone adjacent to the study area were obtained by the US Coast and Geodetic Survey in 1937 and 1972, and by the Corps of Engineers between 1994 and 1996. Together these sources constitute a record which documents the historic shoreline evolution for the study area in response to both man-made and natural causes, and to a lesser degree, gives insight into the corresponding changes occurring in the offshore zone.

Previous Analyses.

House Document (H.D.) 83-206. This document presents the results of an investigation completed by the Philadelphia District of the Army Corps of Engineers in 1951, and approved by the Chief of Engineers in 1952. This report documented changes which had occurred in the study area up to the year 1948, which is 37 years after the completion of the Cape May Inlet jetties. The period from 1927 to 1948 received particular emphasis in this report due to the availability of shoreline mapping and beach profiles of the shoreline from Wildwood to Cape May Point. The principal findings of the report included a determination that the Wildwood beaches within two miles east (i.e., updrift) of Cape May Inlet were continuing to accrete between 1927 and 1948, at rates of between 10 and nearly 20 feet per year. West (i.e., downdrift) of Cape May Inlet, the shoreline fronting the US Coast Guard Base was eroding at a rate of approximately 20 feet per year for the 1927 to 1948 period. Along the frontage of Cape May City, the shoreline improvements (outlined in the previous section of this analysis) led to a condition of approximate stability of the shoreline, reasonably attributable to the effects of the extensive groin field constructed beginning in 1914 and continuing past the 1948 date of the report.

In Lower Cape May Meadows, the 1927 to 1948 response of the shoreline was a loss of approximately 22 feet per year at a profile line located midway along this 7,500 foot long

shoreline reach, and about 17 feet per year erosion at a profile line in the eastern third of this reach. For this same location, H.D. 83-206 presents the following shoreline change rates for several other periods: 1842 to 1879, -15 feet/year; 1879 to 1933, -4 feet/year; and for 1899 to 1927, -2 feet/year. The large rate of change between 1842 and 1879 reflects a significant, natural adjustment of the shore alignment between Cape May City and Cape May Point. In this period, the irregular "S" shaped shore alignment of 1842 adjusted to a gently curved, convex-seaward shoreline of 1879. The shoreline losses at Lower Cape May Meadows and Point between 1842 and 1879 are balanced by corresponding gains at Cape May City. The year 1879 thus marks the first surveyed date at which a relatively regular and stable shore alignment existed between Cape May Point on the west and Cold Spring Inlet on the east.

At Cape May Point, the shoreline eroded in certain areas and accreted in others, in part reflecting the competing influences of regional long-term erosion and the mitigating effects of groin field construction. It should be noted here that the extreme shoreline change rates documented in the 1927 to 1948 period, e.g., 20 feet per year of accretion updrift of the Cape May Inlet jetties, and erosion of comparable magnitude at Lower Cape May Meadows, are indicative of highly unstable localized conditions with respect to sediment transport and shoreline response. Changes of this magnitude persisting over periods of one to several decades are very rare, and typically occur either at locations in close proximity to a tidal inlet, or where a man-made coastal structure has altered the longshore sediment transport regime.

US Army Corps of Engineers Coastal Engineering Research Center (CERC) Analysis.

Aerial Photo Shoreline Change Analysis. The Philadelphia District was assisted by CERC between 1978 and 1981 in the preparation of the "Cape May Inlet to Lower Township, New Jersey, Phase 1 General Design Memorandum." Specifically, CERC performed an analysis of the shoreline from Hereford Inlet to Cape May Point, with the chief data source being aerial photography obtained between 1949 and 1978. The objectives of this work included determining shoreline change rates, sediment volume change rates, and estimated rate and direction of longshore transport within the study area, with particular emphasis on the reach from Cape May Inlet to Cape May Point.

For this analysis, CERC established a total of 68 shore-normal reference lines between Hereford Inlet and the west end of Cape May Point. At each line for each aerial photography date, the location of the shoreline was determined relative to a baseline on land. A time series of shoreline locations at each profile line was created, and the data were then compiled for analysis. The results of the shoreline change analysis indicated that the beach updrift of the Cape May Inlet jetties (Wildwood Crest) continued to accrete on the order of 5 to 8 feet per year within two miles of the east jetty between 1949 and 1978. This behavior can be compared to the findings reported in H.D. 83-206 for the same reach, which indicated an accretion rate of between 10 and 20 feet per year for the 1927 to 1948 period. It is evident that 4,500 foot long east jetty at Cape May Inlet continued to intercept the predominantly westward regional littoral transport at least

through 1978, some 67 years after the completion of Cape May Inlet jetty construction.

Downdrift of the Cape May Inlet jetties, the CERC analysis indicated continued erosion between 1949 and 1978 which averaged about 10 feet per year over the 7,000 foot-long US Coast Guard reach. The maximum erosion rate for this period exceeded 20 feet per year near the center of the Coast Guard shoreline. Along the Cape May City frontage of approximately 12,000 lineal feet, the eastern two-thirds of the reach experienced a nominal shoreline retreat on the order of 1 to 2 feet per year, while the western one-third accreted over the 1949 to 1978 period. It should be noted that the apparent low rate of shoreline retreat along the eastern portion of Cape May City was primarily due to the fact that, by 1949, the beach had essentially retreated back to the continuous seawall fronting this reach, leaving little or no visible beach even at low tide condition.

The gains experienced in the western portion of Cape May City between 1949 and 1978 are largely attributed to the construction of two new groins at Patterson and Third Avenues, and the extension of five then-existing groins, along the western end of Cape May City by non-Federal interests in 1952-1954. New groin construction and improvement of older groins at these locations was consistent with recommendations contained in H.D. 83-206 for purposes of stabilizing the developed but eroding shoreline at Cape May City. The groins were successful in trapping littoral sediments transported from further east in Cape May City in the predominant westward direction. The groins and the accompanying nominal shoreline accretion served to offset erosion impacts experienced since the 1911 completion of the Cape May Inlet jetties.

The CERC aerial photo analysis indicated that the 1949 to 1978 period in Lower Cape May Meadows was marked by erosion which averaged 20 feet per year over the entire 7,500 foot-long reach. This shoreline response is very similar to the behavior observed between 1927 and 1948, prior to construction of the Patterson and Third Avenue groins, as documented in H.D. 83-406. It is important to note here that the shoreline erosion rate for Lower Cape May Meadows did not change significantly in response to the 1952 construction of the Third Avenue terminal groin in Cape May City, indicating that the large losses documented by CERC actually are a continuation of the shoreline loss rate experienced in the 1927 to 1948 pre-terminal groin period.

The CERC analysis demonstrated that the 1949 to 1978 period at Cape May Point was marked by minor accretion in the eastern groin compartments of that reach, with minor erosion experienced in the western groin compartments.

Sediment Volume Change Analysis. CERC utilized the previously discussed aerial photography data analysis to develop a volumetric sediment budget for the shoreline reach from Hereford Inlet to Cape May Point. Shoreline change data were converted to assumed volume change equivalents by applying a generally accepted, if inexact, coastal engineering "rule of thumb" which states that one foot of shoreline position change corresponds to one cubic yard of sediment volume change per lineal foot of shoreline. By applying this linear relationship to

shoreline change rates over specific reach lengths, CERC concluded the following:

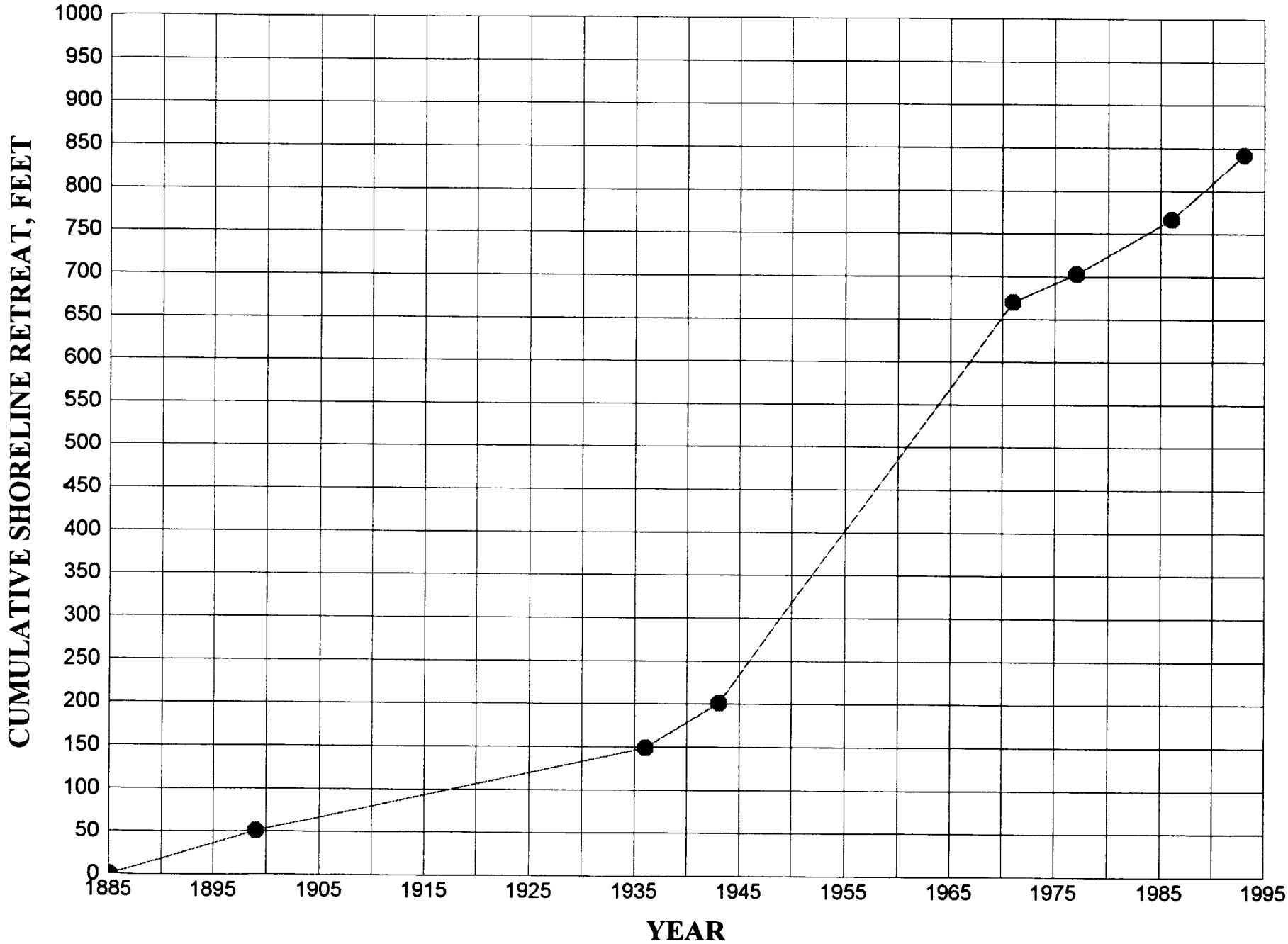
- that the two mile reach updrift (east) of Cape May Inlet was accreting 72,000 cubic yards per year (cy/yr);
- that the US Coast Guard Base immediately west of the inlet was losing 170,000 cy/yr;
- that the eastern half of Cape May City was losing 10,000 cy/yr while the western half was gaining 29,000 cy/yr;
- that Lower Cape May Meadows was losing 187,000 cy/yr; and finally
- that Cape May Point was gaining a statistically insignificant quantity of 2,300 cy/yr.

It is not the premise of the present analysis to conclude that the volumetric rates developed by CERC are incorrect. Rather, it should be recognized that the CERC volume change rates are simply a reasonable proxy, based on two-dimensional aerial photographic data, for the highly three-dimensional phenomenon of longshore sediment transport. The principal utility of the CERC volumetric sediment budget quantities was in the development of beach nourishment quantity estimates for potential beach fill projects within the study area.

Feasibility Study Analyses. During the Feasibility Study, work was performed under contract to the Philadelphia District to evaluate coastal processes within the study area. This work involved the development of nearshore wave and tidal current hindcasts for storm and normal conditions, and computed longshore transport rates, as documented in detail in a previous section of this report. The work also included collection of prototype nearshore current data to assess the potential role of Delaware Bay tidal circulation on sediment transport in the study area, and a reevaluation of historic shoreline change mapping and surveying. The contractor utilized the digital historic shoreline mapping developed by the University of Maryland as a data base for the shoreline change analysis. This analysis is regarded as particularly important because it includes the period from 1885 to 1993, a period of record of 108 years which is substantially longer than those used in the other cited analyses. Another advantage of the Feasibility Study analysis is that it included aerial photographic data up through 1993, and therefore gives the best representation of existing conditions and processes relevant to the study area and its shoreline erosion problems.

Figure 7.6.1.1.3-1 displays the results of the Feasibility Study shoreline change analysis for Lower Cape May Meadows. The period included in the analysis extends from 1885 to 1993. The y-axis value plotted for each date corresponds to the cumulative shoreline retreat, averaged over the 7,500 foot length of The Meadows shoreline, referred to the starting condition of 1885. The plot shows a distinct break in slope at the 1936 data point. Between 1885 and 1936, the period mean shoreline retreat rate for The Meadows corresponds to 2.9 feet per year. The period mean over the 1936 to 1993 interval is 12.3 feet per year. The ratio of the latter (post-1936) erosion rate to the former (pre-1936) rate is approximately 4, which indicates that the pre-1936 erosion rate was only one-quarter the rate experienced from 1936 to the present.

Figure 7.6.1.1.3 - 1
LOWER CAPE MAY MEADOWS
HISTORIC SHORELINE RETREAT SINCE 1885



7.6.1.1.4 Summary Discussion of Navigation Project Impacts on Lower Cape May Meadows. Results from three distinct analyses, dating from 1951, 1981, and 1997, have been presented and reviewed. The analyses differ in ways that have been discussed, including both the period of record and the type of data utilized. The 1951 analysis presented in H.D. 83-206 included data only through 1948. The CERC 1981 analysis examined in detail the period between 1949 and 1978, but did not consider the pre-1949 period. The obvious advantage held by work performed during the Feasibility Study is the considerably longer period of record - from 1885 through 1993 - for which data were available, as well as the advantage of having access to the two previous analyses and the data and insights contained therein. Neither of the two older investigations specifically addressed the question of whether the Cape May Inlet navigation project caused quantifiable adverse impacts on the Lower Cape May Meadows shoreline, although both investigations present data and historical information pertinent to the fundamental question.

The historic shoreline position data which predate the 1911 construction of the Cape May Inlet jetties indicate that shoreline erosion is not a phenomenon unique to the post-1911 period for the study area in general, nor for the shoreline of Lower Cape May Meadows in particular. The 1842 to 1879 period was marked by a significant, natural adjustment of the shoreline between Cape May Point on the west and the natural, unstabilized Cold Spring Inlet on the east. This adjustment added beach area to Cape May City, presumably at the expense of the beaches fronting Lower Cape May Meadows and Point. However, by 1879, the shoreline from Cape May Point east to Cold Spring Inlet had attained a gently curved, convex-seaward alignment, uninterrupted by man-made structures or significant irregularities in shore alignment. The first significant modification imposed on the post-1879 shoreline configuration is the 1911 construction of the jetties at Cape May Inlet. These structures each extended 4,500 feet seaward from their landward origin, and terminated at the 25-foot depth contour. These are among the longest shore-normal structures on the mid-Atlantic coast, and their interaction with the regional longshore sediment transport regime initiated a series of shoreline responses which continue to be experienced nearly nine decades later.

The Wildwood beach updrift of the jetties began to accrete in response to the dominant westward littoral transport even before the jetties were completed to their ultimate length. Studies of shoreline change performed in 1951, in 1981, and as recently as 1997, indicate that the updrift beach has continued to accrete along at least two miles of shoreline east of the inlet, albeit at a rate which has declined in the past decade compared to the preceding eight. This is indicative not of a cessation of impacts on the downdrift beaches, but rather an indication that the updrift beach is attaining an equilibrium geometry, with excess longshore transport directed offshore to deep water at the ends of the Cape May Inlet jetties.

The history of the study area beaches on the downdrift side of Cape May Inlet is equally as dramatic and persistent as that of the updrift, Wildwood beaches. The interruption of longshore transport across the formerly natural Cold Spring Inlet caused by the 1911 jetty construction

induced immediate impacts on the west, downdrift side of the inlet. In the 1927 to 1948 period, the US Coast Guard beach was eroding at a rate of about 20 feet per year. As recently as 1988, with the inception of the Federal shore protection project for Cape May City, the US Coast Guard beach was continuing to lose on the order of 20 feet per year at the apex of its concave-seaward shoreline. In Cape May City, adjacent on the west side of the Coast Guard beach, the first remedial shore protection works were constructed in 1914 to prevent further loss of developed upland. This construction at the eastern, updrift end of Cape May City was indicative of the progression of adverse impacts of the Cape May Inlet jetties in the downdrift direction. Within ten years of the construction of the first protective works at the eastern end of Cape May City, additional structures were deemed necessary. A sequence of groin construction, initiated in 1924, was largely completed by 1952, but was technically completed only in 1991 with modification to the Baltimore and Trenton Avenue groins at the east end of the city shoreline as part of the most recent Federal project.

At Lower Cape May Meadows, adjacent to Cape May City on the downdrift side, the lack of upland development commensurate with that in Cape May City was the principal reason that protective works were not constructed in the decades after the 1911 jetty construction at Cape May Inlet. The Lower Cape May Meadows shoreline experienced the same downdrift progression of erosion effects as was experienced at Cape May City, and earlier, at the US Coast Guard base shoreline. The physical explanation for this delayed impact at Lower Cape May Meadows, relative to impacts at Cape May City, is that it requires time, on the order of one or more decades, for a decreased supply of longshore sediment to manifest itself at a distance of over three miles from the source of the interruption. The sequence of protective measures constructed at Cape May City, i.e., the 12,000 lineal feet of shoreline compartmented by the groin field, were a direct response to the sediment deficit induced by the inlet jetties. The reduced littoral sediment transport to the Cape May City reach necessitating the groin field eventually was experienced along Lower Cape May Meadows. Evidence indicates that by approximately 1936, the reduced rate of supply of littoral sediment to Lower Cape May Meadows induced a significantly accelerated shoreline erosion rate. This rate of shoreline retreat was shown to average 20 feet per year over the entire reach for certain periods, to have exceeded 30 feet per year erosion at the most critical section of The Meadows shoreline, and to be on the order of four times greater than was experienced before the jetty impact had progressed to this reach. Between 1885 and 1936, the period mean shoreline retreat rate for The Meadows corresponds to 2.9 feet per year. The period mean over the 1936 to 1993 interval is 12.3 feet per year. Consequently, it is concluded that the impacts induced by the Cape May Inlet navigation project are directly responsible for 76% ((12.3 ft/yr - 2.9 ft/yr) / 12.3 ft/yr) of losses to the Lower Cape May Meadows shoreline[2].

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[2]This percentage was determined "reasonable" by the US Army Waterways Experiment Station, Coastal and Hydraulics Laboratory (CHL) in March 1998.

7.6.2. Cost-Sharing. The selected plan was in-part formulated in response to the adverse impacts of the Federal navigation project at Cape May Inlet. The protective dune/berm component of the project at Lower Cape May Meadows will be cost-shared consistent with Section 111 of the River and Harbor Act of 1968, as amended by Section 940 of the Water Resources Development Act of 1986. The costs of implementing measures under Section 111 authority are cost-shared on the same percentage as the cost of the project causing the damage. . Separable ecosystem restoration project features shall be cost-shared 65% Federal, 35% non-Federal in accordance with the Water Resources Development Act of 1996 (Public Law 104-303, Section 210). In accordance with Section 103(c) of the Water Resources Development Act of 1986 (Public Law 99-662), separable project features that provide Hurricane & Storm Damage Reduction (H&SDR) benefits (the protective dune/berm along Cape May Point) will be cost-shared 65 percent Federal and 35 percent non-Federal.

The Administration has proposed a new cost sharing policy for the periodic nourishment of shore protection projects. Cost sharing of the initial cost of construction is unchanged and will continue to be specified by Section 111 of the River and Harbor Act of 1968, as amended and Section 103 of WRDA of 1986. Under the proposed cost sharing policy, periodic nourishment will generally be 35 percent Federal and 65 percent non-Federal. For the Lower Cape May Meadows project, cost sharing of the periodic nourishment associated with the plan to respond to natural erosion (24 percent natural processes) and periodic nourishment associated with the Cape May Point storm damage reduction project would be affected by the proposed cost sharing. The non-Federal sponsor supports the implementation of the project and supports cost sharing of project features consistent with existing law and implementation of periodic nourishment elements consistent with cost sharing enacted by Congress in law.

All costs also include; planning, engineering, and design; construction; Lands Easements, Rights-of-Ways, Relocations and Dredged Material Disposal Areas (LERRD). The estimated market value of LERRD provided by non-Federal interests is included in the total project cost, and they shall receive credit for the value of these contributions against the non-Federal cost share. Operation, Maintenance, Repairs, Replacement, and Rehabilitaion (OMRR&R) is a non-Federal responsibility.

Shoreline erosion at The Meadows was found to be caused 76% by the Federal navigation project (Cape May Inlet jetties) and 24% by natural processes. Therefore, 76% of the protective dune/berm costs along The Meadows will be cost-shared under Section 111 authority (90% Federal, 10% non-Federal) and 24% will be cost-shared in accordance with WRDA 86 as amended (65%/35%).

The cost-sharing for the selected plan is based on a total first cost of $15,548,000 and does not include interest during construction, which is only used for economic justification purposes. A breakdown of costs is shown in Table 7.6.2 -1. The cost apportionment between the Federal and non-Federal total cost of the selected plan is shown in Table 7.6.2-2.

Table 7.6.2-1
Costs for the Selected Plan
(October 1997 price level)

ITEM	COST
1. INITIAL CONSTRUCTION (includes monitoring)	
- Protective Berm/Dune	$12,442,000
- Internal Ecosystem Restoration	$2,961,000
SUB-TOTAL	**$15,403,000**
2. LANDS, EASEMENTS, RIGHTS-OF-WAY, RELOCATIONS, DISPOSAL AREAS (LERRD)	**$145,000**
3. PERIODIC NOURISHMENT (50 year project life - includes monitoring)	**$58,023,000**
ULTIMATE PROJECT COST (50 YEAR)	**$73,571,000**

Table does not include Operation and Maintenance costs throughout the 50 year project life which are estimated to be $761,000.

Table 7.6.2-2
Cost Allocation (October 1997 price level)

Project Component	Total Cost	% Causal Effect	Cost-Sharing	
			Federal	Non-Federal
INITIAL CONSTRUCTION				
Lower Cape May Meadows				
Protective Dune/Berm (Initial Construction) LERRD	$8,902,000 $69,000			
Subtotal	$8,971,000	76% jetties effect (Section 111) $6,817,960	90% $6,136,000	10% $682,000
		24% natural processes $2,153,040	65% $1,399,000	35% $754,000
Subtotal			*$7,535,000*	*$1,436,000*
LERRD Credit			*$0*	*$69,000*
Cash Contribution			*$7,535,000*	*$1,367,000*
Internal Ecosystem Restoration (including wetland monitoring) LERRD	$2,961,000 $50,000			
Subtotal	*$3,011,000*		*65%* *$1,957,000*	*35%* *$1,054,000*
LERRD Credit			*$0*	*$50,000*
Cash Contribution			*$1,957,000*	*$1,004,000*
Cape May Point				
Protective Dune/Berm (Initial Construction) LERRD	$3,540,000 $26,000			

Table 7.6.2-2
Cost Allocation (October 1997 price level)

Project Component	Total Cost	% Causal Effect	Cost-Sharing	
			Federal	Non-Federal
Subtotal	*$3,566,000*		*65%* *$2,318,000*	*35%* *$1,248,000*
LERRD Credit			*$0*	*$26,000*
Cash Contribution			*$2,318,000*	*$1,222,000*
INITIAL CONSTRUCTION TOTAL	**$15,548,000**		**76.0%** **$11,810,000**	**24.0%** **$3,738,000**
Initial Construction (LERRD credit)			**$0**	**$145,000**
Initial Construction (cash contribution)			**$11,810,000**	**$3,593,000**

Table 7.6.2-2
Cost Allocation (October 1997 price level)

Project Component	Total Cost	% Causal Effect	Cost-Sharing	
			Federal	Non-Federal
PERIODIC NOURISHMENT				
Lower Cape May Meadows				
Protective Dune/Berm	$47,282,000	76% jetties effect (Section 111) $35,934,320	90% $32,341,000	10% $3,593,000
			WRDA 86 cost-sharing	
		24% natural processes $11,347,680	65% $7,376,000	35% $3,972,000
			Administration proposed WRDA 98 cost-sharing	
			35% $3,972,000	65% $7,376,000
Cape May Point (Hurricane and Storm Damage Reduction)				
			WRDA 86 cost-sharing	
Protective Dune/Berm	$10,741,000		65% $6,982,000	35% $3,759,000
			Administration proposed WRDA 98 cost-sharing	
			35% $3,759,000	65% $6,982,000
PERIODIC NOURISHMENT TOTAL	**$58,023,000**	WRDA 86 cost-sharing	**80.5% $46,699,000**	**19.5% $11,324,000**
		Administration proposed WRDA 98 cost-sharing	**69.1% $40,072,000**	**30.9% $17,951,000**

Table 7.6.2-2
Cost Allocation (October 1997 price level)

Project Component	Total Cost	% Causal Effect	Cost-Sharing	
			Federal	Non-Federal
TOTAL COSTS				
ULTIMATE PROJECT COST (50 YEAR)	**$73,571,000**	WRDA 86 cost-sharing	79.5% **$58,509,000**	**20.5% $15,062,000**
		Administration proposed WRDA 98 cost-sharing	70.5% **$51,882,000**	**29.5% $21,689,000**
LERRD Credit			**$0**	**$145,000**
ULTIMATE PROJECT COST (50 YEAR) Cash Contribution		WRDA 86 cost-sharing	**$58,509,000**	**$14,917,000**
		Administration Proposed WRDA 98 cost-sharing	**$51,882,000**	**$21,544,000**

Table does not include Operation and Maintenance costs throughout the 50 year project life which are estimated to be $761,000 and are a non-Federal responsibility.

Table 7.6.2-3
Cost Allocation per Project Component
(WRDA 86 cost-sharing)

Section 111 authority - Lower Cape May Meadows		
	Federal costs	Non-Federal costs
Protective Dune/Berm (Initial Construction)	$6,136,000	$682,000
Protective Dune/Berm (Periodic Nourishment)	$32,341,000	$3,593,000
% of Ultimate Project Cost (50 Year)	52.3%	5.8%
Ecosystem Restoration - Lower Cape May Meadows		
Protective Dune/Berm (Initial Construction)	$1,399,000	$754,000
Protective Dune/Berm (Periodic Nourishment)	$7,376,000	$3,972,000
Internal Ecosystem Restoration (including wetland monitoring	$1,957,000	$1,054,000
% of Ultimate Project Cost (50 Year)	14.6%	7.9%
Hurricane and Storm Damage Reduction - Cape May Point		
Protective Dune/Berm (Initial Construction)	$2,318,000	$1,248,000
Protective Dune/Berm (Periodic Nourishment)	$6,982,000	$3,759,000
% of Ultimate Project Cost (50 Year)	12.6%	6.8%

Cost Allocation per Project Component
(Administration Proposed WRDA 98 cost-sharing)

Section 111 authority - Lower Cape May Meadows		
	Federal costs	Non-Federal costs
Protective Dune/Berm (Initial Construction)	$6,136,000	$682,000
Protective Dune/Berm (Periodic Nourishment)	$32,341,000	$3,593,000
% of Ultimate Project Cost (50 Year)	52.3%	5.8%
Ecosystem Restoration - Lower Cape May Meadows		
Protective Dune/Berm (Initial Construction)	$1,399,000	$754,000
Protective Dune/Berm (Periodic Nourishment)	$3,972,000	$7,376,000
Internal Ecosystem Restoration (including wetland monitoring	$1,957,000	$1,054,000
% of Ultimate Project Cost (50 Year)	10.0%	12.5%
Hurricane and Storm Damage Reduction - Cape May Point		
Protective Dune/Berm (Initial Construction)	$2,318,000	$1,248,000
Protective Dune/Berm (Periodic Nourishment)	$3,759,000	$6,982,000
% of Ultimate Project Cost (50 Year)	8.3%	11.1%

7.6.3 Sponsor Financing. In accordance with Section 105 (a)(1) of WRDA 1986, the Lower Cape May Meadows - Cape May Point feasibility study was cost shared 50%-50% between the Federal Government and the State of New Jersey. The contributed funds of the non-Federal sponsor, the New Jersey Department of Environmental Protection (NJDEP) demonstrates their intent to support a project for the study area. The state has a stable source of funding for shore protection projects and has further indicated its intent to enter into a PCA at the conclusion of this study by a letter dated 5 November 1997 (see appendix A).

7.6.4 Project Cooperation Agreement. A fully coordinated Project Cooperation Agreement (PCA) package (to include the non-Federal sponsor's financing plan) will be prepared subsequent to the approval of the feasibility phase and will reflect the recommendations of this feasibility study. The non-Federal sponsor, NJDEP, has indicated support of the recommendations presented in this feasibility report and the desire to execute a PCA for the recommended plan.

In the PCA the non-Federal sponsor will:

- Provide percentage of the project costs as follows (see Table 7.6.2-3):

  - Section 111 component - 5.8%
  - Ecosystem Restoration component - 7.9%
  - Hurricane and Storm Damage Reduction component - 6.8%

  or

  Administration Proposed WRDA 98 cost-sharing

  - Section 111 component - 5.8%
  - Ecosystem Restoration component - 12.5%
  - Hurricane and Storm Damage Reduction component - 11.1%

- Provide all lands, easements, and rights-of-way, including suitable borrow and dredged or excavated material disposal areas, and perform or ensure the performance of all relocations determined by the Federal Government to be necessary for the initial construction, periodic nourishment, operation, and maintenance of the Project.

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

- Provide, during construction, any additional amounts as are necessary to make its contribution equal to project cost percentage detailed in Table 7.6.2-3.

  WRDA 86 cost-sharing

  - Section 111 component - 5.8%
  - Ecosystem Restoration component - 7.9%
  - Hurricane and Storm Damage Reduction component - 6.8%

  or

  Administration Proposed WRDA 98 cost-sharing

  - Section 111 component - 5.8%
  - Ecosystem Restoration component - 12.5%
  - Hurricane and Storm Damage Reduction component - 11.1%

- For so long as the Project remains authorized, operate, maintain, repair replace, and rehabilitate the completed Project, or functional portion of the Project, at no cost to the Federal Government, in a manner compatible with the Project's authorized purposes and in accordance with applicable Federal and State laws and regulations and any specific directions prescribed by the Federal Government.

- Give the Federal Government a right to enter, at reasonable manner, upon property that the Non-Federal Sponsor, now or hereafter, owns or controls for access to the Project for the purpose of inspection, and, if necessary after failure to perform by the Non-Federal Sponsor, for the purpose of completing, operating, maintaining, repairing, replacing, or rehabilitating the Project. No completion, operation, maintenance, repair, replacement, or rehabilitation by the Federal Government shall operate to relieve the Non-Federal Sponsor of responsibility to meet the Non-Federal Sponsor's obligations, or to preclude the Federal Government from pursuing any other remedy at law or equity to ensure faithful performance.

- Hold and save United States free from all damages arising from the initial construction, periodic nourishment, operation, maintenance, repair, replacement, and rehabilitation of the Project and any Project-related betterments, except for damages due to the fault or negligence of the United States or its contractors.

- Keep, and maintain books, records, and other evidence pertaining to costs and expenses incurred pursuant to the Project in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants

and Cooperative Agreements to State and Local Governments at 32 Code of Federal Regulations (CFR) Section 33.20.

- Perform, or cause to be performed, any investigations for hazardous substances as are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Public Law (PL) 96-510, as amended, 42 U.S.C. 9601-9675, that may exist in, on, or, under lands, easements, or rights-of-way that the Federal Government determines to be required for the initial construction, periodic nourishment, operation, and maintenance of the Project. However, for lands that the Federal Government determines to be subject to the navigation servitude, only the Federal Government shall perform such investigations unless the Federal Government provides the Non-Federal Sponsor with prior specific written direction, in which case the Non-Federal Sponsor shall perform such investigations in accordance with such written direction.

- Assume complete financial responsibility, as between the Federal Government and the Non-Federal Sponsor for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be necessary for the initial construction, periodic nourishment, operation, or maintenance of the Project.

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

- Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended by Title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1957 (Public Law 100-17), and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way, required for the initial construction, periodic nourishment, operation, and maintenance of the Project, including those necessary for relocations, borrow material, and dredged or excavated material disposal, and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act.

- Comply with all applicable Federal and State laws and regulations, including, but not limited to, Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d), and Department of Defense Directive 5500.11 issued pursuant thereto, as well as Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army".

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

- Not less than once each year inform affected interests of the extent of protection afforded by the Project.

- Publicize flood plain information in the area concerned and provide this information to zoning and other regulatory agencies for their use in preventing unwise future development in the flood plain and in adopting such regulations as may be necessary to prevent unwise future development and to ensure compatibility with the protection provided by the Project.

- For so long as the project remains authorized, the Non-Federal Sponsor shall ensure continued conditions of public ownership and use of the shore upon which the amount of Federal participation is based.

- Provide and maintain necessary access roads, parking areas, and other public use facilities, open and available to all on equal terms.

- In an effort to keep the non-Federal sponsor informed of study progress, close coordination through telephone conversations, formal and informal meetings continued throughout the feasibility phase. In addition, newsletters were distributed through general mailings describing the ongoing feasibility study efforts.

- Coordination efforts shall continue through the authorization phase, including coordination of this report with other State and Federal agencies. It is currently anticipated that a public meeting will be held upon approval of this feasibility report.

- Control water pollution to safeguard the health of bathers.

- Prescribe and enforce regulations to prevent obstruction of or encroachment on the project that would reduce the level of protection it affords or that would hinder operation or maintenance of the project.

- At least annually perform surveillance of the beach to determine losses of nourishment material from the project design section and provide the results of such surveillance to the Government.

8. CONCLUSIONS AND RECOMMENDATIONS

8.1 Conclusions

Lower Cape May Meadows is an internationally significant coastal wetland situated along the Atlantic flyway. This area is included in the Ramsar List of Wetlands of International Importance, is part of the Western Hemisphere Shorebird Reserve Network, the Delaware Estuary Program, the Coastal Ecosystems Program, and has been identified as an Important Waterfowl Habitat Area under the Atlantic Coast Joint Venture of the North American Waterfowl Management Plan. In addition, this study is included in and endorsed by the Coastal America Program. The Meadows provides a vital resting spot for shorebirds, birds of prey, and songbirds during their seasonal migration as well as providing habitat for native species. It is considered by Federal, State and private organizations to be one of the foremost avian viewing areas in North America attracting more than 100,000 birders each year.

The selected ecosystem restoration plan consists of the following:

- The selected plan includes protective dune/berm restoration. The dune crest has a top elevation of +18.0 ft NGVD (+16.7 ft NAVD88), a top width of 25 feet, and slopes of 1V:3H and 1V:5H on the landward and seaward side slopes, respectively. The total width of this dune from toe to toe is 105 feet.

- The dune will be planted with 18 acres of vegetation and stabilized with 15,000 linear feet of sand fence. Vegetation will consist of approximately 11 acres of beachgrass (70%) and coastal panicgrass (30%) and will be planted on the newly constructed dune. In addition, approximately 7 acres along the landward toe of the dune will be planted with a combination of bayberry, wax myrtle, beach plum, and shore juniper.

- "Walkovers" for piping plovers will be located along the dune to allow access to back water feeding habitat. The walkovers will be approximately 100 feet wide and be positioned along the length of the project approximately every 600 feet. The "walkovers" will be sparsely vegetated and most likely enclosed by sand fencing to discourage public usage.

- The berm will extend from the seaward toe of the dune for a distance of 20 feet (at elevation +8.0 ft NGVD) before sloping down at 1V:25H to elevation -1.65 ft NGVD (MLW). The remainder of the fill assumes the offshore fill required is parallel to the existing preplacement slope out to the closure depth for each survey profile (CETN-II-5, 10/81). The total width of the berm from the seaward toe of dune to MHW is equal to 157 feet.

- The dune/berm will extend from the 3rd Avenue terminal groin in Cape May City to the Central Avenue groin in Cape May Point at which point the fill translates to tie into the existing beach and dune. The total length of fill is 10,050 linear feet (1.9 miles).

- Initial sand quantity is 2,372,000 cy, which includes initial design fill (1,722,000 cy) plus advanced nourishment (650,000 cy). Periodic nourishment of 650,000 cy will be placed every 4 years. Material would be taken from borrow areas P1 and P2 (Figure 2.6.1). *Note: In July 1998, NJDEP-Land Use Regulation requested that borrow area P2 not be used and that P1 be reconfigured in an effort to minimize impacts to surf clams and prime fishing areas. During the Preconstruction Engineering and Design phase, the Corps will be investigating the possibility of using other borrow areas, as well as the possibility of using sand from Cape May Inlet for nourishment activities to further reduce the potential impact to marine species. Any permanent changes to the borrow areas will be coordinated with the appropriate agencies.*

- Seaward restoration of 35 acres of previously eroded emergent wetland. This will move the MHW line seaward a maximum distance of 280 feet.

- Elimination of 95 acres of Phragmites australis through herbicidial spraying and burning.

- Planting of 105 acres of emergent wetland vegetation.

- Excavation to restore flow within existing drainage ditches and link hydrologic segments. Ditches to be excavated will be configured with a bottom width of 20 ft and 1V:5H side slopes. Depth of excavation ranges from a maximum of 4 feet (in the State Park) to a minimum of 0.5 ft. (in The Nature Conservancy property), and vary with existing ground elevations. Total excavation equals 8,000 linear feet.

- Installation of 2 weir flow control structures.

- Creation of a total of 6 fish reservoirs within existing ponds. Depth of the ponds is equal to 3 feet below existing bottom of the ponds. Each pond will be approximately 70 sq feet with side slopes of 1V:5H.

- Construction of a shallow earthen water retaining structure to allow for approximately 25 acres of tidal marsh. The water retaining structure (berm) will extend from the landward side of the proposed dune to high ground to the north for a distance of approximately 1,000 feet. The berm will have a top elevation of +4.0 ft NGVD. Side slopes are set at 1V:6H and will be planted with woody vegetation to discourage growth of Phragmites australis. The crest width of the berm will be 15 ft and the total width of this berm will be 45 feet from toe to toe.

To properly assess and assure the desired function of the project, a monitoring program is included in the plan. This includes wetland monitoring, which includes growth factor and survival studies, beach profile surveys, hydrographic surveys of borrow area, sediment sampling of the beach and borrow areas, and aerial photography.

As a requirement in completing the feasibility study, a public notice shall be issued to inform all interested parties of the plan selected herein. Because the design of the recommended plan is not technically complex and is essentially complete, a Design Memorandum would not be required (pending North Atlantic Divison approval) before the initiation of construction. In addition, final environmental coordination and documentation can be accomplished concurrent with preparation of plans and specifications for construction. The Project Management Plan (PMP) provides for the completion of the Preconstruction Engineering and Design (PED) phase and construction activities.

8.2 Recommendations

Overall Assessment

In making the following recommendations, I have given consideration to all significant aspects in the overall public interest, including environmental quality, social effects, economic effects, engineering feasibility, and compatibility of the project with the policies, desires and capabilities of the State of New Jersey and other non-Federal interests. A project has been identified that is technically sound, economically cost-effective over the life of the project, is socially and environmentally acceptable, and has broad local and national support.

Current Cost-Sharing

The selected plan was in-part formulated in response to the adverse impacts of the Federal navigation project at Cape May Inlet. Accordingly, the protective dune/berm component of the project at Lower Cape May Meadows will be cost-shared consistent with Section 111 of the River and Harbor Act of 1968, as amended by Section 940 of the Water Resources Development Act of 1986. The costs of implementing measures under Section 111 authority are cost-shared on the same percentage as the cost of the project causing the damage. Ecosystem restoration project features shall be cost-shared 65% Federal, 35% non-Federal in accordance with the Water Resources Development Act of 1996 (Public Law 104-303, Section 210). In accordance with Section 103(c) of the Water Resources Development Act of 1986 (Public Law 99-662), separable project features that provide Hurricane & Storm Damage Reduction (H&SDR) benefits (the protective dune/berm along Cape May Point) will be cost-shared 65 percent Federal and 35 percent non-Federal. Periodic nourishment is also cost-shared consistent with the regulations identified above.

Proposed Cost-Sharing Changes

The Administration has proposed a new cost sharing policy for the periodic nourishment of shore protection projects. Cost sharing of the initial cost of construction is unchanged and will continue to be specified by Section 111 of the River and Harbor Act of 1968, as amended and Section 103 of WRDA 1986. Under the proposed cost sharing policy, periodic nourishment associated with plans to respond to natural erosion and storm damage reduction will generally be cost-shared 35 percent Federal and 65 percent non-Federal. For the Lower Cape May Meadows project, cost sharing of the periodic nourishment associated with the plan to respond to natural erosion (24 percent natural processes) and periodic nourishment associated with the Cape May Point storm damage reduction project would be affected by the proposed cost sharing. The non-Federal sponsor supports the implementation of the project and supports cost sharing of project features consistent with existing law and implementation of periodic nourishment elements consistent with cost sharing enacted by Congress in law.

Initial Project Cost

Based on October 1997 price levels, the total initial project cost of construction is estimated to be $15,548,000. The Federal share of this first cost is $11,810,000 and the non-Federal share is $3,738,000. Lands Easements, Rights-of-Ways, Relocations and Dredged Material Disposal Areas (LERRD) costs are $145,000 and will be credited against the non-Federal sponsor's cash contribution.

Continuing Construction Cost

Periodic nourishment is expected to occur at 4 year intervals subsequent to the completion of initial construction (year 0) of the dune/berm component of the project. Based on a volume of 650,000 cy for each nourishment cycle, the cost per cycle is $4,740,000 (Oct 1997 price level) for construction years 4, 12, 20, 36, and 44; $4,793,000 (Oct 1997 price level) for construction years 8, 16, 24, 32, 40, and 48; $4,826,000 for construction year 28. (The reason for this variation is due to varying engineering and design (E&D) costs, specifically geotechnical investigations). Over the 50-year project life, the total periodic nourishment cost is estimated to be $58,023,000 (Oct 1997 price level) and includes E&D monitoring during construction. As stated previously, cost sharing for periodic nourishment (relating to natural erosion or shore protection) will either be in accordance with Section 103(c) of the Water Resources Development Act of 1986 or based on Administration proposed WRDA 98 cost-sharing (see Table 7.6.3-3 of this report).

Ultimate Project Cost

The ultimate cost of construction which includes initial construction, project monitoring, and fifty years of periodic nourishment is estimated to be $73,571,000 (October 1997 price levels), cost-shared 79.5% Federal, 20.5% non-Federal, based on WRDA 1986 cost-sharing (see Tables 7.6.2-2 and 7.6.2-3 for cost-sharing allocation). All costs also include planning, engineering, and design. Operation, Maintenance, Repair, Replacement, and Rehabilitation (OMRR&R) is a non-Federal responsibility. The ultimate cost-sharing percentage may be altered due to Administration proposed WRDA 98 cost-sharing of the periodic nourishment project component.

Benefits

The selected plan has primary outputs based on ecosystem restoration and secondary outputs for hurricane and storm damage reduction. The selected plan is recommended for implementation subject to the Administration proposed WRDA 98 cost-sharing for the shore protection component of the recommended plan as enacted by Congress in law, with such modifications as in the discretion of the Chief of Engineers may be advisable.

Modifications

These recommendations reflect the information available at the time and current Departmental policies governing formulation of individual projects. These recommendations may be modified before they are transmitted to the Congress as proposals for authorization and implementation funding. However, prior to transmittal to the Congress, the Sponsor, the States, interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

Debra M. Lewis

Debra M. Lewis
Lieutenant Colonel, Corps of Engineers
District Engineer

CENAD-DE (CENAP/Aug 98) (1105-2-10c) 1st End Mr. Pippens/8725
SUBJECT: New Jersey Shore Protection Study, Lower Cape May Meadows - Cape May Point Final Feasibility Study and Integrated Environmental Impact Statement

Commander, North Atlantic Division, Corps of Engineers, ATTN: CENAD-ET-P, FT. Hamilton Military Community, 301 General Lee Avenue, Brooklyn, New York 11252

FOR COMMANDER, HQUSACE ATTN: Policy Review Branch, Policy Review and Analysis Division, Kingman Building, Fort Belvoir, Virginia 22060-5576

I generally concur in the Conclusions and Recommendations of the District Commander. The plan developed is technically sound, economically justified, and socially and environmentally acceptable, and Federal participation in the design and construction of this ecosystem restoration and protection project is recommended.

JERRY L. SINN
Major General, USA
Commanding

9. LIST OF PREPARERS

INDIVIDUAL CONTRIBUTORS AND THEIR RESPONSIBILITIES

The following individuals were primarily responsible for the preparation of this Feasibility Report and Environmental Impact Statement.

Individual	Responsibility
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Anthony Bley	Photography
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Jeff Gebert B.S. Geology & Geophysics 17 years coastal engineering experience 4 years coastal planning experience	Shore Processes/Section 111 Analysis
Gizella M. Geissele, P.E. B.S. Civil Engineering 7 years project design experience	Project Design Shore Protection Structural Inventory
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Sterling Johnson B.S. Materials Science and Engineering 9 years cost engineering experience	Project Cost Estimation
Robert Moore B.S. Civil Engineering 16 years hydraulic/hydrologic engineering experience	Hydraulics/Coastal Engineering/Interior Hydrology
Adam Oestreich B.S. Business 3 years civil projects experience	Real Estate Analysis
Karen Reavy	Graphics
Mike Swanda B.A. Archaeology M.A. Archaeology 23 years cultural resource experience	Scoping, EIS Preparation (Cultural Resources) Cultural Resources Analysis
Carmen G. Zappile B.S. Civil Engineering 7 years project management experience	Study Manager

10. PUBLIC INVOLVEMENT

Coordination for this project was done with Federal, State and local resource agencies. Agencies notified of this study included the U.S. Fish and Wildlife Service (USFWS), U.S. Environmental Protection Agency (USEPA), National Marine Fisheries Service (NMFS), New Jersey Department of Environmental Protection (NJDEP), and New Jersey State Historic Preservation Office.

A Planning Aid Letter and draft Section 2(b) Fish and Wildlife Coordination Act Report were prepared the USFWS and are provided in Appendix C of this report. A final Section 2(b) report will be prepared by the USFWS following the review of this draft document. The final Section 2(b) report can be found in the Appendix A, Section 2 of this report (Agency/Public Review Comments and Responses).

The draft Section 2(b) report states that "The Service strongly supports the Corps' proposed ecosystem restoration at The Meadows and views the proposed project as beneficial to fish and wildlife by restoring and enhancing beach and dune areas that support valuable fish and wildlife habitats. Additionally, the proposed project would restore critical freshwater wetland areas within The Meadows, providing valuable habitat for a variety of fish and wildlife resources including the 12 HEP evaluation species and the species guilds that they represent. The proposed project has the potential to provide additional habitat for federally listed and State-listed threatened and endangered species (e.g., piping plover)." The FWS also felt that potential project-related adverse impacts to fish and wildlife could be minimized and project-related beneficial impacts could be maximized by incorporating the following recommendations into the final project design.

1. Prepare a Biological Assessment to address potential project-related adverse impacts to the piping plover.

2. Reinitiate consultation with the Service to ensure the continued protection of the piping plover.

3. Incorporate the following project modifications to minimize impacts on piping plovers:

    a. Avoid all work in the project area between April 1 and August 15 in order to avoid potential adverse impacts on nesting piping plovers. This seasonal restriction would be applicable to maintenance work that may be necessary in subsequent years. Associated work includes, but is not limited to: the placement, movement, or maintenance or pipelines; stockpiling of construction material and equipment; and, the pumping, placement, or distribution of sand.

b. Establish protective zones in accordance with the Service's "Guidelines for Managing Recreational Activities in Piping Plover Breeding Habitat on the U.S. Atlantic Coast to Avoid Take Under Section 9 of the Endangered Species Act" (Guidelines), dated April 15, 1994 (Appendix B). Protective zones for piping plover nests shall take precedence over all recreational activities (e.g., vehicle access, sunbathing, kite-flying, swimming, walking). In addition, other measures identified in the Guidelines shall be instituted, such as prohibiting dogs in the vicinity of protective zones or ensuring that all dogs are leashed. Establishment of the protective zones must be coordinated with ENSP.

c. Maintain multiple access passages between the proposed beach and the existing freshwater wetlands and feeding areas (e.g., poorly vegetated areas) landward of the proposed dune to preserve freshwater wetland feeding areas for piping plovers.

4. Identify the location of all State-listed and rare plants within The Meadows and take appropriate measures to protect these areas from common reed (Phragmites australis) control activities to ensure that adverse impacts on these species are avoided. Additionally, contact the New Jersey Natural Heritage Program and ENSP regarding the protection of State-listed plant species.

5. Analyze each HEP evaluation species independently in the cost benefit analysis for the Meadows' project.

6. Use the material from the Delaware River Main Channel Deepening Project for direct beneficial uses (e.g., The Meadows) consistent with Section 207 of the WRDA of 1996.

7. Conduct a clam survey using appropriate methodology to estimate the adult population of surf clams in the proposed borrow areas.

8. Conduct each renourishment dredging phase in a limited portion of the borrow area and alternate locations for each subsequent renourishment cycle (i.e., rotational dredging).

9. Avoid the creation of excessively deep, poorly flushed borrow sites; dredge during a period of low biological activity (November to January); and, use a hydraulic dredge with a pipeline delivery system to minimize impacts on benthic invertebrates.

10. Coordinate with the New Jersey Division of Fish, Game and Wildlife, Bureau of Marine Fisheries and the Cape May Charter Boat Association to minimize adverse impacts on recreational fisheries from dredging activities.

11. Dune plantings should be minimized and sand fencing should be in a broken

configuration using a zig-zag pattern parallel to the shore or a Y-type design perpendicular to the shore to avoid or reduce restrictions on wildlife movement between the dunes and the shore.

12. Coordinate with the Service, NJDPF, ENSP, and The Nature Conservancy to develop a water level management plan to identify appropriate water level objectives to maximize benefits for fish and wildlife resources within The Meadows.

13. Coordinate with the Service, NJDPF, ENSP, and The Nature Conservancy to develop a monitoring program to gather information on long-term beneficial (and adverse) impacts of the proposed project on fish and wildlife resources, including beach nesting birds. The monitoring program should also incorporate remedial actions that would take place if proposed goals and objectives are not attained.

14. Revegetate the freshwater wetlands within The Meadows following common reed control using the suggested plantings listed in Appendix D.

The Corps has the following responses to the recommendations made by the USFWS in their draft Section 2(b) Report.

Recommendation 1. The Corps is currently preparing a Biological Assessment for piping plovers for all Philadelphia District projects in New Jersey which have the potential to impact piping plovers. This assessment will address potential project related adverse impacts to the piping plover. Once the Assessment is complete, the USFWS will prepare a Biological Opinion. This coordination will help the Corps to minimize potential impacts to the piping plovers within the study area, as well as other study areas for the various Philadelphia District projects in New Jersey.

Recommendation 2. The Corps agrees to reinitiate consultation with the USFWS prior to any construction or renourishment activities for The Meadows.

Recommendation 3. The Corps agrees to do everything possible to minimize impacts to the piping plover during construction and renourishment activities. It is anticipated that project specific mitigation measures will be developed during the preparation of the Biological Assessment and Biological Opinion. The recommendations developed in these documents will help to develop a plan of action to minimize potential impacts to the piping plovers. Any changes in site conditions over the life of the project will be fully coordinated with the USFWS. In addition, the plover "walkovers will help to ensure that plovers can easily access the backwater feeding habitats thereby improving the value of the nesting habitat.

Recommendation 4. As stated in this Feasibility and Integrated EIS, an updated survey of all State-listed and rare plants will be conducted prior to any construction activities. All

necessary precautions will be taken to protect these plants during the Phragmites australis removal as well as other construction activities. All activities involving potential impacts to State-listed and rare plants will be fully coordinated with the appropriate groups/agencies.

Recommendation 5. Each HEP species was evaluated separately using the incremental cost analysis procedures. These evaluations were forwarded to the USFWS for review.

Recommendation 6. At this time, it is not possible to link The Meadows with the Delaware River Main Channel Deepening Project. Depending upon construction schedules and authorization however, it may be possible to use some material from the deepening project to benefit The Meadows.

Recommendation 7. Through the distribution of the draft document, the Corps coordinated with the NJDEP, Bureau of Shellfisheries to determine if further sampling for surf clams is necessary. As a result of this coordination, it was decided that additional sampling would be conducted during the Preconstruction Engineering and Design Phase and that alternate borrow areas would be investigated.

Recommendation 8. The Corps will make every effort to utilize rotational dredging techniques during nourishment activities. The actual location of dredging within the borrow areas will be dependent upon the amount and location of sand within the borrow areas immediately prior to dredging activities.

Recommendation 9. The Corps will avoid creating excessively deep, poorly flushed borrow sites during the initial construction as well as subsequent nourishment cycles. It may not be possible however, to conduct all dredging operations during the months of November to January due to the possibility of severe winter storms. All efforts will be made to minimize impacts to the benthic community.

Recommendation 10. Coordination with these agencies/groups was conducted through the distribution of the Draft Feasibility Report and Integrated EIS for review and comment. All comments received by theses agencies/groups can be found in the comment/response section (Appendix A, Section 2).

Recommendation 11. Dune plantings and sand fencing will be installed so that wildlife movement between the dunes and the shore will not be impeded.

Recommendation 12. Coordination will be done to develop a water level management plan within The Meadows.

Recommendation 13. A monitoring plan will be developed to gather information on the beneficial (and adverse) impacts of the proposed project on fish and wildlife resources.

Currently, the NJDEP is responsible for monitoring beach nesting birds, especially the piping plover. The Corps believes that this responsibility will remain within the State.

Recommendation 14. The revegetation plan for the wetlands was developed based on the suggested planting list provided by the USFWS.

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11. CLEAN AIR ACT STATEMENT OF CONFORMITY

CLEAN AIR ACT
STATEMENT OF CONFORMITY
LOWER CAPE MAY MEADOWS AND CAPE MAY POINT
CAPE MAY COUNTY, NEW JERSEY

Based on the conformity analysis in the subject report, I have determined that the proposed action conforms to the applicable State Implementation Plan (SIP). The U.S. Environmental Protection Agency had no adverse comments under their Clean Air Act Authority. No comments from the air quality management district were received during coordination of the draft Feasibility Report and Environmental Impact Statement. The proposed project would comply with Section 176 (c)(1) of the Clean Air Act Amendments of 1990.

7 August 98
Date

Debra M. Lewis

Debra M. Lewis
Lieutenant Colonel, Corps of Engineers
District Engineer

12. EVALUATION OF 404(B)(1) GUIDELINES

I. PROJECT DESCRIPTION

A. Location

The proposed project site is located at the southern tip of New Jersey on the Atlantic Ocean side of the Cape May Peninsula (See Figure 1-1) and includes the area known as the Lower Cape May Meadows, the Borough of Cape May Point, and the Borough of West Cape May. The Cape May Point portion of the study is defined as the area from the groin located at Lighthouse Avenue west to the Alexander Avenue groin. The Meadows section of the study area includes the Cape May Point State Park and The Nature Conservancy's Migratory Bird Refuge.

B. General Description

The dune/berm would extend from the 3rd Avenue terminal groin in Cape May City to the Central Avenue Groin in Cape May Point, 10,050 linear feet. The beachfill would consist of a 20-foot wide berm with an elevation of +8.0 feet NGVD (+6.7 NAVD88) and a dune with an elevation of +18 feet NGVD (+16.7 NAVD88). The berm has a foreshore slope from the design line at elevation +8.0 NGVD to Mean Low Water (MLW). The beach width, measured from the seaward toe of the dune to Mean High Water (MHW) extends 157 feet. The dune crest width is 25 feet with side slopes of 1V:5H. Initial sand quantity is 2,372,000 cy, which includes initial design fill (1,722,000 cy) plus advanced nourishment (650,000 cy). The selected plan includes the planting of 18 acres of beach grass and 15,000 linear feet of sand fence. Periodic nourishment of 650,000 cy is scheduled to occur every 4 years. Material would be taken from borrow areas P1 and P2 (Figure 2.6.1). *Note: In July 1998, NJDEP-Land Use Regulation requested that borrow area P2 not be used and that P1 be reconfigured in an effort to minimize impacts to surf clams and prime fishing areas. During the Preconstruction Engineering and Design phase, the Corps will be investigating the possibility of using other borrow areas, as well as the possibility of using sand from Cape May Inlet for nourishment activities to further reduce the potential impact to marine species. Any permanent changes to the borrow areas will be coordinated with the appropriate agencies.*

The interior improvements to The Meadows include excavating 18,180 cubic yards of material from ponds and drainage ditches to improve water quality, flow and to provide permanent water for fish reservoirs. All material excavated will be used on site as organic material for newly created wetlands. Ninety-five acres of Phragmites australis will be sprayed (twice) with the herbicide Rodeo and burned. This area will then be re-planted with emergent vegetation. An interior berm will be constructed that is 1045 feet in length and will house one of the 2 water control structures to be installed. The selected beachfill plan moves the shoreline seaward a

maximum of 280 feet, gaining (restoring) 35 acres of wetlands.

C. Authority and Purpose

The authority for the proposed project is the resolution of the Committee on Public Works and Transportation of the United States House of Representatives, and the Committee on Environment and Public Works of the United States Senate, dated December 1987.

The Senate resolution adopted by the Committee on Environment and Pubic Works on December 17, 1987 states:

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

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

> *"That the Board of Engineers for Rivers and Harbors is hereby requested to review existing reports for the Chief of Engineers for the entire coast of New Jersey with a view to study, in cooperation with the State of New Jersey, its political subdivisions and agencies and instrumentalities thereof, the changing coastal processes along the coast of New Jersey. Included in this study will be the development of a physical, environmental, and engineering database on coastal area changes and processes, including appropriate monitoring, as the basis for actions and programs to prevent the harmful effects of shoreline erosion and storm damage; and, in cooperation with the Environmental Protection Agency and other Federal agencies as appropriate, the development of recommendations for actions and solutions needed to preclude further water quality degradation*

and coastal pollution from existing and anticipated uses of coastal waters affecting the New Jersey Coast. Site specific studies for beach erosion control, hurricane protection, and related purposes should be undertaken in areas identified as having potential for a Federal project, action, or response which is engineeringly, economically, and environmentally feasible".

The purpose of the project is to protect and restore beach and freshwater wetland habitat, improve internal water quality, eliminate/control nuisance plant species (Phragmites australis), increase availability of freshwater, reduce ocean water inundation via The Meadows to the towns of Cape May Point and West Cape May, and to reduce storm damage vulnerability along Cape May Point oceanfront in Cape May County, New Jersey.

During the Preconstruction Engineering, and Design Phase, the Corps will be investigating the possibility of not using borrow area P2 and reconfiguring P1 to minimize impacts to surf clams and prime fishing araes. In addition, the possibility of obtaining sand form Cape May Inlet for periodic norishment activities will be investigated

D. General Description of Dredged or Fill Material

Borrow areas P1 and P2 were selected as the sources of sand for this project. It was necessary to use both areas in order to have enough material for the 50 year project life. It is currently estimated that approximately 1,722,000 cy of material will be removed over an area of approximately 138 acres from borrow area P1. The remaining 650,000 cy for initial construction will be obtained from borrow area P2, over an area of approximately 99 acres. Depths of excavation are expected to range between 6.5 and 10 feet. Borrow area is located offshore of Cape May City and is adjacent to the borrow area currently used for the ongoing Federal project in that area. Borrow area P2 is located just offshore of Lower Cape May Meadows near the abandoned military bunker and south of Eph Shoal (Figure 2.3-3).

The proposed borrow material is medium to fine sand with little or no gravel present. Clay, silt and organic content are low with neutral pH and low fertility. This material has been trapped by a combination of tidal and littoral forces, and has been exposed to a high energy circulation regime. Grain size analyses have demonstrated that the borrow material is comparable to the native beach sand. As such, the borrow material is considered ideal for beach restoration and nourishment.

The total quantity of sand required for initial construction is estimated to be 2,372,000 cubic yards. Approximately 650,000 cubic yards of sand would be required every 4 years for periodic nourishment of the beachfill. The project life is 50 years.

E. Description of the Proposed Discharge Site

Erosion has resulted in the direct loss of beach and wetland habitat; and has left the existing, unique freshwater ecosystem in The Meadows substantially degraded. Breaching of the dunes at The Meadows also causes flooding to Cape May Point, West Cape May and Lower Township. This beach erosion is due to both long-term and storm-related shore process along with the influence of man-made structures along the shore line, namely the jetties at Cape May Inlet.

Since 1955, erosion has removed more than 1100 feet of shoreline containing approximately 124 acres. Erosion of the dune system has left the existing freshwater ecosystem in The Meadows substantially degraded through saltwater intrusion. Since 1991, the dunes protecting the wetlands have been breached six times, resulting in saltwater intrusion. Very few plants or animal species can adapt to these large fluctuations of salinity ranges. These conditions have lead to the proliferation of the common reed, Phragmites australis, which is known as a nuisance plant. Dense stands of common reed significantly reduce the ability of the wetlands to support wildlife and compete with endangered plant species.

In addition to its environmental significance, The Meadows serves as a buffer during storms between the ocean and the developed portions of the surrounding towns of Cape May Point and West Cape May. Erosion has created a narrow shoreline with little or no natural dune at The Meadows. To counteract this erosion, a dune was constructed along the entire length of The Meadows from Cape May City to Cape May Point in 1962. This dune has required frequent repair due to breaches and washovers caused by coastal storms.

F. Description of Placement Method

A hydraulic dredge or hopper dredge would be used to excavate the borrow material from the borrow areas. The material would be transported using a pipeline delivery system to the beachfill placement site. Subsequently, final grading would be accomplished using standard construction equipment.

As part of the interior restoration plan, discharges would result from earth disturbances associated with excavation and grading for ditches, ponds, and moving the shoreline to restore 35 acres of emergent wetlands. Approximately 18,180 cubic yards of material to be excavated will be used as a source of organic substrate for the restored wetlands.

II. FACTUAL DETERMINATION

A. Physical Substrate Determinations

1. The final proposed elevation of the beach substrate after fill placement would be +8.0 feet NGVD at the top of the berm. The proposed profile would have a foreshore slope of 25H:1V and an underwater slope that parallels the existing bottom to the depth of closure.

2. The sediment type involved would be sand for the beach restoration. The interior restoration sediment consist of dredged materials composed of silts, clays and sand. The restored area would consist of original marsh mud.

3. The planned construction would establish a construction template that is higher than the final intended design template or profile. It is expected that compaction and erosion would be the primary processes resulting in the change to the design template. Also, the loss of fine grain material into the water column would occur during the initial settlement.

4. The proposed construction would result in removal of the benthic community from the borrow area, and burial of the existing beach and nearshore communities when this material is put in place during berm construction.

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

6. Actions taken to minimize impacts include selection of fill material that is similar in nature to the pre-existing substrate. Also, standard construction practices to minimize turbidity and erosion would be employed.

B. Water Circulation, Fluctuation, and Salinity Determinations

1. Water. Consider effects on:

a. Salinity - No effect.
b. Water chemistry - No significant effect.
c. Clarity - Minor short-term increase in turbidity during construction.
d. Color - No effect.
e. Odor - No effect.
f. Taste - No effect.
g. Dissolved gas levels - No significant effect.
h. Nutrients - Minor effect.
i. Eutrophication - No effect.
j. Others as appropriate - None.

2. Current patterns and circulation

a. Current patterns and flow - Circulation would only be impacted by the proposed work in the immediate vicinity of the borrow area, and in the nearshore zone where the existing circulation pattern would be offset seaward the width of the beach nourishment.

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

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

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

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

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

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

C. Suspended Particulate/Turbidity Determinations

Expected Changes in Suspended Particulates and Turbidity Levels in the Vicinity of the Beach Nourishment and Borrow Sites - There would be a short-term elevation of suspended particulate concentrations during construction phases in the immediate vicinity of the dredging and at the discharge. Elevated levels of particulate concentrations at the discharge locations may also result from "washout" after beachfill is placed.

Effects (degree and duration) on Chemical and Physical Properties of the Water Column -

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

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

Toxic metals and organics - Because the borrow material originates from a clean, high energy environment, and because it is essentially all medium to fine sand, no toxic metals or organics

are anticipated.

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

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

3. Effects on Biota

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

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

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

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

D. Contaminant Determinations

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

Aquatic Ecosystem and Organism Determinations

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

Effects on Benthos - Although there is a major disruption of the benthic community in the borrow areas when the fill material is excavated, the 404(b)(1) analysis focuses on the disposal area effects. Here the disruption is significant as the entire community is subject to burial or displacement; however, the actual biomass of organisms impacted is far less due to the harsher environmental conditions present on the beach and in the surf zone. The loss is somewhat offset by the expected rapid opportunistic recolonization from adjacent areas that would occur following cessation of construction activities. Recolonization is expected to occur in the disposal (beachfill placement) area through horizontal and in some cases vertical migrations of benthos.

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

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

had occurred.

Effect on Special Aquatic Sites -

Sanctuaries and refuges - Not applicable.

Wetlands - The selected plan would protect approximately 40 acres of emergent marsh habitat from being lost due to erosion between 1997 and 2050 and will restore 35 acres of wetlands previously lost due to erosion. The project would convert 95 acres of degraded *Phragmites* dominated marsh into 70 acres of emergent freshwater marsh and 25 acres of tidal salt marsh.

Vegetated shallows - No effect. No submerged aquatic vegetation beds currently occur along the beach area. No SAV's would be impacted within the interior restoration area.

Threatened and Endangered Species - The piping plover (Charadrius melodus), a Federal and State threatened species, could potentially be impacted by the construction of the proposed project. This bird nests on ocean beaches, including the project area. Once constructed, the project will provide more nesting habitat for the plovers and other beach nesters. Several species of threatened and endangered sea turtles may be migrating through the sand borrow area depending on the time of year. Sea turtles have been known to become entrained and subsequently destroyed by suction hopper dredges. Use of a hopper dredge during a time of high likely presence in the area could potentially entrain and destroy a sea turtle(s).

Other Wildlife - The proposed plan is expected to have a positive impact on other wildlife.

Actions to minimize impacts - Impacts to benthic resources can be minimized at the borrow areas by dredging in a manner as to avoid the creation of deep pits and alternating locations of periodic dredging. Impacts to Federal and State threatened piping plover can be avoided or minimized by establishing a buffer zone around a piping plover nest(s) and limiting construction outside of the nesting season. Depending on the timing of the dredging and the type of dredge to be used, potential impacts to Federal and State threatened or endangered sea turtles can be minimized by employing NMFS approved sea turtle monitors, hardened dragarm deflectors, and trawling.

F. Proposed Disposal Site Determinations

1. Mixing Zone Determination

a. Depth of water - 0 to 20 feet mean low water
b. Current velocity - Generally under 3 feet per second
c. Degree of turbulence - Moderate
d. Stratification - None
e. Discharge vessel speed and direction - Not applicable
f. Rate of discharge - Typically this is estimated to be 780 cubic yards per hour
g. Dredged material characteristics - medium-fine sand for beach nourishment
h. Number of discharge actions per unit time - Continuous over the construction period

2. Determination of compliance with applicable water quality standards - After review of the Draft Feasibility Report and EIS, the NJDEP should indicate that project construction will be consistent

with the New Jersey Coastal Zone Management Program, in accordance with Section 307 (c) of the Coastal Zone Management Act, and the applicable rules guiding issuance of a Water Quality Certificate, in accordance with Section 401 of the Clean Water Act.

3. Potential Effects on Human Use Characteristics -

   a. Municipal and private water supply - No effect.
   b. Recreational and commercial fisheries - Short-term effect during construction; there would be a temporary loss of benthic food stocks within the borrow area from dredging.
   c. Water related recreation - Short-term effect during construction
   d. Aesthetics - Short-term effect during construction.

   Parks, national and historic monuments, national seashores, wilderness areas, etc. - Short-term effect during construction.

G. <u>Determination of Cumulative Effects on the Aquatic Ecosystem</u>- None anticipated. The selected plan provides long-term protection and restoration to wetlands within The Meadows, improving the overall aquatic ecosystem.

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

III. <u>FINDINGS OF COMPLIANCE OR NON-COMPLIANCE WITH THE RESTRICTIONS ON DISCHARGE</u>

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

B. The alternative measures considered for accomplishing the project objectives are detailed in Section 5 of this document, of which this 404(b)(1) analysis is a part.

C. The New Jersey Department of Environmental Protection should, after review of the Draft Feasibility Report and DEIS, indicate that project construction will be consistent with the applicable rules guiding issuance of a Water Quality Certificate, in accordance with Section 401 of the Clean Water Act.

D. The proposed beach nourishment will not violate the Toxic Effluent Standards of Section 307 of the Clean Water Act.

E. The proposed beach nourishment will comply with the Endangered Species Act of 1973. Informal coordination procedures have been completed.

F. The proposed beach nourishment will not violate the protective measures for any Marine

Sanctuaries designated by the Marine Protection, Research, and Sanctuaries Act of 1972.

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

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

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

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Appendix A

Pertinent Correspondence

Section 1 - General Correspondence

Section 2 - Agency/Public Review Comments and Responses

Appendix A

Pertinent Correspondence

Section 1 - General Correspondence

State of New Jersey

Christine Todd Whitman
Governor

Department of Environmental Protection
Natural & Historic Resources
Division of Engineering & Construction

Robert C. Shinn, Jr.
Commissioner

November 5, 1997

Mr. Robert Callegari, Chief
Planning Division
Philadelphia, District, USACE
Wanamaker Building
100 Penn Square East
Philadelphia, PA 19107-3390

Subject: Lower Cape May Meadows – Cape May Point Feasibility Study

Dear Mr. Callegari:

I am writing this letter in support of the ongoing Lower Cape May Meadows – Cape May Point Feasibility Study. This study indicates that an ecosystem restoration plan appears to be justified and feasible. This plan includes dune and berm restorations well as restoration of freshwater wetlands. The State is prepared to enter in a Project Cooperation Agreement at the conclusion of the feasibility study.

There is considerable agency and public support for this project. Lower Cape May Meadows is an internationally recognized coastal freshwater wetland. It is considered one of the foremost avian viewing areas in North America, attracting hundreds of thousands of visitors each year. The State of New Jersey is very supportive of ecosystem restoration in the study area. We look forward to working with the Corps of Engineers in construction of a project that preserves this important ecosystem.

Sincerely,

Bernard J. Moore
Administrator

Phone
(908)-255-0767

1510 Hooper Avenue, Toms River, NJ 08753

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(908)-255-0774

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State of New Jersey

Christine Todd Whitman
Governor

Department of Environmental Protection

Robert C. Shinn, Jr.
Commissioner

CAPE MAY POINT STATE PARK
P.O. BOX 107
CAPE MAY POINT, NJ 08212-0107
TEL. # 609-884-2159
FAX. # 609-884-0352

October 22, 1997

Lieutenant Colonel Robert B. Keyser
Department of the Army
U.S. Army Engineer District, Phila.
Corps of Engineers
Wanamaker Building-100 Penn Square East
Philadelphia, PA 19107-3390

Dear Lt. Col. Keyser:

This is being written to advise you of my concern for the land known as the Lower Cape May Meadows, which is now under consideration by your agency for shore protection and habitat restoration projects.

The Lower Cape May Meadows is extremely valuable from an environmental perspective as a unique ecosystem, which provides food and shelter to many species of plants and animals; and birds. This area has been subjected to severe erosion for many years. Approximately 180 acres of critical upland and marsh habitat has been lost to the sea since the early 1900's. Many homes and structures were destroyed and many more are being threatened by erosion that shows no signs of abating.

Of particular concern to the area I manage is the effect on threatened or endangered plants and animals that live here or migrate through and depend on the area for rest and food. It is believed that the populations of some species of migratory birds are declining because of the loss of habitat at this location. Some plants that once thrived in Cape May Point State Park have completely vanished and many more are on the verge of disappearing as well. The problem is not land loss alone, but also the saltwater which floods the ecosystem when the protective dune is breached. The saltwater is bad because the ecosystem is basically fresh to slightly brackish and many species are <u>not</u> salt tolerant.

If no action is taken to protect the over 300 acres of remaining lands, the freshwater habitat will soon be totally destroyed by saltwater intrusion. The land will continue to erode, structures in the park and adjacent towns of Cape May Point and West Cape May will be destroyed. Populations of many species of plants and animals will continue to decline with the distinct possibility of

total extinction occurring in some species. Many of these species are migratory, and depend on the area as a critical resting and feeding spot.

I am pleased that the U.S. Army Corp of Engineers has been studying the Lower Cape May Meadows, which includes Cape May Point State Park and Natural Area, and trust that the final feasibility report, due to be submitted in November, will prove beyond a shadow of a doubt that the area should indeed be protected and restored.

You have my wholehearted support of a comprehensive shore protection and habitat restoration effort. If I can be of assistance, please do not hesitate to contact me.

Sincerely,

Dean S. Cramer
Superintendent

The Nature Conservancy®
DELAWARE BAYSHORES OFFICE

9550 Highland Street
P.O. Box 194
Mauricetown, New Jersey 08329
TEL 609 785-1735
FAX 609 785-1766

International Headquarters
Arlington, Virginia
TEL 703 841-5300

October 31, 1997

Mr. Robert Keyser
U.S. Army Corps of Engineers
Wanamaker Bldg.
100 Penn Square E.
Philadelphia, P.A. 19107-3390

Dear Mr. Keyser;

I am writing concerning the beach erosion, flooding, and ecological problems at the Cape May Migratory Bird Refuge located between the towns of Cape May and Cape May Point, Cape May County, New Jersey.

The Nature Conservancy is a private, nonprofit organization dedicated to the preservation of rare plants, animals and natural communities and the lands and waters they need to survive. We acquired the Cape May Migratory Bird Refuge in 1981 to protect habitat for nesting and migratory birds.

During the period that we've owned the preserve, many acres of critical habitat have eroded away due to past jetty construction projects. These jetties, coupled with the severe coastal storms of recent years have drastically reduced the beach nesting habitat available for least terns and piping plovers. Erosion and breaching of the dunes has altered the freshwater nature of part of the preserve by allowing salt water to enter the system. These processes have also promoted the spread of the invasive plant phragmities austrailus that has resulted in the loss of large portions of the preserve's natural biological diversity.

Our neighbors who live in the adjacent communities have also experienced flooding and other problems associated with an inadequate system of both stormwater and coastal water management in the immediate area.

recycled paper

We endorse the concept of addressing these ecological and community problems through a comprehensive approach to the freshwater and salt water management of the site. As such, we encourage the Army Corps to continue the detailed study of specific alternatives to solving the problems in this area. If we can be of any assistance, please do not hesitate to contact our office.

Cordially,

Jay Laubengeyer
Director, Delaware Bayshores Office

BOROUGH OF CAPE MAY POINT

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Linda M. Monge
Municipal Clerk

Malcolm C. Fraser
Mayor

Craig Pilczuk
Commissioner

James Handley
Commissioner

October 30, 1997

Army Corps of Engineers
Philadelphia District
100 Penn Square East
Philadelphia, Pennsylvania 19107-3390

Attention: Lieutenant Colonel Robert B. Keyser

Subject: Lower Cape Meadows - Cape May Point Feasibility Study

The "Lower Cape Meadows - Cape May Point" area is in reality an integral and interdependant unit.

Oceanic storm flooding in the Nature Conservancy at the eastern end of the "unit", carries all the way to the Borough of Cape May Point on the western end of the unit. Likewise, a drought that dries up the Borough and its Lake Lily headwaters, severely impacts the natural flow of water eastward to the State Park, and in turn lowers the water levels in the Nature Conservancy -- to the detriment of the wildlife !

The lack of a sufficient littoral drift has severely eroded the entire Lower Cape Meadows area. This has put a severe strain on the beach & dune infrastructure in the State Park headquarters area, and appears to be damaging the Lighthouse Avenue Jetty its the adjacent offshore beach cell in front of the Convent. If left uncorrected, this jetty will crumble into the 35 foot deep "scour hole" in the Convent beach cell.

As the beachfront has been driven back in front of the State Park headquarters, it is more difficult for the littoral sand to drift around the Lighthouse Jetty to continue westward. The diminished sand quantity of the littoral drift has starved the swimming beaches within the Borough. In the time period since the Reconnaissance Study began, this lack of sand action has taken out most of the St. Peters Beach strand and is now actively attacking the massive dune on Cape Beach.

The entire area, including the Borough itself, is one of the prime Natural Areas of the world -- particularly with the annual bird and butterfly migrations. The migrating birds depend upon the fresh water and indigenous food source to sustain their further journey south. The U.S. Fish & Wildlife Service estimates that between 75,000 and 90,000 bird watchers visit this study area each year. It is of utmost importance that the entire South Meadows "drainage basin" be protected from salt water intrusion during coastal storms. This basin is like one large saucer.

While stressing the interdependancy of this entire area, let us reaffirm that the Borough Officials, the State Park Supt., the Nature Conservancy Director, and Bernie Moore have routinely communicated on beach protection action. The Borough itself has perhaps been one of the most active Jersey Shore communities in its beach protection activities.

Let me express the sincere appreciation of the Cape May Point Borough Commission and the entire Borough citizenry for the thoroughness and dedication of the Army Corps people working on the project. The cooperation and communication has been excellent.

Respectfully,

Malcolm C. Fraser, Mayor

cc - Borough Commission
Bernie Moore, Administrator, NJ-DEP Coastal Engineering
Dean Cramer, Supt., CMPT State Park
Senator Frank Lautenberg
Senator Robert Torricelli
Congressman Frank LoBiondo

Appendix A

Pertinent Correspondence

Section 2 - Agency/Public Review Comments and Responses

NEW JERSEY AUDUBON SOCIETY
1897 1997
Department of Conservation
11 Hardscrabble Road, P.O. Box 693, Bernardsville, NJ 07924 (908) 766-5787 / Fax: (908) 766-7775
E-mail: njas@superlink.net Web Site: http://www.nj.com/life/audubon

May 14, 1998
Robert L. Callegari
Chief, Planning Division
Environmental Resources Branch
Philadelphia District, Corps of Engineers
Wanamaker Bldg. 100 Penn Square East
Philadelphia, PA 19107-3391

Dear Mr. Callegari:

Following are comments from New Jersey Audubon Society on the Lower Cape May Meadows Feasibility Study:

1. * Beach Nourishment and Dune Building--use of non-native plants is not a good idea. Native plants from local stock should be used, and should be ordered well in advance.

2. * Elimination of 95 acres of reed--The reed marshes east of the East Road in the Lower Cape May Meadows should not, in our opinion, be eliminated. The NJ Audubon Breeding Bird Atlas of New Jersey completed in 1997 found the following species breeding in these marshes: Pied-billed Grebe(E), Least Bittern, Com. Moorhen, Gadwall, and Blue-winged Teal, among others. The reed marshes here are also regularly used in migration by Am. Coot, Virginia and Sora rails, various shorebirds, and roosting Black-crowned Night-Herons. While reed may under some conditions form an unproductive monoculture, the reed here has open ponds conducive to use by the above mentioned species and others. Great care should be taken not to alter freshwater wetlands that are productive.

3. * Ditches--our concern is that material dug out of ditches not be thrown or scattered on the marsh, and that the surface not be flattened. It is important to allow water to be imported from the State Park in periods of drought, but functioning wetlands should not be altered in the digging process.

4. * A census of the affected project area should be conducted first, to determine species locations. If there are too many sensitive spots, then abandon the removal of some or all of the reed.

Sincerely,

Richard Kane, Vice President
Conservation and Stewardship

cc: TG, PS, BN, ENSP

1. Concur. Native plants from local stock will be used for wetland and dune planting.

2. While the Phragmites currently on the site is used by several bird species, it is our belief that a healthy wetland composed of a variety of plant species, rather than monotypic stands of Phragmites, will be more beneficial to these and other wildlife species. This belief is shared by other agencies involved in the project, including the Nature Conservancy and Cape May State Park, who own the property within the project area. Great care will be taken throughout all stages of the project to maintain (and increase) the productivity of the wetlands within the project area.

3. At this point, it is anticipated that material excavated from the existing drainage ditches will be used as a source of organic material for the 35 acres of wetlands being restored through the seaward relocation of the dune. Extreme care will be taken to ensure that the wetlands are not negatively altered during the excavation (or other) aspects of the construction.

4. As stated in the draft report, a threatened and endangered plant survey will be conducted prior to any construction activities. If this survey identifies an area(s) where the Phragmites cannot be safely sprayed without impacting these species, alternative methods of removal will be investigated. If removal by any means is not feasible in some areas, Phragmites will be allowed to remain.

Sierra Club

Appalachian Regional Office

P.O. Box 160
Nassau, Delaware 19969
May 11, 1998

Mr. Robert L. Callegari
U.S. Army Corps of Engineers
Philadelphia District
Wanamaker Building
100 Penn Square East
Philadelphia, PA 19107-3390

Re: Comments for Lower Cape May Meadows-Cape May Point Feasibility Study-Volume 1-Draft-Feasibility Report-Integrated Environmental Impact Statement (EIS) - Appendix A: Pertinent Correspondence November, 1997

Dear Mr. Callegari,

The following comments are being submitted on behalf of the Sierra Club's New Jersey Marine Committee and the Atlantic Coast Ecoregion (Sierra Club) regarding the above referenced matter. The Sierra Club has reasonable concerns for the sustainable health of aquatic systems, wetland and living marine resources in the region. Since many of our members utilize this region for activities that include boating, fishing, hunting, birding, etc., it gives us cause to consider significant permitting activities such as this to be worthy of scrutiny. Our interest is to ensure that consideration is made for assessing unintended consequences of actions, which sometimes are not readily apparent, but for the function of public comments such as these.

The Sierra Club is this nations oldest conservation organization and normally applauds ecological restoration projects especially when the projects are designed to aid threatened and endangered species. We make that statement because this project is based on that premise in the opening paragraph of the Summary text (page i). What we seek to avoid here is the trading off of one biomass (aquatic) to benefit others (terrestrial and avian). With that in mind we wish the following items be addressed.

1. This EIS fails to take into account the potential adverse impacts to shellfish and finfish, that occur in this region, that are under federal or multi-state fishery management plans (FMP's). Whereas Section 2.3.4.6 (pg's. 2-29 to 2-34) of the EIS lists these species, and again touches on them in Section 7.5.1.5.3.2. (pg. 7-27), there is really nothing of substance found on their behalf in this document. Because of this we believe that this EIS runs counter to the intent of the 104th Congress when they reauthorized the Magnuson-Stevens Fisheries Conservation Act which calls for identification of essential fish habitat for all federally managed species. We request your office contact the appropriate agencies (both federal and multi-state) that have jurisdiction over these species and obtain the most current scientific data available and FMP's and incorporate them into this EIS. As is illustrated in the EIS on page 2-7 commercial fishing and processing plays an integral role in the regional economy and potential impacts this proposal may have to the resources must not be dismissed. The Sierra Club calls on the U.S. Army Corps of Engineers to address the entire system and not just a piece of it.

2. The EIS fails to adequately address cumulative impacts of all direct, secondary and cumulative impacts for all recent past, present and future foreseeable projects in the Mid-Atlantic. We find 7.5.1.1.3

1. Coordination with the National Marine Fisheries Service (NMFS) and various elements within the New Jersey Department of Environmental Protection is continuing. It is the Corps intention to continue this coordination in order to minimize potential adverse impacts to shellfish and finfish. Additional surf clam sampling has been scheduled for the next phase of this project and borrow area P2 may be dropped as a potential borrow area. The results of this sampling will determine what, if any, mitigation may be necessary to minimize impacts to surf clams within the borrow area. In addition, recent studies conducted within the Ocean City borrow area by Versar, Inc. indicates that the macrobenthic community within the borrow area has re-established quickly and that there was a substantial recruitment of juvenile surf clams within the borrow area. For these reasons, we do not believe that the project will be trading one biomass for another.

Cumulative Effects (pg. 7-30) lacking and unacceptable. This EIS should have, at minimum, addressed all coastal hydromodification projects in the Mid Atlantic. This assessment should also include the proposed main channel dredge of the Delaware River and Bay from Philadelphia to the sea (pg. 10-2, #6). From the finfish data that the Sierra Club has obtained it appears that there may well be adverse cumulative impacts impacts to many federal and multi-state managed species of finfish especially when they are in their egg, larvae, and juvenile stages. They must be given full consideration before any action is taken. This also calls into question the waiving of Section 404 (r) of the Clean Water Act and prompts us to call for a new assessment of the 404 (b) (1) evaluation.

3. Since our packet only included Volume 1 we request that Volume 2 be forwarded to us and that an extension period of 30 days be granted for review and commenting for Volume 2.

In conclusion we wish to thank you for the opportunity to comment and request our comments be made part of the public record.

Sincerely,

(MJD)

Kristina R. Schvejda
NJ Chapter Sierra Club
Marine Issues Coordinator
40 Marilyn Street
North Haledon, NJ 07508
973-427-6863

Michael J. D'Amico
Director of Special Projects
Atlantic Coast Ecoregion
302-644-0627 (T)
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2. At this time, a comprehensive cumulative impacts analysis is not within the scope of any of the Corps' proposed or ongoing erosion and storm damage protection, or environmental restoration projects. The Corps does believe however that concerns regarding the issue of cumulative impacts associated with erosion and storm damage protection and environmental restoration projects along the New Jersey coastline are valid. All proposed and ongoing projects in this area consist of post construction surveys to evaluate impacts to benthic and fisheries habitat. These ongoing surveys, and the results they provide, help to track population trends and habitat value. These surveys are, and will continue to be, valuable indicators of impacts associated with specific projects, as well as any cumulative impacts resulting from the implementation of numerous projects.

3. Volume 2 was forwarded to the Sierra Club.

The Nature Conservancy
DELAWARE BAYSHORES OFFICE

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Mr. Robert L. Callegari
Chief, Planning Division
US Army Corps of Engineers, Philadelphia District
Wanamaker Building, 100 Penn Square East
Philadelphia, PA 19107-3390

May 27, 1998

Dear Mr. Callegari:

Enclosed are the initial comments of The Nature Conservancy regarding the Lower Cape May Meadows - Cape May Point Feasibility Study. Feel free to contact me regarding any of these comments, questions and observations.

Thank-you.

Sincerely,

Steve Eisenhauer
Director of Stewardship

c: Jay Laubengeyer - Director, Delaware Bayshores Office

No response required.

The Nature Conservancy
DELAWARE BAYSHORES OFFICE

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Comments about
Lower Cape May Meadows - Cape May Point Feasibility Study
Draft Feasibility Report and Environmental Impact Statement (EIS)
May 11, 1998

Note that these comments represent initial observations and questions after reading the involved report and EIS. These comments do not represent an official TNC stance, nor are they recommendations for changes. They do represent suggestions for further discussion, and requests for clarification about issues and proposed actions. The comments are listed by page number, where a definitive page reference can be made, or by description of the location in the Appendices (note "A" prefix in citations below). Unless otherwise noted, the page references refer to the 13-section Feasibility Study, not the Appendices.

Beach replenishment (includes effects on piping plover and least tern nesting colonies)
Pages vii, 1-7, 1-11, 1-12, 1-16, 2-91, 2-96, 2-111, 3-5, 3-8, 3-12, 5-7, 5-11, 5-45, 5-62, 7-11, 7-21, 7-23, 7-28, 7-40, 7-43, 7-45, 8-1

1. ■ We would like to see the cost:benefit analysis referenced on page 15 of the USFWS 11-97 Assessment in the Appendix.
2. ■ On page 65 of the Section 1, General, of the Engineering and Technical Appendix, it states "Interviews with long term residents of the area indicate that an ocean induced flood event occurs approximately once every 4 years". Even using this gross guide for replenishment, there might be two storms in one four year period, and none in the next four year period. The replenishment schedule should follow a schedule based on cubic yards of sand lost rather than time, e.g, replenish the beach when the benchmarks indicate that 650,400 cu.yds. of sand are gone, regardless if this happens in one year or ten. On page 2 of Appendix A, Section 16, Annual Charges, no. 10. Periodic Nourishment, the schedule is set as a four year cycle regardless of how much sand is lost or how many storms we've had. Is there an emergency fund available to replenish sand if the four year cycle is not adequate for a set period? What if only 200,00 cu.yds. of sand has eroded in four years? By relying on a schedule based on sand lost rather than time, we should be able to minimize the disturbance to the beach and borrow site, yet still keep pace with erosion/sand displacement.
3. ■ Page 87 of above-referenced appendix notes TNC's ownership as 153 acres. TNC's records note the Cape May Migratory Bird Refuge's acreage as 187.
4. ■ On page 27, Groins at the Meadows, it appears the cost with or without groins is very close. Groins have apparently been very effective in stemming the erosion in Cape May, during the same period that the Meadows has lost a disturbing amount of acreage. The erosion on the TNC property has apparently stressed the groins at Cape May Point; the groin gap in the Meadows was created when the earlier evaluation did not weigh the environmental/wildlife benefits enough to permit groin construction in areas without residential/commercial development. We would like to examine in greater detail the relative costs and benefits of

1. The cost-benefits analyses can be found in sections 5, 6 and 7 of the report. The cost-benefit analysis for individual species requested by the USFWS is actually the incremental cost analysis which is measured in Habitat Units (HU's). The incremental cost benefit by species did not accurately reflect the benefits achieved by the proposed project however, and therefor was not included in the Feasibility report. The incremental cost analysis for all species combined can be found in Section 6 of the report.

2. The nourishment plan proposed for this project, 650,400 cubic yards of material every 4 years for 50 years, was developed primarily for the purposes of estimating future commitments of funds. In order for a project to proceed through the Feasibility phase, it is necessary to develop detailed project cost estimates for the fifty year project life. A four year nourishment cycle represents expected nourishment requirements. Once initial construction has been done, beach surveys will be conducted yearly to measure and record the amount and location of sand in the project area. From these surveys it will be determined when, where and how much sand is needed along the length of the project. The surveys enable the nourishment to be completed only when and where it is needed, thereby saving time and money, as well as minimizing environmental impacts. This also means that if nourishment is not required during a given 4 year cycle, it will not be done. Other monitoring, such as wetland monitoring, would continue, regardless of the nourishment cycle.

3. Concur. This reference will be corrected.

4. Since groin construction has been effective in Cape May City, it was also considered along Lower Cape May Meadows but was not found to be as cost-effective as periodic sand nourishment over the 50-year project life. A summary of this analysis is provided in Appendix E, Economic Analysis. More detailed analyses can be provided upon request. In addition, throughout the study process, both the Nature Conservancy and USFWS were not supportive of groin construction due to possible negative effects on piping plover habitat.

including groins in the replenishment plan, and the effects of groin construction on piping plover and least tern colonies (see page 4-20, plate 4.5a of Lower Cape May Meadows/Phase I Hunter Research document, and also figure 5-1).

Protection of woody vegetation
Pages xiii, 1-7, 2-19, 4-23, 4-28, 4-31, 5-13, 6-2, 8-2

5. ■ Protect sassafras, sweetgum and other small trees and woody shrubs in Phase III and other areas. Trees and shrubs take 5 to 20 years or more to become established and, once established, they create important cover and forage areas for migratory songbirds and, if saltwater flooding does not disrupt them, also serve to prevent phragmites from moving into the area. Phragmites does not tolerate the shade created by tree/large-woody-shrub stands.

6. ■ Specs call for keeping aerial glyphosate spray 25 feet away from wooded areas. Is this far enough? Would 50 feet be preferable? Proposed plant and planting costs approach $1 million; every effort to protect already established woody plants represents a savings in planting costs. Hand-spraying with backpack or other land-based spraying equipment could be utilized to address phragmites growing within 50 feet of woody plants.

7. ■ Phase III forested island on eastern end appears to be misrepresented as field habitat. This is an important area to preserve as forest, since phragmites is not growing here and migratory songbirds and raptors use this area for cover and foraging.

Operation, maintenance, periodic inspection responsibilities, expected failure effects of flapper gates and weirs
Pages xiv, 7-8

8. ■ Flapper gates and weirs invariably eventually clog or otherwise fail sometime during their lifetime (often periodically). These failures are often temporary and easily repaired by removing the involved debris. In cases where there is freshwater on both sides of the gate or weir, the negative effects are usually negligible. However, if saltwater floods a freshwater area the effects can be significant: sometimes resulting in a major kill of freshwater-dependent vegetation. The potential exists in these circumstances for phragmites to become established. Should there be a secondary water control device in any areas where this fresh/salt water interface exists (e.g., in the Phase III area near Cape May City flowing into Cape Island Creek)?

Managing visitation after initial work is completed (rebuilding flooded trails: as habitat is improved, visitation is expected to increase)
Pages 1-4; A-B7, 9 & 12 of Versar's "Lower Cape May Meadows Wetlands Hydrologic Model"

9. ■ If the bunker outfall (overflow pipe) is closed, heavy rain can increase the water levels flowing across the TNC preserve approximately one foot in elevation. Some provision must be made to raise or reroute the clamshell paths and possibly build more footbridges or culverts. Perhaps boardwalks are necessary. Should the bunker outfall be kept operational for extreme storm conditions? Page 12 graph shows a potential increase in water level of approximately 1.5 feet in segment 3 (the eastern side of the preserve). What happens if this peak coincides with a high tide? Also note that the page 14 graph shows an approximate 1 foot water level increase for a 10 year flood, and that this flood condition can persist for more than 3 days. On page 18 in the top paragraph, note that while flushing is often good, flooding

5. All trees and shrubs within the project area will be protected to the maximum extent possible. In addition, portions of the selected plan call for the planting of additional trees and shrubs in several areas.

6. This will be further investigated during the next phase of the study. It is anticipated that the aerial spraying will be conducted through the use of helicopters which allow for precision spraying. Coordination on buffer areas will continue however to establish if the 25 feet buffer area is realistic. If it is found that the spraying cannot safely be done within 25 feet of woody vegetation, the buffer area will be increased and another method will be used to remove the Phragmites.

7. The Corps will coordinate with the Nature Conservancy to establish if the habitat has been misrepresented. Care will be taken to protect this habitat, regardless of whether it is field or forested habitat.

8. We believe that a single self-regulating tide gate will be sufficient. The State of New Jersey will enter into a legal agreement (Project Cooperation Agreement) with the Corps, taking responsibility for all operation and maintenance of project features to their design performance. In addition, the berm that has been proposed for the saltwater marsh (segment #3) will act as a secondary barrier against saltwater inundation.

9. The existing bunker outfall pipe (Drainage East) will be fitted with a removable shield therefore enabling operation of this pipe when necessary.

The Versar report referenced has been updated and incorporated into Appendix D, Section 2, "Hydraulics and Hydrology Coastal Processes". This should be used as the main reference relating to hydrologic or hydraulic information. The information found in this section should clarify the information found in the Versar report. The 1.5 foot rise in water elevation discussed in the report would only occur during a 50-year frequency storm event having 7 inches of rain. The proposed project will not worsen any existing flooding conditions in the study area (see page 13 of the Versar report). It should also be noted that the berm being constructed to create the salt marsh will enable this area to handle common rainfall events and tide fluctuations.

is usually not. With many homes in the area, the graphs seem to indicate an additional flood threat. On page 20 in the center of the paragraph (4.0 Discussion and Summary) is noted a "slight increase in water levels": is 1.5 feet a slight increase?

10. ■ On page J-31 of Section 6, Project Design, in the Appendix: is there a provision to build a trail on top of the 1000 ft. berm? Apparently, the current trail system on the preserve will have to be redesigned, with the altered surface and subsurface water flows.

Miscellaneous comments/corrections

Pages 2-43, 2-110, 4-31

11. ■ On page 2-110: the flap gate installed in 1987 appears to be working well, however, it may not be closing completely all of the time. On at least one occasion two summers ago, water was seen flowing upstream at the eastern end of the preserve. Other reports indicate that debris is keeping the flap gate partially open and allowing saltwater back into the preserve.

12. ■ In Appendix B1.1 Introduction/Background of Versar Report: should last sentence of paragraph refer to the western half rather than the southern half, and the eastern half rather than the northern half?

13. ■ In Appendix B1.2: spring peepers have been heard at TNC Preserve this year.

14. ■ On page 18 of the USFWS 11-97 Assessment is referenced possible monitoring done by TNC staff. Is there funding available to pay for this monitoring, and specifically what types of monitoring are involved?

Overwash areas

Pages 2-22, 2-52, 2-111, 5-12.

15. ■ In Appendix B, page 3-1 of the Versar Report; and page 130 of Section 1, General, Engineering Technical Appendix: if the main problem is the ocean eroding the beach and dunes, why would we move any sand seaward? Isn't this movement assisting the documented erosional process. TNC's main concern is protecting the nesting habitat of the piping plovers and least terns; although we would also like to create more freshwater wetland to assist other species, we don't want to sacrifice our main concern, nor do we want to take away from the long-term life of the preserve by moving sand or other soil material seaward (particularly when the erosion rate of the past 50 years is considered). The overwash areas serve as additional protection during extreme storm conditions, buttressing the dune foundation and protecting existing wetlands. The overwash areas on the landward side of the dunes have occasionally been used as a nest site for piping plovers. Disturbing these areas might encourage phragmites growth more than leaving them alone, with selective spraying with glyphosate. During storm conditions (that might destroy nests) these open areas serve as a shorebird refuge protected from the wind. In time, these areas should become vegetated; removing them seems counterproductive. Any money saved by leaving the overwash areas intact should be used to pump more sand onto the seaward side of the dune or onto the berms. The overwash area involved is approximately 7 acres; perhaps this area need not become wetland but would serve habitat diversity better if left alone.

16. ■ Page 3 of the 9-7-94 USFWS letter in Appendix A notes under "Federally-listed species" that the ocean overwash areas are feeding areas for adult piping plovers and chicks.

17. ■ Page 4 of the 11-97 USFWS Assessment in Appendix A notes the creation of wetlands by excavating the overwash areas. With the higher water levels being created in segments 2 and

10. No, currently there is no funding provision to build a trail on top of the 1,000 foot berm. The provision can be discussed during the PED phase.

11. Comment noted.

12. Yes. The area was referenced incorrectly.

13. This updated information will be added to the report.

14. It appears that the USFWS was referring to the development of management plans that would ensure the continued success of the proposed restoration project. Currently, the Corps plans to monitor all aspects of the restoration for a period of 5 years following construction. Following that time, any data collected by the Nature Conservancy would be helpful in tracking the long-term success of the project. At this time however, no money has been budgeted for long-term monitoring by the Corps or any other agency/organization.

15. The erosion rate will likely remain the same regardless of the shoreline position. The periodic nourishment will counteract the erosion.

The selected plan will increase the available habitat for both piping plovers and least terns. The existing sand overwash areas will be "pushed-out" to create the new dune. Reusing this sand decreases project costs since it lessens the amount of material needed to be pumped from offshore.

In order to move the dune seaward, it will be necessary to remove the existing overwash areas. In order to maintain this type of habitat however, the Corps is considering creating an overwash area within the tidal portion of the restoration site. In addition, plover walkovers will be created to allow the beach nesters access to the freshwater feeding habitat on the landward side of the dune. While there may be some temporary impacts to beach nesters during the initial construction (ie - habitat will not be as suitable) it is anticipated that the final project will increase the area and quality of plover and tern nesting and feeding habitat.

16. Concur. For this reason, the Corps will be including plover walkovers and an overwash area in the final plan.

17. In order to construct the selected plan, it will be necessary to remove the existing overwash areas. The removal of the overwash areas and the movement of the shoreline seaward will result in the creation/restoration of 35 acres of wetlands which have previously been lost due to erosion and dune overtopping.

3 (the TNC Preserve), particularly area flooded after significant rainfall periods, more wetland acreage will be created anyway.

Mosquito spraying subsequent to project initiation

Page 2 of Versars "Lower Cape May Meadows Wetland Hydrologic Model" and page 5 in the 11-97 USFWS Assessment (both in Appendix A)

18. ■ Establish strictly-enforced standards to ensure that spraying to control mosquitoes is not done unless absolutely required. The proposed work emphasizes the creation of ponds where fish can thrive year-round to control the mosquito larvae populations. If mosquitoes become a problem, address the problem by readjusting the hydrologic conditions, and restocking the created ponds with the necessary fish species. Quantify the sentence in the USFWS Assessment "reduce the need for the Cape May County Mosquito Commission to apply pesticides in the Meadows".

Rare and endangered plants and animals (other than piping plover and least terns)

Pages 2-35, 1-2, 4-28

19. ■ Add Juncus coriaceus and Diodia virginiana to rare plant list – TNC has information about some of the locations for these plants

20. ■ There is concern that plastic sheets put down to protect plants and amphibians may smother them if kept down too long. Another possible solution might be to use removable 4' by 8' sheets of plywood that cover the rare plants (most of which grow no higher than one foot). These plywood sheets might also work well when backpack spraying is done along existing boardwalks and paths where phragmites is growing with rare and other more-common plants.

21. ■ At least one gray tree frog has been found on the state park property along the boardwalk, and others have been heard on the TNC preserve. It is uncertain if these are the rare southern or the more common northern species.

22. ■ Page 20 of USFWS 11-97 Assessment (no. 4) states "to ensure that adverse impacts on these (State-listed plant) species are avoided". This is a difficult goal, considering the location of these plants, particularly the whorled marsh pennywort. Creative methods will have to be utilized to ensure that this goal is met.

23. ■ An official from the N.J. Natural Heritage Program has commented to TNC that he is concerned about how rare plants will be protected from use of glyphosate. He was not impressed with the Versar plant inventory, and notes that there are a number of rare plants that didn't show up in the report. He also noted that many of the plants on the Cape May Preserve require somewhat brackish conditions; there is a concern that the suggested changes would permanently change the habitat to one favoring the strictly-freshwater species. The question arose about whether the ponds are somewhat brackish due to occasional storm events introducing saltwater.

Use of synthetic fabrics

Pages 2-55, 5-6; page 136 of Section 1, General, or Engineering Technical Appendix.

24. ■ Note that any use of geotextile fabrics for tubes or mats, engenders questions about their life and whether funds have been made available to dispose of the fabric when their useful life is

18. The USFWS is also in favor of reducing the frequency/necessity of mosquito spraying within The Meadows. Components of the proposed plan, such as the fish reservoirs and the re-establishment of water movement between ponds were established with the help of many agencies, including the Mosquito Commission. The establishment of a water management plan between the State Park and the Nature Conservancy will help to ensure minimal involvement of the Mosquito Commission throughout the life of the project.

19. These species will be added to the report. It is anticipated that their presence and location will be confirmed during the threatened and endangered plant survey that is scheduled to be completed prior to construction.

20. Concur. These suggestion will be further investigated in the PED phase to ensure the best methods are used to protect threatened and endangered species within the project area.

21. The presence of this species will be investigated in the PED phase of the project.

22. Concur. The Corps expects to work closely with the Nature Conservancy, the NJDEP, the State Park, and the Natural Areas Council to minimize adverse impacts to these and other threatened and endangered species.

23. As stated above, extensive coordination will be continued in the PED phase of the project to ensure the protection of all threatened and endangered species. The Corps will involve the Natural Heritage Program in this coordination. Another plant survey is scheduled closer to initial construction and all efforts will be made to ensure that species are not missed during the inventory. It will be necessary to balance the needs of freshwater species with the needs of brackish water species. The Corps appreciates the concern regarding brackish species but must also take into account freshwater species which have been declining due to the overtopping. These issues will also be further investigated in the PED phase.

24. Noted. Geotextile fabric is not included in the selected plan.

over. Erosional forces will eventually uncover them, regardless of their useful life, sometime within the next century, or perhaps within the next decade or two.

25. ■ Page J-1 of Section 6, Project Design, in Appendix, refers to use of Armor Mattress, with 3 to 4 inch stone inside. Is there a threat to the piping plovers and their chicks from this mattress (becoming trapped)? And is there funding available to dispose of it when its useful life is over? Will the stones be left, and the mat removed? And on page J-30, what is the life of geoweb when used on side slopes of channels (filled with concrete)? And on page J-31, the same questions about geogrid used at the base of the berm.

Long-term plan for state park outfall

Pages 3-1

26. ■ On page 120 of Section 1, General, of Engineering Technical Appendix, it states "In anticipation of an ocean storm and salt water inflow the locals will manually switch the gate settings such that flow to the Meadows is prevented and the gates to the ocean are open for the eventual draining of the ponded salt water when the ocean stages return to normal". The mechanics of how this happens, and who makes these decisions, and when, are unclear.

Saltwater marsh

Pages 5-70, 7-8

27. ■ Failure of flapgate (Phase III, option 1 vs. 2) would most likely kill much freshwater vegetation upgradient of the gate. The current flapgate allows some saltwater to flow upgradient and may be one of the causes for phragmites becoming established there. Even an overnight failure (piece of vegetation impinged on the flap) can be problematic. Is option 2 a safer option since it allows for more freshwater wetland buffer? Is a double flapgate system necessary wherever the downgradient water is saline?

Planting of vegetation

Pages 5-71, 7-11

28. ■ Check history of NJCF Bear Creek wetlands restoration project (which has many similarities to this project) to help determine preferred plantings.

29. ■ Salinity levels in water and sediment are most likely higher on the east side of the east path of TNC preserve (Phase III) than west of the path. A different plant species mix may be necessary (e.g., more Typha angustifolia than Typha latifolia).

30. ■ Re-evaluate plant list on page 2-ll of Versar report, e.g., Decodon verticillatus (water willow) might not be appropriate: it has become invasive in a number of South Jersey impoundments.

31. ■ Is it practical to assume that there are enough grass/sedge/rush seeds in the seed bank, and available from nearby plants, and that the funds designated for these plants could be more efficiently used for the purchase of more trees and shrubs?

Borrow areas

32. ■ In Appendix A-figure 2 and page 4 of the 11-97 USFWS Assessment: How significant is the different grain size found in two borrow areas? Isn't it better to get borrow material from farther away from the project area, considering that there is the potential that sand will slump or migrate from the beach (or sand that might someday migrate to replenish the beach) into the nearby borrow area?

25. At this time, it is anticipated that the armor mattress, which was installed by the NJDEP, will remain within the project area. Under normal conditions, this mattress will be covered with sand and should pose no threat to plovers or other animals. The implementation of the proposed plan will cover the mattresses with additional sand. If under storm conditions, the mattresses become uncovered, it is anticipated that the sand would be quickly replaced.

The geoweb and geogrid are expected to last for the 50-year project life and should not pose a threat to wildlife.

26. Pg 7-12 (Section 7.3.7) of the report recommends that a water management plan be developed for use by the Nature Conservancy and Cape May Point State Park. It is anticipated that this document will establish daily water management as well as emergency operating procedures for the flap gates and Drainage East.

27. The single flapgate system should be appropriate. In the event of a flapgate failure however, the presence of the berm will provide a level of secondary protection against saltwater inundation during high frequency events.

28. Concur. This study will be investigated.

29. Concur. Planting requirements will be further investigated in the PED phase. The Corps would be happy to receive any other recommendations the Nature Conservancy has on planting suggestions.

30. The Versar plant list was not used to choose species to be planted. The planting list was developed in conjunction with the USFWS and other agencies.

31. Natural revegetation from existing seed banks is expected to occur within the tidal portion of the restoration. Planting was suggested for the remainder of the site due to the fact that in the recent past, most of the area has been vegetated by Phragmites. It was feared that Phragmites would be the first plant to recolonize the area if at least some plantings were not done.

32. The difference in grain size is not significant. Ideally, borrow material should be the same size, or slightly coarser than the native material on the beach to be nourished. If the borrow material has a significantly smaller grain size, the profile will be out of equilibrium with the local wave and current environment, and will therefore be quickly eroded either offshore or along shore. Coarser material only presents an aesthetic difference.

Yes, choosing a borrow area too close to the shoreline could adversely affect the project. The borrow areas chosen for the selected plan are a significant distance away in terms of coastal processes. Additionally, the cost of the project increases as the distance from the borrow area increases.

Use of glyphosate

In Appendix A, pages B2-6 Versar Report, and p. 15 of 11-97 USFWS Assessment:

33. ■ If spraying is done in August and October, won't some areas be sprayed twice? Is this two month period enough time to determine if the first spray was successful or not?

34. ■ Assess the danger to any endangered amphibians due to glyphosate/surfactant application, and recommend techniques or timing that will reduce any danger.

35. ■ Sentence in USFWS Assessment under "Common Reed Control" reads: "Glyphosate is a water-soluble chemical with a short half-life and has no significant impact on macroinvertebrates, fish or wildlife." Use of the word "wildlife" is inaccurate since glyphosate has not been fully tested for all wildlife (e.g., all amphibians and insects).

36. ■ The N.J. Natural Heritage Program has indicated to TNC their concern that rare plants might be killed by glyphosate spraying.

33. If the Phragmites is sprayed twice, it will be done over a two year period. The time between the months of August and October is the most effective time for the application of the glyphosate.

34. This will be investigated during the PED phase.

35. This will be investigated during the PED phase.

36. As previously stated, coordination will continue prior to construction in order to maximize the protection afforded to endangered plants. If an area(s) exists where glyphosate cannot be safely applied without impacting endangered plants, Phragmites will be allowed to remain in that area(s).

Lower Cape May Meadows - Cape May Point Feasibility Study
Cape May Point Natural Area

Summary and Staff Recommendation
May 5, 1998

The draft Lower Cape May Meadows - Cape May Point Feasibility Study prepared by the U.S. Army Corps of Engineers (ACOE), Philadelphia District, and dated November 7, 1997, was received by the ONLM on March 18, 1998. The draft presents the results of the feasibility phase of study detailing an implementable solution to ecosystem restoration to The Lower Cape May Meadows (The Meadows - composed of Cape May Point State Park and Natural Area, and The Nature Conservancy's South Cape May Meadows preserve) and storm damage reduction to the residential communities of Cape May Point and West Cape May. ONLM staff has requested that the complete draft Feasibility Study be forwarded to all Council members. Please notify the ONLM if you have not received a copy. The ACOE has requested comments on the draft by May 11, 1998.

Background

ACOE study of this segment of coast is one of six site-specific study areas recommended by the NJ Shore Protection Study, and was authorized by resolutions adopted by the U.S. House of Representatives and U.S. Senate on December 10, 1987. The Water Resources Development Act of 1986 directs the ACOE to conduct water resources studies in two phases: reconnaissance and feasibility. The Lower Cape May Meadows Reconnaissance Study was initiated in 1993 to address both the rapid shoreline erosion and consequent ecosystem degradation of this unique coastal wetland segment and the erosion and flooding problems in Cape May Point and West Cape May. The reconnaissance study, which identified problems and opportunities in the study area and recommended an ecosystem restoration approach, was completed in August 1994 and recommended proceeding to the feasibility phase of study.

The Lower Cape May Meadows - Cape May Point Feasibility Study was initiated in April 1995. The purpose of the feasibility study is to ensure the timely and economical completion of a quality feasibility report recommending implementable solutions to problems identified in the feasibility study. Integral to the feasibility study is an environmental impact statement. The NJDEP is the non-Federal sponsor for the feasibility study, providing 50 percent of the study cost. The feasibility study covers a project life of 50 years.

The Feasibility Report identifies the following two principal problems within the study area: 1) ecosystem degradation and habitat loss at The Meadows, and 2) storm damage vulnerability to the towns of Cape May Point and West Cape May. The ultimate cause of these problems is beach erosion that has resulted from both natural shore processes and the construction of shoreline structures, particularly the two jetties at Cape May Inlet that were installed by the ACOE between 1908 and 1911. The Cold Spring Jetties, each almost a mile in length, severely interrupted natural littoral transport to downdrift beaches resulting in severe beach erosion. Erosion has resulted in direct loss of beach and wetland habitat, and breaching of the remaining dunes during storm events has both degraded the remaining freshwater ecosystem and caused flooding events in the study area towns. Some of the results of these processes are as follows:

No response required.

* More than 1100 feet of shoreline has vanished since 1938, and it is predicted that an additional 138 acres of habitat, or half of the remaining Lower Cape May Meadows, will be lost to erosion between 1997 and 2050 if shoreline erosion is allowed to continue unabated.

* Storm events have periodically resulted in ocean water overtopping the dunes with subsequent intrusion and drainage pattern alterations. Results include loss of fish species, a proliferation of common reed (*Phragmites australis*), an overall degradation of habitat, and loss of endangered species and productivity.

* Loss and degradation of stopover habitat is believed to have resulted in declines in the numbers of many Neotropical migratory bird species over the past several decades.

* Dune breaches from coastal storms frequently result in inundation or storm water retention within the communities of Cape May Point and West Cape May.

Summary of Proposed Actions and Staff Recommendations

The following analysis and recommendations by staff attempts to consider only the selected plan outlined in the Feasibility Study as it relates to the Cape May Point Natural Area. Because the Feasibility Study treats the undeveloped portions of the study area as a single unit (The Meadows) it was difficult for staff to isolate the effects of plan implementation specifically on the natural area. At the meeting, ACOE representatives will present a summary of the extent of the proposed improvements and potential impacts on the natural area, and will be available to answer questions by Council members. Staff review did not include consideration of alternatives identified in the feasibility report or project costs.

Component 1: Dune/berm Restoration

Description of the Proposed Action - The existing dune protecting the natural area will be removed. The dune proposed for construction includes a dune crest with a top elevation of +18.0 feet NGVD, a top width of 25 feet, and slopes of 1 vertical:3 horizontal and 1 vertical:5 horizontal on landward and seaward slopes, respectively, for a total dune width of 105 feet. The proposed berm will extend from the seaward toe of the dune and consist of a plateau 20 feet wide at elevation +8.0 NGVD and then sloping gently down (1 vertical:25 horizontal) to an elevation of -1.65 feet NGVD or the mean low water (MLW) level. The total width of the berm is 157 feet. The dune/berm will include the entire length of the natural area, extending from the Third Avenue terminal groin in Cape May City to the Central Avenue groin in Cape May Point. The total length of the fill is 1.9 miles, or 10,050 linear feet, resulting in a 35 acre seaward extension of the beach. Creation of the dune/berm will require deposition of an initial 2,312,000 cubic yards of sand; an additional 650,000 cy of sand will be required every four years after initial construction during the 50 year project life (cubic yards of sand to be deposited adjacent to the natural area not known). All fill material will be obtained from two borrow areas located approximately 1-2 miles offshore. Following construction, the dune will be planted with 18 acres of vegetation and stabilized with 15,000 linear feet of sand fence (acres of planted vegetation and length of sand fence adjacent to the natural area not known). Dune planting will consist of 11 acres of beachgrass (60%), coastal panicgrass (20%), and Japanese sedge (20%), and 7 acres along the landward toe of the dune will be planted with a mixture of bayberry, wax myrtle, beach plum and shore juniper (acreage of planting in the area adjacent to the natural area not known). Dune/berm restoration activities will

necessitate extension of the Drainage East outfall pipe 112 feet seaward of its current discharge location. See Attachments A and B for depictions of the proposed dune/berm restoration.

Treatment in Adopted Management Plan - The problems of dune erosion, resulting ultimately from construction of the Cold Spring Jetty by the ACOE, subsequent overwash of temporarily constructed dunes, and saltwater inundation of formerly freshwater wetland habitats are all examined in the adopted management plan. Beach erosion is identified as a major threat to both vegetation and wildlife in the natural area. Six major storm events and dune stabilization efforts are listed for the period between 1962 and 1984. The management plan includes the following management techniques for dune stabilization:

* Reconstruction and repair of breached dunes by bulldozing sand and/or drag lines to remove storm deposition from the ponds will continue to be sought by the Park Service (administering agency).

* Major dune restoration projects will be coordinated with the ONLM and be reviewed by the Natural Areas Council. The Council will also review any expansion of the dune inland from its current position.

* Fertilization of beachgrass planting shall be performed following dune restoration projects to assist with stabilization of the dune.

* Crossing over the dunes by pedestrians and vehicles should be prohibited at all times except at designated access points. The road located behind the existing dune should be maintained for use by Park Service vehicles only.

* A study seeking viable alternative solutions to combat the severe dune erosion problem at Cape May Point and portions of Lower Township is proposed as a long-term management goal of the Division of Parks and Forestry. In considering a long-term solution to the erosion problem, plans must also include the adjacent South Cape May Meadows preserve.

The Drainage East pipeline was installed subsequent to adoption of the management plan. This project, sought by the Borough of Cape May Point, was reviewed and recommended for approval by the Council at a meeting held on September 1, 1993. It was installed in 1994. The pipeline, which extends from Shallow Pond to the ocean, serves to limit the water level in the natural area to 3.5 feet above sea level, thereby relieving periodic flooding within the Borough and State Park resulting from storm events. Following construction, the drainage system came under the ownership and maintenance of Cape May Point State Park.

Staff Recommendation - The dune/berm restoration project envisioned in the Feasibility Report appears to be consistent with the adopted management plan for this natural area. Staff agrees with the conclusions of the Feasibility Report that failure to proceed with a restoration effort of this scale will ultimately result in the permanent loss of freshwater habitat in the natural area and considerable loss of acreage to the park. Although no restoration effort can be considered permanent, the 50 year duration of this project is considerable. Although impacts on benthic organisms of the selected borrow areas and the entire beachfill zone will be catastrophic, they should be temporary. Council is reminded that almost all of the dune/berm restoration operation will be performed outside and seaward of the boundary of the natural area. If proper precautions are taken, impacts to threatened and endangered beach nesting birds can easily be avoided. It is anticipated that the tremendous net increase in nesting habitat that will result

from this project will have a positive effect on piping plover and least tern nesting, which has not occurred in recent years on the beaches of the natural area.

Staff recommends that the dune/berm restoration component of this project be approved by the Council with the following considerations, which must be addressed in the final Feasibility Report:

1. * Japanese sedge (*Carex kobomugi*) should be eliminated from the mix of species used to revegetate the dune. Although shown to rapidly vegetate dunes, this species is an invasive exotic that is currently displacing American beachgrass in many locations, including Island Beach State Park. The sedge forms a dense turf that is exclusive of other dune colonizers, resulting in a monoculture. Although Japanese sedge appears successful in colonizing coastal dunes, its ecological value as a component of primary dune vegetation is not known. Use of coastal panicgrass as a component of dune plantings is also questionable. The Feasibility Report does not specify if the intended species for use is *Panicum virgatum* or some other coastal species. *Panicum virgatum* may be most suitable for planting at the landward toe of the dune, in the zone adjacent to areas planted in freshwater marsh, but would be less suitable as a foredune stabilizer. A more diverse assemblage of native species is recommended, including the use of seaside goldenrod (*Solidago sempervirens*). It is further recommended that only native vegetation be used for all dune revegetation, and that fertilization following installation of plantings be considered, as recommended in the adopted management plan.

2. * Stabilization of the dune with a continuous line of sand fence should be considered a temporary measure to be used only until vegetation of the dune is established. Following establishment of vegetation, installation of sand fence should proceed only on an as-needed basis to repair breaches and discourage public access.

3. * Staff questions the need to extend the existing Drainage East pipeline, as proposed in the Feasibility Report. The internal restoration components outlined in the Feasibility Report, discussed below, appear to make retention of this structure superfluous. This issue is not adequately covered in the Feasibility Report and should be addressed by ACOE representatives at the Council meeting.

4. * Consideration should be provided in the Feasibility Report for maintenance of access to park vehicles behind the reconstructed dune for trail maintenance and emergency purposes.

5. * The ACOE should address the following inconsistencies in the Feasibility Report: 1) Report indicates an initial fill quantity of 1,662,000 cy (p. 7-5) while the Description of the Selected Plan on p. v indicates an initial fill volume of 1,247,000 cy; 2) Report indicates a 35 acre seaward extension of the beach, yet p. 5-49 of text indicates that construction will add 18 acres of dune habitat and 29 acres of beach habitat, for a total of 47 acres.

Component 2: Restoration of 35 acres of emergent wetland

Description of the Proposed Action - The reconstructed dune/berm will result in movement of the MHW line seaward a maximum distance of 280 feet. This movement of the existing shoreline seaward will result in the creation or restoration of 35 acres of previously eroded emergent vegetation. It is anticipated that all 35 reclaimed acres will be located throughout The Meadows portion of the study area (the Natural Area and South Cape May Meadows). This restoration will be created by excavating

General: A meeting was held on 5 May, 1998 with the COE, the Natural Areas Council, and Dean Cramer, Superintendent, Cape May State Park to discuss the recommendations from the Council. In additions to the responses provided below, it was decided that a working group would be developed during the PED phase of the study. The working group would consist of Council members, NJDEP, COE, USFWS, etc in order to establish the details of the restoration project (ie protection of endangered species, timing of Phragmites removal, etc).

1. Japanese sedge will be removed from the proposed planting list. Coordination will continue to develop an acceptable planting regime for the dune. Only native vegetation will be used and it was decided that fertilizer would not be used in this location.

2. Concur. Sand fencing will be used in order to stabilize the dune immediately following construction. It is not anticipated that additional sand fencing will be necessary following the initial construction.

3. The Drainage East outfall is being extended as a safety measure in order to protect the Nature Conservancy, the State Park and the city of Cape May Point. While the proposed plan will eliminated most storm induced overtopping and dune breaches, the possibility still exists for such events. If this were to happen, the removable shield over Drainage East could be removed in order to drain excess water from The Meadows. During all other times, the shield will remain in place and no water will be lost from the system through Drainage East.

4. Concur. This feature will be coordinated with the State Park personnel.

5. (1) The correct initial fill quantity is 1,662,000 cy (not including 650,000 cy of advanced nourishment which will also be placed at the time of initial construction).
(2) The 35 acres gained in the seaward extension of the dune is in addition to the 47 acres of beach and dune habitat which will result from the project.

the existing dune material down to elevation +2.0 NGVD and recycling the excavated material into the new dune/berm, thereby reducing the amount of fill removed from offshore borrow areas. (An exception to this plan will be made along a portion of the State Park frontage extending approximately from the bunker location west to the park boundary. In this location, the proposed dune will be placed on the existing dune which possesses a Tensar stone mattress.) The dune/berm would then be constructed using normal beachfilling operations. Directly behind the landward toe of the reconstructed dune, a 25 ft wide sand buffer would be constructed and planted with scrub/brush vegetation. The area behind this buffer zone will then be filled to a depth of 10 inches with organic material obtained from other excavations within The Meadows and this organic material will be planted with wetland vegetation. Refer to Attachments A and B for depictions of the proposed emergent wetland restoration.

Treatment in Adopted Management Plan - The management plan does not specifically address the issue of restoration of emergent wetland habitat. However, the management plan does state that ecological restoration and preservation of various habitats of the natural area are primary goals for the long-term benefit of the large numbers of birds and wildlife dependent on this area.

Staff Recommendation - Although a portion of this proposed component will occur within the natural area east of the bunker location, the vast majority of emergent wetland restoration will occur within the South Cape May Meadows preserve. It would be instructive to know the historical vegetation component of this zone behind the primary dune/berm. However, staff is supportive of the concept of wetlands restoration because it will result in an overall increase in wetlands acreage and values for The Meadows. Staff recommends that the Council approve of the proposed wetlands restoration subject to the inclusion of the following in the final Feasibility Report:

6. * A complete list of species to be used for plantings in both the buffer and emergent wetlands zones created as a result of this project component. The list of planting should take into consideration historical information on habitats that formerly occupied the zone proposed for wetlands restoration, if available.

7. * The potential for establishment of *Phragmites* and other invasive plant species in the restoration zone, including actions that may be taken in the event of invasive species establishment. The potential for failure of plantings and means by which water levels will be maintained within the emergent wetland zone should also be addressed.

8. * The extent of wetlands restoration planned within the state natural area portion of The Meadows.

Component 3: Elimination/control of 95 acres of *Phragmites australis*

Description of the Proposed Action - Large sections of The Meadows are currently overgrown with monotypic stands of common reed (*Phragmites australis*), which provides poor habitat for wildlife and can be a fire hazard. The Feasibility Report and appendixed Environmental Analysis identifies the reduction and control of *Phragmites* and replacement with wetland vegetation of higher value to wildlife as a priority. Small-scale control of *Phragmites* through application of herbicides is currently practiced by The Nature Conservancy at the South Cape May Meadows. This component involves aerial application of the herbicide Rodeo (glyphosate), most likely from a helicopter, which allows for quick precise application. Known locations of threatened and endangered species will be protected from coming into contact with the herbicide during application. In order to minimize loss of species, the following mitigative measures will be implemented: an updated threatened and endangered plant survey

6. Concur. A planting list will be finalized based upon input from the working group that will be established.

7. The Corps will be actively managing the site for a minimum of 5 years after all construction activities have been completed. During this time, any recurrence of Phragmites will be addressed. In addition, the health and survival rate of all planted vegetation will be monitored. Money has been budgeted in order to address additional Phragmites removal and to replace vegetation as necessary. The Corps has recommended that the State Park and the Nature Conservancy develop a water management plan in order to ensure that the goals of all parties are met in terms of water level management.

8. It is estimated that approximately 8 acres of newly created wetlands will be restored within the natural area portion of The Meadows with the movement of the shoreline. In addition, it is anticipated that restoration activities will take place within the acres of Phragmites present on the site.

will be performed prior to construction; creation of buffer zones or other measures will be taken to protect plant species during herbicide application, and; creation of fire breaks around or otherwise protecting plants during burning activities will be implemented. Buffer areas near forested and emergent wetlands will also be protected from herbicide application and burning activities. Application will be made during the fall for two consecutive seasons to ensure minimal survival of *Phragmites*. Following the two Rodeo applications, all *Phragmites* dominated areas will be control burned. All phases of *Phragmites* removal will be performed by trained professionals and will be fully coordinated with the proper Federal, State and local agencies, as well as the surrounding community. Attachment C indicates areas within The Meadows vegetated by *Phragmites* marsh.

Treatment in Adopted Management Plan - The management plan includes little consideration for the presence of *Phragmites* throughout the natural area marshes. It is implied in the plan that higher water levels present at the time of plan development may have suppressed the proliferation of *Phragmites*, although no detail is provided and the extent of *Phragmites* is not indicated in the map of vegetation. The fire hazard associated with the presence of *Phragmites* marshes is mentioned in the discussion of threats and impacts.

The management plan contains lists of endangered/threatened wildlife and rare plants known to utilize or believed to inhabit the natural area at the time of plan development. The low habitat value of *Phragmites* for wildlife and potential threat posed by this species for recorded rare plant species is not discussed in the management plan. Management techniques addressing rare species specify that planned activities or uses in the natural area that may result in the alteration or destruction of existing habitats must be reviewed by the Council with regard to potential impacts on these species.

Staff Recommendation - Staff has had numerous discussions with Superintendent Dean Cramer since plan adoption on the spread of *Phragmites* and the need for control. In addition, prior to development of the Reconnaissance Study, Superintendent Cramer and staff indicated to ACOE representatives their interest in examining options for control of *Phragmites* and other invasive plant species in the natural area. The management objective of the natural area includes preservation of a freshwater marsh behind a coastal dune, habitat diversity for migratory birds, and rare species habitat. The current abundance of *Phragmites* is not a natural occurrence but is the direct result of periodic dune overtopping and breaching during storm events, with resultant saltwater inundation of the previously freshwater habitats in interior portions of the natural area, as well as the deteriorating water level management within and surrounding the natural area. Proliferation of *Phragmites* alone has likely resulted in the extirpation of several rare plant species historically known from the natural area. Therefore, despite the massive nature of the eradication effort, which presumably includes all *Phragmites* dominated areas within the natural area, staff is supportive of the control effort because it is consistent with the management objective of the natural area.

However, additional information is required to properly assess the impact of the proposed action. As recommended in the Report, a thorough survey of the entire treatment area and all surrounding areas for the presence of rare plants is required prior to application. Although it appears unlikely that such plants remain extant following domination by *Phragmites*, it seems equally unlikely that any rare plants located within glyphosate treatment and burning areas will be able to survive such treatment, despite use of the precautions indicated. Staff recommends that the Council approve of the concept of *Phragmites* control, but request that final detailed plans be presented at a later date for review by the Council prior to implementation. The following should be included in the final Feasibility Report:

9. * A map indicating the area proposed for *Phragmites* removal is needed to properly evaluate

9. It is currently proposed that all Phragmites on the site (approximately 95 acres) will be removed. It is acknowledged however that this may not be practical/possible due to the presence of endangered species and forested areas. If Phragmites removal cannot be accomplished in certain areas without negatively impacting other species, Phragmites will be allowed to remain in these areas.

potential impacts on the natural area. The Feasibility Report does not indicate if all stands of *Phragmites* are proposed for elimination/control efforts. Attachment C includes 101.2 acres of habitat dominated by *Phragmites*, while the Feasibility Report proposes eradication of 95 acres of *Phragmites*.

10. * An assessment of the potential impacts of glyphosate application and prescribed burning on wildlife, including rare/endangered reptiles, amphibians and fish species.

11. * Specific means by which endangered and rare plant species will be shielded from the effects of glyphosate application and controlled burning must be provided, together with follow-up measures for control of *Phragmites* should applied procedures fail.

Component 4: Planting of 105 acres of emergent wetland vegetation

Description of the Proposed Action - (Note: It is assumed that the 105 acres proposed for planting with emergent wetland vegetation is in addition to the 35 acres of restored emergent wetland vegetation previously described under Component 2.) This component would be performed in conjunction with glyphosate application and prescribed burning of *Phragmites* dominated areas described under Component 3. Once the *Phragmites* is removed, emergent wetland plants of greater value to wildlife can be planted. The newly established plants will help keep the *Phragmites* at bay, and may be able to outcompete them for growing area. Vegetation used would vary depending upon elevations, adjoining habitat, and water levels. Immediately around the open water areas, species such as wild rice, smartweeds, bulrush and cattails would be planted. In palustrine emergent habitat, species such as sedges, rice cutgrass, smartweeds, spike rush and widgeon grass would be planted. In adjacent uplands and transitions areas, species such as bayberry, wax myrtle, marsh elder and marsh goldenrod would be planted. The report by Versar, Inc., located in Appendix B to the Feasibility Report, recommends the following: planting a total of 2,125,200 plants throughout The Meadows, or approximately 21,000 herbaceous plants per acre. The Versar, Inc. report recommends that all plantings must be native to southern New Jersey, plants used must be commercially available from local nurseries and installed in the spring following winter prescribed burn.

Treatment in Adopted Management Plan - Removal of *Phragmites* stands and reestablishment of freshwater emergent vegetation was not envisioned in the adopted management plan.

Staff Recommendation - Staff fully supports the concept that all areas from which *Phragmites* is eradicated or controlled must be planted with native freshwater wetland species. If possible, the composition of the plantings should resemble that which occurred prior to invasion by *Phragmites*. In addition, plantings must be monitored for a considerable time following installation to ensure success. The Feasibility Report provides insufficient detail on procedures and standards to allow for adequate assessment of this component of the overall project. Potential impacts of the proposed action are not addressed in the Report. In addition, staff was not able to ascertain the discrepancy between the number of acres proposed for *Phragmites* eradication efforts (95 acres) and the area to be replanted with native emergents (105 acres). Staff recommends that the Council approve of the concept of revegetation of all denuded areas, but requests that final detailed plans be presented at a later date for review by the Council prior to implementation. The following should be included in the final Feasibility Report:

12. * An attempt to determine the vegetation composition of the freshwater marsh areas prior to domination by *Phragmites*, if available, and use this information to develop a specific

10. These potential impacts will be further addressed in the PED phase with the assistance of the working group. Glyphosate is a contact herbicide which breaks down in water, making it the ideal means for Phragmites removal in an aquatic environment. All efforts will be made to time the spraying for maximum effectiveness against Phragmites while minimizing impacts to the surrounding area. It is anticipated that burning will be done in phases to provide some refuge for species which may be displaced from the Phragmites.

11. It is anticipated that the proper means to protect the endangered plants will be discussed and decided by the working group. Since the glyphosate will only impact plant species that it comes in contact with, some ideas for their protection include covering with plastic or constructing a small wooden "shelter" to cover the vegetation during the spraying.

12. A final planting list will be developed through coordination with the USFWS and the working group. During the May 1998 meeting, the Corps requested that the Natural Areas Council provide a list of species they would like to have planted on the site. In addition, current and historic plant communities will be taken into consideration.

revegetation plan for these wetlands.

13. * Resolution of the discrepancy between the acreage proposed for *Phragmites* removal (95 acres) and the acreage proposed for replanting (105 acres).

14. * A contingency plan that addresses the possibility that replanting efforts will be unsuccessful, including details on follow-up operations to ensure the success of plantings and discourage the return of *Phragmites*.

Component 5: Excavation to Restore Freshwater Flow Within Existing Drainage Ditches

Description of the Proposed Action - Due to both storm damage and erosion over the years, natural drainage channels that existed in The Meadows have been lost. This has hydrologically isolated many of the ponds, creating areas of stagnant water and low water flow, which has negatively impacted the area. Physically connecting some of the isolated ponds to the main ponds by restoring natural channels between them would be an improvement. Increasing the freshwater inputs into these isolated ponds will improve their water quality and promote the desired maintenance as a freshwater marsh. Flow restoration is also expected to decrease the spread of *Phragmites*. The proposed solution involves deepening or clearing out of several existing channels. Refer to Attachment D for a depiction of proposed channel clearing projects. Ditches to be excavated will be configured with a bottom width of 20 feet and 1 vertical:5 horizontal side slopes. Refer to Attachment E for a typical cross-section. Depth of excavation ranges from a maximum of 4 feet (in the Natural Area) to a minimum of 0.5 feet (in the South Cape May Meadows), depending on existing ground conditions. To prevent potential loss of freshwater from The Meadows via the existing Drainage East pipeline, a removable "shield" will be placed on the inlet structure (see Attachment A).

Treatment in Adopted Management Plan - The complex hydrology of the natural area is the result historical land alterations, storm events, sand deposition and ocean encroachment. The management plan outlines various recommended control structures to support the maintenance of desirable water levels, maintain freshwater habitat, encourage biological diversity, promote biological control of mosquitos, and improve water quality. However, these recommendations may not be currently valid based on changes in the hydrology of the area since adoption of the management plan. The plan indicates that the superintendent will monitor water conditions in the natural area, and that any water management activities will be coordinated with the ONLM prior to installation and construction.

Staff Recommendation - All of the excavations proposed in the Feasibility Report include excavations of previously existing drainage connections. Staff has discussed this component of the project with Superintendent Dean Cramer, who feels that the excavations will provide a significant benefit to the natural area by reducing stagnant water conditions in the ponds, increasing freshwater inputs, maintaining fish populations, reducing mosquito populations and the need for periodic application of chemical controls, and reducing periodic flooding. Staff recommends that the Council approve of the proposed excavations, but requests that final detailed plans be presented at a later date for review by the Council prior to implementation. The following should be included in the final Feasibility Report:

15. * A discussion of the potential impacts to the natural area resulting from the clearing of existing drainage ditches connecting hydrological elements. The discussion should include both direct and indirect impacts as well as the temporary secondary impacts to surrounding habitats.

13. The restoration will consist of 105 acres of wetlands being planted. This figure was arrived at by adding the acres of Phragmites to be removed (95 acres) to the acres of wetlands gained by moving the shoreline seaward (35 acres) and then subtracting the 25 acres of Phragmites area which will be converted to salt marsh and allowed to revegetate naturally.

14. The Corps will be actively monitoring the restoration site for a minimum of 5 years following all initial construction activities. If, during that time Phragmites begins to appear at the site, spot spraying of glyphosate or other removal methods will be employed. The vegetation that will be planted will also be monitored for growth and survival rates. If planting efforts are not successful, the cause of the problem will be evaluated and corrective measures taken. These measures could consist of changing the site hydrology or simply planting addition vegetation or different species of vegetation. Following the 5 years of monitoring, the responsibility of site maintenance will be turned over to the sponsor and the State Park and the Nature Conservancy.

15. It is expected that the impacts to the natural area resulting from the clearing of drainage ditches will be minimal and temporary. No material will be deposited within the natural area and existing elevations should not be changed. The possibility exists that equipment from the Mosquito Commission will be used for the excavation since this equipment is tailored to working in this type of environment with minimal impacts. Further details of the excavation (location of access roads, exact location of excavation, etc) will be finalized during PED with the help of the working group.

16. • Discussion of the need for retention of the Drainage East pipeline following hydrological modifications to the natural area.

Component 6: Creation of Two New Drainage Ditches Linking Hydrological Segments and Installation of Weir Flow Control Structures

Description of the Proposed Action - The two new drainage connections proposed under this component are intended to assist in accomplishing both control of *Phragmites* and increasing the availability of freshwater to the interior ponds of The Meadows. The drainage ditch proposed for the natural area (Attachment D) will connect Cattail Pond with an unnamed pond located just landward of the existing dune. The channel will have the same configuration as previously described (see Attachment E), but will be regulated with a weir control structure. The weir will consist of removable 10 foot wide timber flash boards which are supported by small concrete gravity walls designed to resist saturated earth pressures. The bottom width of the channels narrow from 20 ft to 10 ft at each weir structure. Graded riprap will be placed at the bottom of the channel at the entrance and exits of the weirs to provide scour protection. The side slopes of the channel in the transition between 20 and 10 feet bottom widths will be stabilized with geoweb, the compartments of which will be filed with low slump concrete. The geoweb will only be placed on those areas of the side slopes that result in slopes greater than 1V:3H as the channel narrows but bottom elevations remains essentially the same.

Treatment in Adopted Management Plan - Water management recommendations in the management plan indicate the presence of a ditch which roughly coincides with the eastern boundary of the park. The ditch does not directly extend to Cattail Pond but drains into the main drainage channel behind the beach. Installation of three "rudimentary weirs" along this channel is proposed to maintain optimum water levels within Cattail Pond, which at that time still supported a healthy surrounding stand of cattail. The Pond is now completely encircled by *Phragmites*. The drainage ditch proposed in the Feasibility Report would extend directly to Cattail Pond and would terminate at a weir structure near an unnamed pond located just landward of the existing dune.

Staff Recommendation - Creating a channel connecting Cattail Pond with the other hydrological elements throughout The Meadows should result in the same benefits gained from excavating existing drainage ditches throughout the natural area. Creation of this new channel is similarly supported by Superintendent Dean Cramer. Staff recommends that the Council approve of excavation of this channel, but requests that final detailed plans be presented at a later date for review by the Council prior to implementation. The following should be included in the final Feasibility Report:

17. • A discussion of the potential impacts to the natural area resulting from the creation of this new drainage ditch connecting hydrological elements. The discussion should include both direct and indirect impacts as well as the temporary secondary impacts to surrounding habitats.

18. • A discussion of the value of including a weir structure as part of this new drainage channel.

Component 7: Creation of Fish Reservoirs

Description of the Proposed Action - Hydrological alterations caused by storm event have resulted in the isolation of many of the ponds throughout The Meadows. As a result, many of the isolated ponds become completely dry during periods of low water. This can cause fish mortality,

16. See response number 3.

17. Per conversations with Park Superintendent, Dean Cramer, it was established that there is currently an existing channel leading from Cattail Pond to the area behind the dune. The channel is currently covered with vegetation. It is anticipated that the impacts associated with clearing this channel will be similar to those expected in other portions of the site.

18. This water control structure will serve as a tool to manage all water levels in the ponds and drainage ditches within the State Park and the Natural Area, not just Cattail Pond. It will also control the amount of water transferred from this portion of the project to the Nature Conservancy's portion of the project. This will allow the site to be better managed for birds and wildlife, lowering water levels when desired and holding water to prevent areas from completely drying out, when conditions permit.

increase mosquito breeding, and can have deleterious effects on species which depend on The Meadows as a source of food and water. The Feasibility Report proposes the excavation of six deep water fish reservoirs in The Meadows, three in ponds in the natural area. The purpose of the fish reservoirs will be to provide a constant source of water, even during periods of low rainfall. Constant water will allow the continued survival of fish living within the ponds and the birds that feed on them. Also, by creating deep water, the reservoirs will prevent mosquitos from breeding. This, in turn, will reduce the need for mosquito ditching and spraying, both of which result in negative impacts on other species. The reservoirs will be approximately three feet deep and 0.25 acres in size, and will slope back to the existing bottom level of the pond with side slopes of 1V:5H. Refer to Attachment D for locations of the proposed fish reservoirs in the natural area and to Attachment E for a typical cross section of a fish reservoir.

Treatment in Adopted Management Plan - Creation of fish reservoirs for the purpose of enhancing wildlife and controlling mosquitos was not envisioned in the management plan. Although the plan prohibits physical manipulation of the marshes by the Cape May County Mosquito Commission to control mosquito populations, water management measures conducted by the park to naturally control mosquito populations are acceptable.

Staff Recommendation - Staff has discussed this issue with Superintendent Dean Cramer, who feels that it is essential that deeper areas be created to avoid decimation of fish populations during periods of severe drought. He also supports the secondary benefits of maintaining fish populations, including mosquito larvae reduction and reduced need for chemical control of mosquitoes. Staff agrees that maintenance of fish populations fits into the overall goal of water management and mosquito control within the natural area. Staff recommends that the Council approve of the creation of fish reservoirs in the natural area if an analysis and determination in the final Feasibility Report demonstrates that this activity will not result in significant impacts to the natural area.

Component 8: Construction of a Berm Resulting in the Creation of 25 Acres of Tidal Wetland

This component is proposed for the South Cape May Meadows portion of the study area and has therefore not been subjected to staff review.

State of New Jersey

Christine Todd Whitman
Governor

Department of Environmental Protection

Robert C. S
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Office of Program Coordination
PO Box 418
Trenton, NJ 08625-0418
Phone 609-292-2662
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May 12, 1998

Mr. Robert L. Callegari
Chief, Planning Division
Philadelphia District, Corps of Engineers
Wanamaker Building, 100 Penn Square East
Philadelphia, PA 19107-3391

RE: Lower Cape May Meadows – Cape May Point
Draft Feasibility Studyand Integrated Environmental Impact Statement

Dear Mr. Callegari:

The Office of Program Coordination of the New Jersey Department of Environmental Protection (NJDEP) has completed its review of the Lower Cape May Meadows – Cape May Point Draft Feasibility Study and Integrated Environmental Impact Statement (IEIS). We offer the following comments for your consideration regarding natural resources, Coastal Zone Management rules, cultural resources, and open space resources.

NATURAL RESOURCES

The Department's Division of Fish Game and Wildlife has the following comments and concerns regarding this project:

1. The draft document lacks sufficient detail regarding the methods and phasing of the proposed project. Significant potential exists to temporarily disturb nesting habitat and disrupt nesting activity of least terns and piping plovers, depending on the methods and timing of the proposed project. Much more detail should be presented in the final IEIS so that negative short-term impacts of proposed activities on endangered beach nesting birds can be adequately ascertained and avoided.

2. Studies on piping plover feeding and nesting in areas where "back bay" or other "back water" feeding habitats are available have shown that these areas are used preferentially to oceanfront feeding areas. In these same studies, plovers that used these "alternative" feeding habitats has greater nesting productivity than those that did not. Prior to the most recent reconstruction of the dune/dike and the

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1. It is anticipated that beach construction activities will be scheduled to avoid plover and tern nesting seasons. Further details regarding the timing of other construction activities will be finalized during the PED phase of the project. Extensive coordination between the Corps and other interested groups and agencies will be conducted to ensure that the timing of the work will not have significant impacts on any nesting species.

2. Through coordination with the USFWS and NJDEP, it has been decided that plover "walkovers" will be created on the new dune to allow plovers (and other birds) access to the back water feeding habitat. Each walkover will be approximately 100' wide and will be spaced approximately 600' apart along most of the length of the project. The walkovers will have an approximate slope of 1:7 and will have very sparse vegetative coverage. The exact location of each walkover will be coordinated with the appropriate agencies. In addition, the Corps is investigating the possibility of creating an overwash area within the tidal portion of the site for plover usage.

commencement of the Cape May City beach fill project, periodic breaches in the dunes at south Cape May Meadows provided back water feeding habitat in the form of sand and mud flats extending into freshwater wetlands areas. Overwash nesting habitat was also created by storm events. If the proposed project is carried out, not only will remnants of this habitat type be lost, future natural creation of such areas will be prevented. The report does not adequately address this issue and there appears to be no creation of back water feeding habitats or provisions for access to such areas included in the preferred alternative.

The Division of Fish, Game and Wildlife recognizes that the natural provisions of overwash nesting habitat and feeding habitat may be incompatible with protection of freshwater wetland habitats behind the dune. If so, the study should acknowledge the loss of this important piping plover feeding habitat, address potential impacts to plovers, and weigh the loss of this habitat against the gains for other species and habitats. The proposed project should also include attempts at mitigating for the losses of overwash nesting habitat and back water feeding habitat.

3. Dune plantings should include only native species. Japanese sedge should definitely not be used as it forms dense stands and it out-competes native species. Vegetation of the dune should allow for within-dune nesting of piping plovers and should not be so dense as to preclude that use of back water feeding habitats by unflighted plover chicks. A vegetation control plan should be included to insure that dunes do not become over-vegetated in the vicinity of piping plover nesting areas.

4. The area selected for extraction of beach material is within an area denoted by the Division of Fish, Game and Wildlife as a "Prime Fishing Area" and as such, should not be subjected to sand or gravel mining which would alter existing bathometry to a significant degree (7:7E-3.4). Such sand mining could have significant impacts upon the commercial and recreational fishing fleet that is important to the Cape May County economy.

5. The heavy presence of juvenile surf clams found in the sampling causes us to be concerned that the sand mining could deplete a major population. We recommend that another season of sampling be conducted on the borrow sites to determine if the young surf-clam population is actually thriving or just transitory in nature. No extraction from these two sites should be conducted until this is determined.

COASTAL ZONE MANAGEMENT RULES

6. The Department's Land Use Regulation Program is also reviewing the draft IEIS. They have determined that the selected plan is inconsistent with a number of Coastal Zone Management (CZM) rules (prime fishing area, surf clam area, threatened and endangered species habitat, see **NATURAL RESOURCES** section of this letter). The Land Use Regulation Program will forward a letter directly to your office suggesting measures that would make the project consistent with the CZM rules.

3. Japanese sedge will be removed from the planting plan. As stated above, the plover "walkovers" will allow access over the top of the dunes and will also provide areas of sparse vegetation.

4. Coordination on this issue is ongoing with NJDEP. Initial coordination has resulted in the Corps trying not to use borrow area P2 as well as investigating reorienting borrow area P1. In addition, the possibility exists that sand could be obtained from Cape May Inlet for nourishment activities. The Corps will continue to investigate these alternatives and coordinate the results with NJDEP during the PED phase.

5. Concur. Surf clam sampling will be conducted in the PED phase of the project, prior to any excavation activities.

6. Please refer to the enclosed NJDEP Land Use Regulation Program letter and the Corps response letter with regard to these issues.

CULTURAL RESOURCES

7. The Department's Office of Historic Preservation has completed its review of the DIEIS and the draft Phase I survey for the project. The preliminary finding of the review was sent directly to you in the attached April 29, 1998 letter. Their preliminary findings note, "It does appear at this time, however, that with HABS/HAER level recording, and the monitoring to ensure avoidance of impacts as proposed in your March 25, 1998 letter, that the effect on Harbor Defense Batteries #223 and #26 will not be adverse. After additional fieldwork and analysis of treatment options, the Office will be able to provide you with our determination of effect for the project."

OPEN SPACE RESOURCES

The Department's Division of Parks and Forestry supports this project. Dean Cramer, Superintendent of Cape May Point State Park, has been coordinating the interest of his Division with your office.

Thank you for the opportunity to comment on the draft document for this important project.

Sincerely,

Lawrence Schmidt
Director
Office of Program Coordination

C: Bernard Moore, NJDEP
Robert McDowell, NJDEP
Andy Didun, NJDEP
Lee Widjeskog, NJDEP
Dean Cramer, NJDEP
Ruth Ehinger, NJDEP
Helen Fasano, NJDEP
Dorothy Guzzo, NJDEP
Deborah Fimble, NJDEP

Attachment

7. Concur. All additional investigations will be provided to the Office of Historic Preservation in order for them to make a determination of project effects.

State of New Jersey

Christine Todd Whitman
Governor

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Division of Parks & Forestry
Historic Preservation Office
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Robert C. Sh
Comm

April 29, 1998
HPO-D98-165

Mr. Robert L. Callegari
Chief, Planning Division
Department of the Army
Philadelphia District, Corps of Engineers
Wanamaker Building, 100 Penn Square East
Philadelphia, Pennsylvania 19107-3391

ATTN: Michael Swanda:

Dear Mr. Callegari:

Thank you for having provided the opportunity to review the Draft Feasibility Report and Integrated Environmental Impact Statement for the Lower Cape May Meadows – Cape May Point Feasibility Study and the draft Phase I survey for the project prepared September 1997 by Dolan Research, Inc. and Richard Hunter, Inc. The draft report is acceptable as prepared. We concur that Harbor Defense Batteries #223 and #26 are eligible for inclusion in the National Register of Historic Places under Criteria A, C, and D. The Office looks forward to receiving additional information about Delaware Harbor Defense Battery #7 and Cape May Point Bunker in terms of remains present, potential eligibility and specific treatment proposed. Once additional survey is conducted on this resource and on the 1847 Cape May Lighthouse site, I will provide the Corps of Engineers with Section 106 comments of the project as a whole. It does appear at this time, however, that with HABS/HAER level recording, and the monitoring to ensure avoidance of impacts as proposed in you March 25, 1998 letter, that the effect on Harbor Defense Batteries #223 and #26 will not be adverse. After additional fieldwork and analysis of treatment options, the Office will be able to provide you with our determination of effect for the project.

Thank you again for your submission and for your continuing stewardship of New Jersey's historic resources. If you have any questions, please do not hesitate to contact Deborah Fimbel.

Sincerely

Dorothy P. Guzzo
Deputy State Historic
Preservation Officer

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1. Concur. All additional investigations will be provided to the Office of Historic Preservation in order for them to make a determination of project effects.

State of New Jersey

Todd Whitman

Department of Environmental Protection
Land Use Regulation Program
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Robert C. S.
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April 9, 1998

Robert L. Callegari
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Philadelphia, Pennsylvania 19107-3391

RE: Lower Cape Meadows – Cape May Point Feasibility Study
Federal Consistency Determination and Section 401 Water Quality Certification

Dear Mr. Callegari:

This is to request additional information regarding the above referenced Federal Consistency determination. You have not provided sufficient information for the Land Use Regulation Program to make a favorable determination for this project. Please submit 3 copies of the information as enumerated below to assist in the determination.

1. Provide a bathrymetric survey which shows the proposed borrow areas.

2. Provide a detail drawing of the proposed borrow areas, showing pre and post dredge contours.

3. Based on your sediment transport data and tidal current data can you determine if the borrow sites will fill back up, or if new lumps will be created, and approximately how long that will take?

4. Please address potential impacts to marine fish, horseshoe crab habitat, and prime fishing areas associated with the dredging operation.

5. Please provide any additional sampling data that you may have for surf clams in the borrow areas. The Bureau of Shellfisheries has seen an increase in the density and size of surf clams in the project area in recent years, which may indicate that the population is rebounding. Additional information, such as recent clam surveys are needed to determine if the borrow areas are surf clam habitat.

6. Please provide more specific information regarding the location of State listed threatened and endangered plant species relative to the areas where Phragmites will be sprayed or burned.

7. Does the project entail the extension of any existing outfalls, or the creation of new outfalls either in the ocean or State open waters?

The various offices within our Division of Fish, Game and Wildlife are still reviewing the initial information provided by your office, and I anticipate that additional questions and concerns will arise over the next few weeks. The information requested above will assist in their review.

The 45 day decision deadline for this consistency determination is May 3, 1998. As Mark Mauriello discussed with you today, we would like to request an additional 45 day review period, with the intent of working out any outstanding issues that would prevent the Land Use Regulation Program from making an unfavorable decision on this study.

If you have any questions regarding this request please do not hesitate to call me or Mark Mauriello at (6509)292-8262.

Sincerely,

Helen A. Fasano

Helen A. Fasano
Project Manager, Shorefront Region
Bureau of Coastal Regulation

c. Beth Brandreth, U.S. ACOE, Philadelphia District

In response to this letter, the Corps wrote a response letter which can be found immediately following the NJDEP letter.

Helen A. Fasano
Project Manager, Shorefront Region
Bureau of Coastal Regulation
Land Use Regulation Program
Department of Environmental Protection
State of New Jersey
P.O. Box 439
Trenton, New Jersey 08625

Dear Ms. Fasano:

Provided are responses to comments from your letter dated 9 April 1998.

Comment #1. Provide a bathymetric survey which shows the proposed borrow areas.

Response #2. *Attached are three figures that depict the bathymetry of proposed borrow sites P1 and P2. Figure 1 shows the spatial relationship of P1 and P2 relative to existing borrow area M1. Figure 2 presents a detailed view of Area P1, and Figure 3 presents a detailed view of Area P2. Scales are indicated on each figure. The bathymetric data were obtained from the National Ocean Service (NOS) digital hydrographic survey (i.e., "bathymetric") database for the US East Coast. The original digital data were imported into the Corps of Engineers' Groundwater Modeling System (GMS) for manipulation. A Triangulated Irregular Network (TIN) was created for the zone from Cape May Point east to Cape May Inlet, out to a distance of about two miles from the shoreline. The included figures were extracted from the larger mapped offshore area. The vertical datum of the soundings is NAVD88, which is approximately equivalent to an elevation of + 3.0 feet MLLW. Therefore a depth shown on the figures as "-10 feet NAVD88" is approximately equal to a depth of "-7 feet MLLW."*

Comment #2. Provide a detail drawing of the proposed borrow areas, showing pre- and post-dredging contours.

Response #2. *Pre-dredge contours can be seen in figures 1-3. A schematic showing the dredging depth to the borrow areas (P1 and P2) can be found in figure #4.*

Comment #3. Based on your sediment transport data and tidal current data, can you determine if the borrow sites will fill back up, or if new lumps will be created, and approximately how long that will take?

Response #3. *During the Feasibility Study, we evaluated historic bathymetric changes between 1937, 1972, and 1994-96, and tidal current and wave transport of bottom sediments offshore of the study area. These analyses indicated that significant sediment transport occurs over time scales of years to decades, out to at least a distance of 2 miles from the present Cape May Point to Cape May Inlet shoreline. This sediment transport is reflected in relatively large changes in the configuration of the offshore bottom, as shoal and "scour trough" features migrate generally in a northwestward direction toward the entrance to Delaware Bay. While we presently have a reasonable qualitative understanding of this transport, we are unable to determine either the quantity of material that may "refill" the borrow area or the duration required. Additional analysis will be performed during the Preconstruction, Engineering, and Design (PED) phase to improve our quantitative understanding of transport rates and directions.*

Comment #4. Please address potential impacts to marine fish, horseshoe crab habitat and prime fishing area associated with the dredging operation.

Response #4. *Potential impacts to marine fish and fishing areas are addressed on pages 7-27 and 7-29 of the Draft Feasibility Report and Integrated EIS. It is not anticipated that the potential impacts associated with the dredging operation will be significant or long term with respect to marine fish or fishing areas.*

It is not anticipated that the dredging operations associated with this project will impact horseshoe crab habitat. The removal of material from the borrow areas will change the depth and possibly the topography of the borrow areas but not in such a way as to preclude horseshoe crab use in this area. In addition, dredging activities will most likely take place outside of the horseshoe crab spawning season so impacts to horseshoe crab spawning are not likely. In fact, once the project is constructed, a larger, more stable beach will exist which may actually be beneficial to spawning horseshoe crabs.

Comment #5. Please provide any additional sampling data that you may have for surf clams in the borrow areas. The Bureau of Shellfisheries has seen an increase in the density and size of surf clams in the project area in recent years, which may indicate that the population is rebounding. Additional information, such as recent clam surveys are needed to determine in the borrow areas are surf clam habitat

Response #5. *The original benthic sampling for this project was conducted by Versar, Inc. in September of 1996. Since this time, no further benthic or surf clam sampling has been conducted. Based on reports from the Bureau of Shellfisheries, the Corps was under the impression that the surf clam populations in the area where the borrow areas are located were not substantial enough to warrant specific surf clam sampling (ie. surf clam tows). In addition, on April 8, 1997, a copy of the benthic report was sent to Ms. Gail Rowe, NJDEP, for review and comment. No comments were received on the report.*

Based on the above information, no further surf clam information is available at this time.

Comment #6. Please provide more specific information regarding the location of State listed threatened and endangered plant species relative to the areas where Phragmites will be sprayed and burned.

Response #6. *Enclosed is a copy of the rare, threatened and endangered plant survey which was conducted for this project. Included with this survey is a map outlining the location of threatened and endangered plant species which were identified during the 1995/1996 survey. In addition, as stated in the Draft Feasibility Report and Integrated EIS, another survey will be conducted prior to construction to accurately locate any species which may be present at that time.*

Comment #7. Does the project entail the extension of any existing outfalls, or the creation of new outfalls either in the ocean or State open waters?

Response #7. *Page 7-5 of the Draft Feasibility Report states that the existing Drainage East outfall pipe does not extend past the construction template and will need to be extended 112 feet. It should be noted that a removable "shield" would be placed on the inlet structure leading to this outfall to prevent unnecessary freshwater loss to the ecosystem.*

Regarding your request for a 45 day extension to review the report; the study sponsor, New Jersey Department of Environmental Protection, Bureau of Engineering and Construction, is anxious to begin the next phase (Preconstruction, Engineering, and Design) for this potential project. Any extension of the existing review period, which ends 11 May 1998, would delay the initiation of that phase and also impact scheduled milestones. Please assist us in meeting our schedule.

Please contact Mr. Carmen Zappile (215-656-6576) of my office if you have any questions or require further information.

Sincerely,

Robert L. Callegari
Chief, Planning Division

State of New Jersey

ine Todd Whitman
nor

Department of Environmental Protection
Land Use Regulation Program
P.O. Box 439, Trenton, New Jersey 08625
FAX # (609) 777-3656
FAX # (609) 292-8115

Robert C.
Comr

May 8, 1998

Robert L. Callegari
Chief, Planning Division
Department of the Army
Philadelphia District, Corps of Engineers
Wanamaker Building
100 Penn Square East
Philadelphia, Pennsylvania 19107-3391

RE: Lower Cape Meadows – Cape May Point Feasibility Study
Federal Consistency Determination and Section 401 Water Quality Certification
Land Use Regulation Program File No. 0503-98-0002.1

Dear Mr. Callegari:

The U.S. Army Corps of Engineers has proposed a project intended to provide ecosystem restoration to Lower Cape May Meadows and storm damage reduction to Cape May Point. The project includes construction of a dune/berm, initial sand nourishment of 1,247,000 cubic yards with periodic nourishment of 650,000 cubic yards every 4 years over a 50 year project life, seaward restoration of 35 acres of emergent wetland, elimination of 95 acres of Phragmites australis, planting 105 acres of emergent wetland, excavation of existing drainage ditches and creation of new drainage ditches, installation of 2 weir flow control structures, creation of 6 fish reservoirs within existing ponds, construction of a low earthen berm, and creation of 25 acres of tidal marsh.

The New Jersey Department of Environmental Protection, Land Use Regulation Program, acting under Section 307 of the Federal Coastal Zone Management Act (P.L. 92-583) as amended, has reviewed the "Lower Cape Meadows – Cape May Point Feasibility Study, Draft Feasibility Report, Integrated Environmental Impact Statement (EIS) Appendix A through G, Volumes 1 and 2" dated November 1997. The Program has also considered information discussed at a May 11, 1998 meeting with Carmen Zappile of the ACOE, Mark Mauriello of the Land Use Regulation Program, and representatives of New Jersey's Division of Fish, Game and Wildlife, and additional information submitted in the form of a letter from Richard Callegari to Helen Fasano on April 20, 1998. Based on the above, the Program has determined that the draft plan and project as currently designed can not be found consistent, with New Jersey's Rules on Coastal Zone Management N.J.A.C. 7:7E-1.1 et seq, as amended to February 17, 1998 and the applicable Rules guiding issuance of a Section 401 Water Quality Certificate. However, provided that the

In response to this letter, the Corps wrote a response letter which can be found immediately following the NJDEP letter. In addition, a meeting was held between the Corps and NJDEP, Land Use Regulation Program on 9 July, 1998 to discuss outstanding issues.

ACOE can satisfactorily address the issues discussed in this letter in the Final Report and Plans submitted for a federal consistency, a favorable determination will be made upon review of that report.

7:7E-3.3 Surf Clam Areas

Development which would result in destruction, condemnation, or contamination of surf clam areas is prohibited. Sampling performed by Versar, Inc. in September 1996 indicate that a heavy presence of juvenile surf clams was found in borrow areas P1 and P2, with approximately 39 percent of the clams greater than 2 cm at borrow area P1, and none greater than 2 cm at borrow area P2. Versar found, and the Bureau of Shellfisheries concurs, that these results indicate that although juvenile surf clams are settling and surviving in borrow area P2, they may not be reaching older life stages. Prior to submission of the final report the ACOE shall sample the borrow areas for another season to determine if the young surf clam population is actually thriving or just transitory in nature. No extraction from these two sites (P1 & P2) may occur until this determination is made by the Department. If the population is found to be thriving, the ACOE shall coordinate with the NJDEP Bureau of Shellfisheries to locate another borrow area, or to develop a management plan to minimize impacts to the surf clam area. The plan may include, but not be limited to, pre-dredging harvest, and restricting the location or contours of the borrow area. Be advised that due to the high mortality rates surf clam transplant is not a practicable alternative.

7:7E-3.4 Prime Fishing Areas

Prohibited uses include sand or gravel submarine mining which would alter existing bathymetry to a significant degree so as to reduce the high fishery productivity of these areas. The proposed dredging of borrow areas P1 and P2 will result in the destruction of underwater sand formations ("lumps and fingers") which are prime fishing areas where fish tend to congregate. Prior to the submittal of the final report the ACOE shall coordinate with the NJDEP Bureau of Marine Fisheries to locate another borrow area which is not a Prime Fishing Area or Surf Clam Habitat. The Bureau of Marine Fisheries has recommended that you investigate areas to the northeast, closer to the Cape May Inlet. Only one 1980 CERC core was taken from this area, so it has not been ruled out for consideration based on grain size or quantity.

7:7E-3.16 Dunes

Development is prohibited on dunes, except for development that has no practicable or feasible alternative in an area other than a dune, and that will not cause significant adverse long-term impacts on the natural functioning of a dune system, either individually or in combination with other existing or proposed structures, land disturbance or activities. In addition, the removal of vegetation from any dune, and the excavation, bulldozing or alteration of dunes is prohibited, unless these activities are a component of a Department approved beach and dune management plan. The final report should only include option 1 which would entail excavation behind the dune, and options 2 and 3 should be eliminated as they would result in the excavation of the existing dunes. Retaining the existing dunes will provide a secondary line of defense and provide beach nesting bird habitat in response to the anticipated loss of beach and dune between renourishment cycles. In addition, the final report/plan should address the existing, interim dune protection provided by the marine mattress installation in the vicinity of the state park. Specifically, the continued maintenance of the revetment, its potential long term impacts to wildlife, including shorebirds, and its suitability for an ecosystem restoration project shall be evaluated.

7:7E-3.27 Wetlands

Development in wetlands defined under the Freshwater Wetlands Act of 1987 is prohibited unless the development is found to be acceptable under the Freshwater Wetlands Protection Act Rules (N.J.A.C. 7:7A). The construction of a berm for the creation of 25 acres of tidal wetlands will result in the discharge of more than 10 cubic yards of fill into freshwater wetlands. The proposed project also involves excavation of freshwater wetlands to restore natural channels to reestablish drainage between ponds, and the creation of a new ditch connecting Cattail Pond with the other hydrological elements throughout the Meadows, the construction of 2 weir control structures, and the excavation of six deep water fish reservoirs. These activities are subject to the Freshwater Wetlands Protection Act of 1987, and an Individual Freshwater Wetlands permit (N.J.A.C 7:7A-3) is required for the proposed project. The final report shall include an alternatives analysis, shall address both direct and indirect impacts to surrounding habitats, and shall clearly demonstrate compliance with the permit standards contained in the Freshwater Wetlands Protection Act Rules (N.J.A.C. 7:7A).

7:7E-3.36 Historic and Archaeological Resources

Development that detracts from, encroaches upon, damages, or destroys the value of historic and archaeological resources is discouraged. The Historic Preservation Office concurs that Harbor Defense Batteries #223 and #26 are eligible for inclusion in the National Register of Historic Places under Criteria A, C, and D. The Historic Preservation Office has requested additional information from the ACOE regarding Delaware Harbor Defense Battery #7, and Cape May Point Bunker, in terms of remains present, potential eligibility and the specific treatment proposed. The ACOE shall coordinate with the Historic Preservation Office to conduct the necessary additional survey on the 1874 Cape May Lighthouse site and to develop a plan to avoid potential impacts to this resource.

Be advised that if alternative borrow areas are proposed, the ACOE is required to perform the necessary cultural surveys and coordinate with the Historic Preservation Office to develop a plan to avoid potential impacts to the resources.

7:7E-3.38 Endangered and Threatened Wildlife or Vegetation Species Habitat

Development in this special area is prohibited unless it can be demonstrated that endangered or threatened wildlife or vegetation species habitat would not directly or through secondary impacts on the relevant site or in the surrounding area be adversely affected. Mitigation (7:7E-1.6) shall be selectively considered on a case-by case basis as compensation for the loss or degradation of a particular natural resource. In general, mitigation should be similar in type and location to the resource disturbed, destroyed, that is replacement in kind, within the same watershed.

1. The proposed project will result in loss of overwash nesting habitat and back water feeding habitat for piping plover. Preserving these existing habitats is not compatible with protection of the freshwater wetland habitats behind the dune, therefore, impacts to

these areas must be addressed, and mitigation for lost habitat must be provided. A mitigation plan shall be developed that includes the creation of one or more overwash and

back water feeding areas, not connected to the freshwater wetland restoration area, as part of this "ecosystem restoration" project, and the plan shall demonstrates that the gains associated with the new plover habitat out weighs the loss of existing beach nesting bird habitat. A beach nesting bird habitat management plan shall be developed in cooperation with NJDEP Division of Fish, Game and Wildlife, and the U.S. Fish and Wildlife Service. The management plan shall address impacts associated with the initial construction as well as impacts associated with maintenance. The management plan shall also include, but not be limited to, buffers, timing restrictions, maintenance vehicle access and limitations, habitat maintenance, sand fence maintenance, and vegetation maintenance. The planting of Japanese sedge shall be deleted from the project plan as it is a non-native species that out-competes native species and forms dense stands that degrade plover nesting habitat and preclude use of back water for feeding by unflighted plover chicks.

2. Adverse impact to State and Federal listed endangered and threatened species is anticipated from the proposed Phragmites control measures and the final report shall address these impacts in greater detail. Bald Eagle, Peregrine Falcon, Piping Plover, Coopers Hawk, Northern Harrier, Upland Sand Piper, Roseate Tern, Least Tern, Skimmer, Short-eared Owl, Cliff Swallow, Short-billed Marsh Wren, Pied-billed Grebe, Southern Gray Tree Frog, Keen Myotis, Small-footed Myotis, Silver-haired Bat, Hoary Bat, S. Flying Squirrel, rice Rat, S. bog Lemming, Meadow Jumping mouse, Least Shrew, Starnose Mole, Red-headed Woodpecker, Barred Owl, Merlin, Osprey, Red-shouldered Hawk, Yellow-crowned Night Heron, Great Blue Heron, Bobolink, Savannah Sparrow, Grasshopper Sparrow, Owl-leaved Rush, Butterfly Pea, Whorled Marsh-pennywort, Mistflower, and Narrow-leaved Wild Crab Apple critical and unique habitats have been identified at the Lower Cape May Meadows by the HEP team. The ACOE shall coordinate with the NJDEP Natural Lands Management Program to develop a thorough survey of the entire treatment area and all surrounding areas for the presence of State and Federally listed rare plants, and rare/endangered reptiles, amphibians and fish species. The management plan shall include the development of an accurate map of the proposed Phragmites removal areas, a complete assessment of the potential impacts of glyphosate application and prescribed burning on wildlife, including all Federal and State threatened and endangered species, and specific means by which the rare/endangered wildlife will be shielded from the effects of glyphosate application and controlled burning must be provided together with follow-up measurers for control of Phragmites should the applied procedure fail.

Public Open Space 7:7E-3.40

Development within existing public open space, is conditionally acceptable, provided that the development complies with the Rules on Coastal Zone Management and is consistent with the character and purpose of public open space, as described by the park master plan when such a plan exists. The final plan shall address maintenance of access to park vehicles landward of the reconstructed dune for trail maintenance and emergency purposes.

7:7E-4.2(l) Acceptability Conditions for Uses, Standards relevant to sand and gravel extraction

Sand extraction for beach nourishment is conditionally acceptable provided that special areas are not directly or indirectly degraded. Provided that the ACOE fulfills the recommendations made by the Land Use Regulation Program, as described in this letter, the project will found to be consistent with this rule.

If you have any questions regarding this letter, or would like assistance in coordination with the Division of Fish, Game and Wildlife, please do not hesitate to call Helen Fasano of our staff at (609) 292-8262.

Sincerely,

Richard H. Kropp
Director
Land Use Regulation Program

c: Beth Brandreth, U.S. ACOE, Philadelphia District
Carmen Zappile, U.S. ACOE, Philadelphia District
Bernie Moore, NJDEP 1510 Hooper Avenue, Toms River, NJ 08625

JUN 1 2 1998

Planning Division

Richard H. Kropp
Director, Land Use Regulation Program
New Jersey Department of Environmental Protection
PO Box 439
Trenton, New Jersey 08625

Dear Mr. Kropp:

In your letter of 8 May 1998, your office determined that the draft Lower Cape May Meadows - Cape May Point Feasibility Study and Integrated EIS were not consistent with New Jersey's Rules on Coastal Zone Management N.J.A.C. 7:7E-1.1 et seq, as amended to February 17, 1998 and the applicable Rules guiding issuance of a Section 401 Water Quality Certificate. Your letter did indicate however several items where more information was needed by your office in order to change this determination to a favorable one, in terms of federal consistency. This letter serves to provide responses to these items with the hope of bringing closure to some of the outstanding issues.

7:7E-3.3 Surf Clam Areas

As discussed in our April 22, 1998 meeting with members of your staff, it will not be possible for further surf clam monitoring to be undertaken prior to the submittal of the final Feasibility Report. Funding for this type of investigation will not be available until the next phase of the project. As also discussed on April 22, we would again like to express our frustration regarding the issue of surf clams as they relate to this project. In April, 1997, a copy of our benthic sampling results, performed by Versar, Inc., was forwarded to your office. Comments and requests for additional sampling were never received until following the review of the draft Feasibility Report in April 1998. Had comments been received prior to the distribution of the draft report, additional surveys could have been conducted at that time in order to determine the proper course of action. Therefore, due to the substantial delay in comments from your office, we are now requesting an equitable and expedient resolution to this matter. When additional funding becomes available in the next phase (currently estimated to begin September 1998), additional surf clam surveys will be conducted and the results forwarded to your office. If the results of these surveys indicate that a thriving surf clam population exists in either borrow area P1 or P2, a management plan will be developed to minimize impacts to the surf clam area. Per your

suggestion, the plan may include, but not be limited to, pre-dredging harvest, and restricting the location or contours of the borrow area. Due to the possible presence of unexploded ordnance in much of the surrounding area (and the original borrow area for the project, see 2-53 of the report) we believe that changing the borrow area(s) is not practicable.

7:7E-3.4 Prime Fishing Areas

As stated above, we do not believe that relocating the borrow area is practicable. In addition to the possibility of unexploded ordnance, the area immediately adjacent to borrow area P1 is currently the borrow area for the ongoing beachfill project at Cape May City. There is not enough material to additionally supply a project at The Meadows location. The Bureau of Marine Fisheries recommended we investigate areas to the northeast, closer to Cape May Inlet. A significant problem associated with this suggestion is the large increase in cost associated not only with investigating a new borrow area (which includes geotechnical, benthic, and cultural investigations) but also the large additional cost incurred when having to pump the sand over a much greater distance. These additional costs would be shared between the Corps and the non-federal sponsor (NJDEP). This cost is already substantial since the original borrow area proposed (during the Reconnaissance Study, August 1994) for the project was ruled out due to the unexploded ordnance issue. In addition, the Corps would have been in a better position to address this possibility if comments had been received following your initial receipt of the borrow area information.

The Corps is more than willing however to do everything possible to minimize impacts to the bathymetry of the site in order to minimize impacts to the fishery habitat. Minimization techniques can include, but not be limited to, avoiding areas within the borrow site(s) with exceptional bathymetry features and creating new "lumps and fingers" following the sand excavation. In addition, as stated in the draft Feasibility Report, it is planned that sand excavation for nourishment activities will be taken only from portions of the borrow areas and that dredging areas will be rotated from one cycle to the next.

7:7E-3.16 Dunes

Your letter of 8 May 1998 states "In addition, the removal of vegetation from any dune, and the excavation, bulldozing or alteration of dunes is prohibited, unless these activities are a component of a Department approved beach and dune management plan". Based on this statement, your office recommends that the dune not be moved seaward to restore 35 acres of wetland habitat since this would require the excavation of the existing dunes. All beach/dune restoration alternatives that were considered during the feasibility study require some excavation, bulldozing and alteration of the dunes in order to construct them to the proper design template. This work will take place regardless of whether or not the shoreline is moved seaward. In addition, we feel that the proposed project <u>is</u> a component of a Department approved beach and dune management plan and will <u>not</u> result in a negative alteration of the dune. The study was requested and funded, in part, by the Department. The project would result in the protection and restoration of State property. All aspects of the plan have been fully developed and coordinated with the Cape May State Park Superintendent, Dean Cramer to meet the management goals of the State Park. The proposed project was also conditionally approved by the Natural Areas Council at a meeting held on 5 May 1998. In addition, the Department will be funding approximately 20% of the construction costs and will be responsible for operation and maintenance of the project over its 50 year-life.

Another point that should be mentioned is the fact that the existing dune system has been essentially man-made since, at least, following the March 1962 storm. Due to continued storm damage and erosion, these dune have been repaired and rebuilt over the years, most recently in 1986, 1991, 1992, and 1996. The existing dunes, rebuilt in 1996, use I-5 stone and recycled concrete as the dune core. In addition, the existing dunes have been disturbed due to a recent NJDEP project. This project installed Tensar mats at the toe of the dune from Cape May Point to the bunker in front of Cape May Point State Park. This activity has removed vegetation from the dune and involved some excavation around the toe of the dune.

In terms of benefits associated with a double dune system, the Corps did look into this alternative early in the planning stage. This alternative was not carried into the final plan

formulation for several reasons. While a double dune does offer some protection and habitat benefits to some species, it is not as significant as the habitat value provided by the 35 acres of restored wetlands. In addition, the value of this double dune habitat is very hard to quantify, especially in terms of a HEP analysis since most beach nesters do not require a double dune but do require easy access to water. Additionally, a double dune system would significantly increase the distance plovers would have to travel between nesting habitat and freshwater feeding habits. Double dunes are also more likely to support the growth of secondary vegetation which would further hinder the movement of plovers. Another factor which comes into play is cost. With the proposed plan, the sand from the existing berm and dune will be used for the new berm and dune. If the existing dune is left in place, that much more sand would need to be excavated from the borrow area which would increase costs and increase the impacts to the benthic and surf clam populations within the borrow area, while providing less benefits than the restored wetlands. Finally, historical conditions come into play. Historically, a double dune system has not existed at The Meadows and Corps regulations do not allow us to undertake "enhancement" activities which would make an area better than it has been in the past. One other point we would like to mention is that with the implementation of the proposed project, it is expected that between nourishment cycles some of the sacrificial beach and dune will be lost but the dune will remain intact, providing protection to The Meadows and beach nesting habitat.

The draft report does mention the Tensar mattresses which have been installed in the vicinity of the State Park. The final report will update this information to address the change in site conditions (i.e. extension of the mattresses) since the draft report was written. This project is a NJDEP project, and they can provide information regarding expected maintenance of the mattresses or their potential long term impacts. We can discuss the mattresses in relation to our project however. With the implementation of the proposed beach and dune restoration, the mattresses would be completely covered by sand. Once this is done, the mattresses would function like a hardened dune core which would continue to act as a last line of defense in the event that a large storm were to damage or destroy the dune. Once the project is in place, we do not expect the mattresses to have any impact on wildlife, shorebirds, or the ecosystem restoration project.

7:7E-3.27 Wetlands

We believe that the application for CZM and Water Quality is sufficient for the state to render a decision on applicable state policies and regulations.

7:7E-3.36 Historic and Archaeological Resources

Concur. The Corps will continue to coordinate with the Historic Preservation Office in order to protect and minimize impacts to any historic resources present at the site. Funds have already been budgeted for the next phase of study in order to further evaluate these resources and develop a management plan to avoid/minimize potential impacts. At this time however, it is believed that the proposed project may actually serve to protect these sites from further environmental degradation by covering them with sand.

7:7E-3.38 Endangered and Threatened Wildlife or Vegetation Species Habitat

While overwash areas do exist at The Meadows landward of the dune, these areas are not (and have not in the recent past) used by piping plovers as nesting habitat. Therefore, while removal of the overwash areas may result in the loss of potential nesting habitat, no active nesting habitat will be permanently lost. The overwash areas are disturbed areas where the elevation has been raised by sand through the overtopping of the dunes. This makes these areas perfect for Phragmites colonization, which is exactly what is happening right now in many of the areas. Without some form of intervention, these areas will not be suitable as potential nesting habitat in the near future.

We do not believe that the proposed project is likely to adversely affect piping plovers. The goal of this project is environmental restoration and protection. The result of the restoration will be the creation of high quality nesting habitat for the plover and other beach nesting birds. Access to backwater feeding habitats will be similar to what presently exists. Concern has been raised however about the density of vegetation and the slope of the dunes in terms of plover access to the backwater feeding areas. For this reason, the Corps has been coordinating with the USFWS in order to ensure that several areas of sparse vegetation will be incorporated into the project design so plover movement will not be impeded. As a result of

this coordination, the final design for the project will include "plover walkovers". These walkovers will be approximately 100 feet wide and spaced approximately 600 feet apart along the dune, starting at the bunker and extending to the limits of the Nature Conservancy's property. The walkovers will have an approximate slope of 1:7 to allow easy access for plover chicks. These areas will also be maintained to ensure that vegetation coverage does not exceed 10%, and the walkways will be fenced off to discourage pedestrian traffic over the dunes in these areas.

At the request of the USFWS, the Corps is preparing a Biological Assessment for piping plovers. This assessment will cover The Meadows project as well as all other District projects which have the potential to impact piping plovers. Based on the results of this Assessment, and the Biological Opinion to be prepared by the USFWS, guidelines will be developed to minimize (or mitigate) impact to the plover which may be associated with construction or maintenance activities for this and other Corps projects. The Corps and the USFWS will be working closely with NJDEP Division of Fish, Game and Wildlife to develop these guidelines.

As stated in the draft report, all necessary precautions will be taken to protect threatened and endangered plant and animal species, as well as other wildlife species. The draft report also stated that a threatened and endangered plant survey will be conducted prior to construction. Once the threatened and endangered plant species are located and identified, a determination will be made as to exactly how and where Phragmites spraying and burning will take place. Due to the rapid change in the threatened and endangered plant communities that has been taking place, it would not be productive, or accurate to make these detailed decisions at this time in the project. In order to obtain the best results from the application of Rodeo, Phragmites is generally sprayed in the fall. Every attempt will be made to schedule this activity at a time that will minimize impacts to migrating birds. It is also anticipated that the Phragmites will be burned in the late fall or winter months when overall productivity of the area is reduced. This and all other aspects of the plan will continue to be closely coordinated with the State Park, the Nature Conservancy, USFWS, the Natural Areas Council, and other applicable parties.

The Corps has met with the Natural Areas Council to discuss their comments on the proposed plan and it was decided that a working group will be formed during the Preconstruction, Engineering, and Design Phase. This group will consist of Council members and other agencies/organizations in order to utilize their expertise in the management and protection of the Natural Area within the State Park.

The next phase in the project will result in the preparation of a monitoring/management plan which will address alternative means of Phragmites control, the monitoring of vegetation, wildlife, water levels, etc.

7:7E-3.40 Public Open Space

Concur. The Corps will coordinate with Dean Cramer (Cape May Point State Park Superintendent) to design an access plan that meets the needs of the park staff and vehicles.

7:7E-4.2(1) Acceptability Conditions for Uses, Standards relevant to sand and gravel extraction

As stated above, the Corps will continue to work with the Department to integrate mitigation measures into the project design that minimize impacts to the benthic and fisheries populations while accomplishing the environmental restoration goals of the project.

We believe that it is both relevant and prudent to reiterate at this time that the proposed project is an environmental restoration project and is construed as a mitigation measure in and of itself.

If you have any questions regarding this letter, please contact Ms. Beth Brandreth of the Environmental Resources Branch at (215) 656-6558.

Sincerely,

Robert L. Callegari
Chief, Planning Division

cc: Eric Schrading, US Fish and Wildlife Service
Bernie Moore, NJDEP
Helen Fasano, NJDEP

State of New Jersey

Christine Todd Whitman
Governor

Department of Environmental Protection
Land Use Regulation Program
P.O. Box 439
Trenton, New Jersey 08625

Robert C. Shinn, Jr.
Commissioner

SEP - 2 1998

Robert L. Callegari
Chief, Planning Division
Department of the Army
Philadelphia District, Corps of Engineers
Wanamaker Building
100 Penn Square East
Philadelphia, Pennsylvania 19107-3391

RE: Lower Cape Meadows – Cape May Point Feasibility Study
Federal Consistency Determination and Section 401 Water Quality Certification
Land Use Regulation Program File No. 0503-98-0002.1

Dear Mr. Callegari:

The New Jersey Department of Environmental Protection, Land Use Regulation Program, acting under Section 307 of the Federal Coastal Zone Management Act (P.L. 92-583) as amended, has reviewed the "Lower Cape Meadows – Cape May Point Feasibility Study, Draft Feasibility Report, Integrated Environmental Impact Statement (EIS) Appendix A through G, Volumes 1 and 2" dated November 1997. Based on submitted information the Program has determined that the draft plan and project is consistent with New Jersey's Rules on Coastal Zone Management N.J.A.C. 7:7E-1.1 et seq, as amended to February 17, 1998 and the applicable Rules guiding issuance of a Section 401 Water Quality Certificate, provided that the conditions discussed below are met to the satisfaction of the Department of Environmental Protection.

Project Description

The U.S. Army Corps of Engineers has proposed a project intended to provide ecosystem restoration to Lower Cape May Meadows and storm damage reduction to Cape May Point. The project includes construction of a dune/berm, initial sand nourishment of 1,247,000 cubic yards with periodic nourishment of 650,000 cubic yards every 4 years over a 50 year project life, seaward restoration of 35 acres of emergent wetland, elimination of 95 acres of Phragmites australis, planting 105 acres of emergent wetland, excavation of existing drainage ditches, installation of 2 weir flow control structures, creation of 6 fish reservoirs within existing ponds, construction of a low earthen berm, and creation of 25 acres of tidal marsh.

This consistency determination is issued subject to compliance with the following conditions:

1. Investigations to find alternative borrow areas will be conducted during the Pre-construction, Engineering, and Design (PED) phase of the project, scheduled to begin September 1998. Borrow area P2 shall be eliminated from the project plan as it is both a prime fishing area and surf clam area. Expansion of borrow sites P1 and M1 for initial beach nourishment and renourishment, and a borrow area within Cape May Inlet for periodic renourishment, shall be investigated. Investigations will include geo-technical, environmental, hydraulic, and cultural surveys. Areas P1 and M1 shall be dredged as shallow as possible, following the existing bottom contours. If alternative borrow sources are not found then a determination will have to be made by the State of the New Jersey and the ACOE regarding the future of the project.

Prior to completion of the PED phase the ACOE shall perform a benthic survey of the borrow areas to determine if the thriving surf clam populations occur there. No extraction from these sites (P1 & M1) may occur until this determination is made by the Department. If the populations are found to be thriving the ACOE shall coordinate with the NJDEP Bureau of Shellfisheries to minimize impacts to the surf clam area. The plan may include, but not be limited to, pre-dredging harvest and restriction of location or contours of the borrow area.

Prior to completion of the PED phase the ACOE shall submit all cultural surveys reports from the proposed borrow areas to the NJDEP Historic Preservation Office, and coordinate with the Historic Preservation Office to develop a plan regarding the need to acquire additional information if necessary, and to avoid potential impacts to the resources.

2. Prior to completion of the PED phase the ACOE shall submit to the Historic Preservation Office additional information regarding Delaware Harbor Defense Battery #7, and Cape May Point Bunker, in terms of remains present, potential eligibility and the specific treatment proposed. The ACOE shall coordinate with the Historic Preservation Office to conduct the necessary additional survey on the 1874 Cape May Lighthouse site and to develop a plan to avoid potential impacts to this resource.

3. Prior to completion of the PED phase a beach nesting bird habitat management plan shall be developed in cooperation with the NJDEP Division of Fish, Game and Wildlife, Endangered and Non-Game Species Program and the U.S. Fish and Wildlife Service. The management plan should consider impacts associated with the initial construction as well as impacts associated with maintenance. The management plan should include the creation of one or more overwash and back water feeding areas, not connected to the freshwater wetland restoration area, as part of this "ecosystem restoration" project. The plan should demonstrate that the gains associated with the new plover habitat out weighs the loss of existing beach nesting bird habitat. The management plan should also include, but not be limited to, buffers, timing restrictions, phased construction, maintenance vehicle access and limitations, habitat maintenance, sand fence maintenance, and vegetation maintenance. The planting of Japanese sedge shall be deleted from the project plan as it is a non-native species that out-competes native species and forms dense stands that degrade plover nesting habitat and preclude use of back water for feeding by unflighted plover chicks. Seasonal restrictions and buffers shall be clearly identified in the project plans and specifications.

4. Prior to completion of the PED phase a thorough survey of the entire treatment area and all surrounding areas for the presence of State and Federally listed rare, endangered or threatened plants, reptiles, amphibians, fish, birds, and mammal species, and a management plan for the identified shall be developed in cooperation with the NJDEP Division of Fish, Game and Wildlife, Endangered and Non-Game Species Program, NJDEP Natural Lands Management, the Nature Conservancy, and the Cape May Bird Observatory. The management plan should include the development of an accurate map of the proposed Phragmites removal areas, a complete assessment of the potential impacts of glyphosate application and prescribed burning on wildlife, including all Federal and State threatened and endangered species, whose presence is confirmed, and specific means by which the rare, threatened, or endangered wildlife will be shielded from the effects of glyphosate application and controlled burning. The management plan should detail the follow-up measurers for control of Phragmites should the applied procedure fail. The management plan should also include, but not be limited to, buffers, timing restrictions, phased construction, maintenance vehicle access and limitations, and habitat maintenance. Seasonal restrictions, buffers, and shielding measures shall be clearly identified in the project plans and specifications.

5. The final plan shall address the maintenance of access ways located landward of the reconstructed dune, for use by park vehicles for trail maintenance and emergency purposes.

Be advised that an Individual Permit pursuant to the Freshwater Wetlands Protection Act (N.J.S.A. 13:19-1 et seq.) **is not** required for work within Freshwater Wetlands provided that the, Integrated Environmental Impact Statement (EIS) Appendix A through G, Volumes 1 and 2" dated November 1997 includes information on the effects of such discharge, including consideration of the guidelines developed under section 404 (b) (1) of the Federal Clean Water Act pursuant to the National Environmental Policy Act of 1969, or provided that the Lower Cape Meadows – Cape May Point Feasibility Study, Final Feasibility Report includes this information and is submitted to Congress before the actual discharge of dredged or fill material in connection with the construction of this project and prior to either authorization of such project or an appropriation of funds for each construction.

If you have any questions regarding this letter, or would like assistance in coordination with the Division of Fish, Game and Wildlife, please do not hesitate to call Helen Fasano of our staff at (609) 292-8262.

Sincerely,

Richard H. Kropp

Richard H. Kropp
Director
Land Use Regulation Program

Date Sept 2, 1998

c: Carmen Zappile, U.S. ACOE, Philadelphia District
Bernard J. Moore, Administrator, NJDEP Engineering & Construction
Andy Didun, NJDEP Division of Fish, Game & Wildlife
Lee Widjeskog, NJDEP Division of Fish, Game & Wildlife
Jeff Normant, NJDEP Bureau of Shellfisheries
Dave Jenkins, NJDEP Endangered & Non-Game Species Program
Robert Cartica, NJDEP Natural Lands Management

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 2
290 BROADWAY
NEW YORK, NY 10007-1866

MAY 08 1998.

Mr. Robert L. Callegari, Chief
Planning Division
Philadelphia District
U.S. Army Corps of Engineers
Wanamaker Building, 100 Penn Square East
Philadelphia, Pennsylvania 19107-3391

Class: EC-2

Dear Mr. Callegari:

The Environmental Protection Agency (EPA) has reviewed the draft environmental impact statement (EIS) for the Lower Cape Meadows - Cape May Point Feasibility Study, located in Cape May County, New Jersey. This review was conducted in accordance with Section 309 of the Clean Air Act, as amended (42 U.S.C. 7609, PL 91-604 12(a), 84 Stat. 1709), and the National Environmental Policy Act.

The proposed project involves beach nourishment, utilizing sand obtained from two proposed borrow areas, and improvements to the interior habitat to restore and protect the remaining Meadows' habitat. Several structural and non-structural alternatives were also evaluated. Interior improvements include moving the existing shoreline seaward to reclaim 35 acres of eroded wetlands, eliminating 95 acres of *Phragmites australis*, planting 105 acres of emergent wetlands vegetation, creating fish reservoirs, restoring water flow between ponds, creating 25 acres of tidal marsh, and installing two water control structures. Beach nourishment would consist of berm and dune restoration along the ocean frontage of the 'The Meadows' and a portion of Cape May Point. This plan would require the placement of approximately 2,312,400 cubic yards of sand for initial construction, with 650,400 cubic yards anticipated for periodic maintenance renourishment every four years over the 50 year project life. The proposed dunes would have 15,000 linear feet of sand fence and would be planted with approximately 18 acres of dune grass. Based on our review, we offer the following comments.

1. The preferred alternative calls for periodic beach renourishment with 650,400 cubic yards of sand every four years. While the draft EIS states that monitoring plans would be implemented to assess the functioning of the beachfill, borrow area, shoreline, wetland, and wave and littoral environments, it does not state that the monitoring results would be used to determine the necessity of maintenance nourishment. EPA is concerned that the proposed maintenance plan may exceed the nourishment needs within the project area, potentially causing unnecessary impacts to the benthic community and water quality. Accordingly, we recommend that the final EIS either demonstrate the need to nourish on a fixed routine basis, or provide beach nourishment plans that are tied very closely to monitoring results. Additionally, a plan to be followed in the event that nourishment is not required should also be included in the final EIS.

1. The nourishment plan proposed for this project, 650,400 cubic yards of material every 4 years for 50 years, was developed primarily for the purposes of estimating future commitments of funds. In order for a project to proceed through the Feasibility phase, it is necessary to develop detailed project cost estimates for the fifty year project life. A four year nourishment cycle represents expected nourishment requirements. Once initial construction has been done, beach surveys will be conducted yearly to measure and record the amount and location of sand in the project area. From these surveys it will be determined when, where and how much sand is needed along the length of the project. The surveys enable the nourishment to be completed only when and where it is needed, thereby saving time and money, as well as minimizing environmental impacts. This also means that if nourishment is not required during a given 4 year cycle, it will not be done. Other monitoring, such as wetland monitoring, would continue, regardless of the nourishment cycle.

2. We understand that this project is one of several proposed and on-going U.S. Army Corps of Engineers (ACE) erosion and storm damage protection projects along the New Jersey Coastline, all of which involve beach nourishment with sand dredged from offshore borrow areas. EPA is concerned that the implementation of these projects could result in adverse cumulative impacts. Unfortunately, a comprehensive evaluation of the cumulative impacts of all these projects has yet to be performed. Accordingly, the ACE should prepare a comprehensive cumulative impacts analysis (possibly through a programmatic EIS) for all of these projects prior to initiation of construction. At a minimum, the evaluation should address impacts to water quality, terrestrial and aquatic ecosystems, including benthic and back bay habitats, and endangered species.

In conclusion, based on our review and in accordance with EPA policy, we have rated this draft EIS as EC-2 indicating we have environmental concerns (EC) about the potential impacts to benthic communities and water quality from beach nourishment maintenance activities, and the potential cumulative impacts associated with this and the other erosion/storm damage protection projects in New Jersey. Accordingly, additional information (2), as outlined in the letter, should be presented in the final EIS to address these issues.

Should you have any questions concerning this letter, please contact Marie Jenet, of my staff, at (212) 637-3747.

Sincerely yours,

Robert W. Hargrove, Chief
Strategic Planning and Multi-Media Programs Branch

2. At this time, a comprehensive cumulative impacts analysis is not within the scope of any of the Corps' proposed or ongoing erosion and storm damage protection, or environmental restoration projects. The Corps does believe however that concerns regarding the issue of cumulative impacts associated with erosion and storm damage protection and environmental restoration projects along the New Jersey coastline are valid. All proposed and ongoing projects in this area consist of post construction surveys to evaluate impacts to benthic and fisheries habitat. These ongoing surveys, and the results they provide, help to track population trends and habitat value. These surveys are, and will continue to be, valuable indicators of impacts associated with specific projects, as well as any cumulative impacts resulting from the implementation of numerous projects.

UNITED STATES DEPARTMENT OF COMMERCE
Office of the Under Secretary for
Oceans and Atmosphere
Washington, D.C. 20230

April 29, 1998

Robert L. Callegari
Chief, Planning Division
US Army Corps of Engineers, Philadelphia District
Wanamaker Bldg, 100 Penn Square East
Philadelphia, PA 19107-3390

Dear Mr. Callegari:

Enclosed are comments on the Draft Environmental Impact Statement for Lower Cape Meadows - Cape May Point Feasibility Study, New Jersey. We hope our comments will assist you. Thank you for giving us an opportunity to review this document.

Sincerely,

Susan Fruchter

Susan B. Fruchter
Acting NEPA Coordinator

Enclosure

No response required.

National Oceanic & Atmospheric Administration (NOAA)

Comments on

Draft Environmental Impact Statement (DEIS)

For

Lower Cape Meadows - Cape May Point

Feasibility Study, New Jersey

The National Marine Fisheries Service (NMFS) has reviewed the Draft Lower Cape Meadows-Cape May Point Feasibility Study and offer the following comments.

Our major concern is in regard to the dredging at borrow areas P1 and P2 where there is evidence for the development of substantial Atlantic surf clam (Spisula solidissima) beds. Specific comments regarding the selection of borrow sites, the effects of dredging on surf clams, surf clam restoration strategies and the need for a surf clam monitoring plan are given below. Also, some minor points such as the omission of a permitted beach erosion control project at Cape May Point and some spelling corrections of scientific names will be noted.

In addition, the Magnuson - Stevens Fishery Conservation and Management Act of 1996 (MSFCA) requires that the essential habitat of any species managed by a Fishery Management Council be recognized and attempts should be made to avoid degrading it. Although the essential fish habitat (EFH) designation process is ongoing, the EFH designations for managed species will be completed in the near future. Many of the managed species for which EFH will be designated use the general area covered by the Lower Cape Meadows-Cape May Point DEIS during key life history stages. A list of managed species is included as Attachment A. Their EFH must be incorporated in the environmental assessments prepared for any future proposal.

Regarding coordination with the National Marine Fisheries Service in accordance with Section 7 of the Endangered Species Act, a Biological Opinion (BO) for all dredging projects within the Philadelphia Corps of Engineers District was issued in 1996; and adherence to the finding of the Biological Opinion will insure compliance with Section 7 of the Endangered Species Act. Recently, the formal consultation that led to the issuance of this BO has been reinitiated to consider an increased take allowance for shortnose sturgeon. However, this should not change the recommendations for sea turtles and, as such, endangered and threatened sea turtle issues have been adequately addressed in the document.

No response required.

Borrow Area Selection

As described in Volume 1, page 12-7 under 'effects on benthos', it is noted "that there is a major disruption of the benthic community in the borrow area when the fill material is excavated".

1. According to Volume 1, pages 2-49 and 2-50, "the majority of the vibrocore boring for borrow area identification were done in two locations." Another was excluded (M2) because it is located within a defined area of ordnance and explosive waste (OEW). According to Volume 1, Figure 2.6.1, vibrocores were performed outside the Cape May Battery Site Firing Fan that are not part of P1 and P2 and which could be potential borrow sites. But other than Figure 2.6.1 there is no further mention of these as potential sites. No data or analysis were found for these. Volume 1, Table 2.6-1 compares the borrow area grain size suitability of borrow site P1 and P2 for beach replenishment at the Meadows and at the Point and grain size suitability is indicated. According to Volume 1 Page -26, borrow sites P1, P2 were proposed, and along with two reference area sites, analyses were made to compare resources and they were compared with six other sites along the Atlantic Coast where previous studies had been performed. Comparisons were made and reported in Volume 2, Table 3-8. It appears that there was no evaluation of other potential borrow sites. Therefore, other potential borrow sites should be identified and sampled so that the sand from the borrow site selected is compatible with that of the beach and that the site is the least biologically productive. The Atlantic surf clam was found in significant numbers at both P1 and P2.

Impacts to Surf Clams and Restoration

2. In Volume 1, page 2-29, it is suggested that surf clams at P2 "may not be reaching older life stages (Versar, Inc. 1997). There is no evidence to suggest that their size has been limited by environmental factors. The clams may be part of a colonization trend toward more southern waters and is in the process of becoming established. On page 2-32 of Volume 1, reference is made to the "surf clam resource below Great Egg Harbor Inlet remains noncontributory to the overall standing stock and continues to provide no evidence of recruitment (N.J. Bureau of Shellfisheries, 1994). This may not be true as of 1998, according to the N.J. Bureau of Shellfisheries (J. Normant, personal communication). Also, Volume 1, page 7-27 refers to this again and suggests that the periodic renourishment "is not expected to have any significant impact on the surf clam population or the commercial fishery along the New Jersey Coast." However, as proposed, the project may substantially impact surf clams, as stated on page 7-26, Volume 1, where it says that "the effects of the four year periodic project over a 50 year project life may have more profound adverse effects" (on benthic communities) "if conducted at the same locations". In addition, as stated in Volume 1 page 7-31, "projects using beach nourishment from offshore borrow sites are becoming increasingly common in coastal areas." On page 7-30, the Council on Environmental Quality is quoted as stating that "cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time". We agree with this and the recommendation on page 7-32 of Volume 1 which states that "prior to any dredging activities updated benthic surveys will be obtained to determine current populations. If viable populations exist within the borrow areas, measures will be taken

1. Results from previous vibrocores dating back to 1978 were analyzed to determine the potential for suitable material. Using this information, recent vibrocores were then focused in the areas currently designated as borrow area P1 and borrow area P2. The other areas shown on Figure 2.6.1 were not found to be suitable. Additional detailed information can be provided upon request.

Coordination has been ongoing with the NJDEP, Land Use Regulation Program to develop actions which can be taken to minimize impacts to surf clams and prime fishing areas. As a result of this coordination, investigations will be conducted to identify other potential borrow areas and to change the configuration of borrow area P1. If at all possible, P2 will not be used as a borrow site. These investigations will be conducted during the Preconstruction, Engineering, and Design Phase of the project.

2. As stated in the draft report, benthic sampling and monitoring will be conducted throughout the life of the project. In addition, coordination with the NJDEP has been continuing with respect to surf clams and the Corps has agreed to conduct additional surf clam sampling during the next phase of the project (Preconstruction, Engineering and Design (PED) Phase). This information will be used to develop a management plan which will be aimed at reducing the impacts to surf clams during dredging activities. In addition, through coordination with NJDEP, it has been decided that borrow area P2 will probably not be used as a sand source for this project and the Corps will investigate the possibility of obtaining sand from the Cape May Inlet for the nourishment cycles associated with the project. NJDEP feels that dredging in the Inlet will reduce impacts to surf clams. Also, the Corps will obtain a copy of the New York District's monitoring plan and review its applicability to our project.

The Corps will continue to coordinate with NOAA and NJDEP to ensure that the impacts to the surf clam population are minimized as much as possible.

to minimize impacts to the clams....include the commercial harvest of clams prior to dredging. dredging a smaller area to greater depths" (without creating deep anoxic holes) "and only disturbing a portion of the site." We strongly support the "implementation of a benthic monitoring program concurrent with periodic maintenance activities which would document project impacts and aid in avoiding impacts to sensitive areas during the periodic maintenance activities." But as indicated in the above section, the avoidance of surf clam beds or the use of a less productive borrow site, has not been fully investigated. If such a site cannot be found, then we then recommend that a comprehensive monitoring plan be developed using the New York District of the U.S. Army Corps of Engineers' Atlantic Coast of New Jersey, Sandy Hook to Barnegat Inlet Beach Erosion Control Project Monitoring Plan as guidance.

Scientific Name Errors

correct spellings:

3. Volume 1, page 2-32- moon snail, *Polinices duplicata*

Volume 1, page 2-34- winter flounder, *Pleuronectes americanus*
tautog, *Tautoga onitis*
summer flounder, *Paralichthys dentatus*
butterfish, *Peprilus triacanthus*

Omission

4. On April 21, 1994, an Army Corps of Engineers permit was issued to the Borough of Cape May Point to install a submerged concrete reef (known as the beach saver) in the Atlantic Ocean between Lehigh and Coral Avenues, in the Borough of Cape May Point, Cape May County, New Jersey to control beach erosion. The status of this project is unknown and was not mentioned in the document.

ATTACHMENT A

NORTHEAST REGION - LIST OF MANAGED SPECIES

American lobster - *Homarus americanus*
American plaice - *Hippoglossoides platessoides*
Atlantic butterfish - *Peprilus triacanthus*
Atlantic cod - *Gadus morhua*
Atlantic halibut - *Hippoglossus hippoglossus*
Atlantic herring - *Clupea harengus*
Atlantic mackerel - *Scomber scombrus*
Atlantic salmon - *Salmo salar*
Atlantic sea scallop - *Placopecten magellanicus*
black sea bass - *Centropristis striata*

3. These corrections have been made to the text.

4. Information on this project can be found on pages 1-16 and 1-17 of the report.

bluefish - *Pomatomus saltatrix*
haddock - *Melanogrammus aeglefinus*
long finned squid - *Loligo pealei*
monkfish - *Lophius americanus*
ocean pout - *Macrozoarces americanus*
ocean quahog - *Arctica islandica*
pollock - *Pollachius virens*
redfish - *Sebastes marinus*
red hake - *Urophycis chuss*
scup - *Stenotomus chrysops*
short finned squid - *Illex illecebrosus*
silver hake - *Merluccius bilinearis*
spiny dogfish - *Squalus acanthias*
summer flounder - *Paralichthys dentatus*
surf clam - *Spisula solidissima*
tilefish - *Lopholatilus chamaeleonticeps*
white hake - *Urophycis tenuis*
windowpane flounder - *Scophthalmus aquosus*
winter flounder - *Pleuronectes americanus*
witch flounder - *Glyptocephalus cynoglossus*
yellowtail flounder -*Limanda ferruginea*

United States Department of the Interior

OFFICE OF THE SECRETARY
Office of Environmental Policy and Compliance
408 Atlantic Avenue - Room 142
Boston, Massachusetts 02210-3334

May 14, 1998

ER 98/173

Lt. Colonel Robert B. Keyser
District Engineer, Philadelphia District
U.S. Army Corps of Engineers
Wanamaker Building
100 Penn Square East
Philadelphia, Pennsylvania 19107-3390

Dear Lt. Colonel Keyser:

The Department of the Interior (Department) has reviewed the Lower Cape May Meadows - Cape May Point Draft Feasibility Study and Integrated Environmental Impact Statement (DEIS). The subject DEIS addresses shoreline protection and ecosystem restoration within the 1.9-mile-long project area, which incorporates intertidal beach habitat, freshwater wetlands, and forested uplands in Cape May County, New Jersey. The project involves 1.9 miles (75 acres) of beach nourishment along the ocean front of Lower Cape May Meadows and Cape May Point, restoration of 25 acres of tidal marsh, elimination of 95 acres of common reed (*Phragmites australis*), planting of 105 acres of emergent wetland vegetation, and construction of hydrological linkages and water control structures within a freshwater marsh.

FEDERALLY LISTED THREATENED AND ENDANGERED SPECIES

The federally listed (threatened) piping plover (*Charadrius melodus*) nests within the proposed project area. The U.S. Fish and Wildlife Service (Service) expects piping plovers will continue to nest on the beaches within the project area between now and the initiation of project construction. Potential and historic nesting areas change over time as a result of coastal storms and littoral drift, which affect beach erosion and accretion. Consequently, some current piping plover nesting areas may become unsuitable over time, while new nesting areas may be formed as a result of accretion or the proposed beach nourishment.

Project-related activities could adversely affect the piping plover. The lead federal agency for a project has the responsibility under Section 7(c) of the Endangered Species Act of 1973 (ESA) (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*) to prepare a Biological Assessment if the project is a construction project that requires an Environmental Impact Statement (EIS) and if the project may affect listed species. Therefore, the Corps must prepare a Biological Assessment to address potential project-related adverse impacts to the piping plover.

The Biological Assessment should contain information concerning listed or proposed species, which may be present in the action area, and an analysis of any potential effects of the proposed action on such species. The following may be considered for inclusion in a Biological Assessment of the proposed project, although actual contents are at the discretion of the federal authorizing agency:

(1) results of field surveys to determine if listed species are present or occur seasonally;

(2) views of recognized experts on the species;

(3) literature review;

(4) analysis of direct, indirect, and cumulative effects of the action on the species; and

(5) analysis of alternative actions.

Specifically, the Biological Assessment should include potential adverse impacts on piping plovers associated with proposed beach nourishment and renourishment activities for the project life (i.e., 50 years). Biological Assessments may be consolidated with procedures for interagency cooperation required by other statutes such as the Fish and Wildlife Coordination Act (48 Stat. 401; 16 U.S.C. 661 *et seq.*) or the National Environmental Policy Act (83 Stat. 852; 42 U.S.C. 4321 *et seq.*). However, satisfying the requirements of these other statutes does not in itself relieve a federal agency of its obligation to comply with the Biological Assessment procedures of the Endangered Species Act. The results of a Biological Assessment may be incorporated in an EIS. If the Biological Assessment indicates that no listed or proposed species are present or will be affected, and the Service concurs in writing with the assessment, then no formal consultation pursuant to Section 7 will be required.

The Corps has agreed to initiate formal consultation with the Service regarding piping plovers and is currently preparing a Biological Assessment for piping plovers associated with all Philadelphia District projects in New Jersey that have the potential to impact the species (U.S. Army Corps of Engineers, 1997a). Additionally, the Corps has agreed to reinitiate consultation with the Service prior to any construction or renourishment activities for Cape May Meadows. Through the formal consultation process, measures to avoid or minimize impacts on piping plovers from project-related activities will be developed and implemented by the Corps. Initiation of formal consultation with the Service early will help to avoid delays in the proposed construction schedule.

The Service recommended the following project modifications to minimize impacts on piping plovers in the Service's Fish and Wildlife Coordination Act Section 2(b) Report (Schrading, 1997).

1. Avoid all work in the project area between April 1 and August 15 in order to avoid potential adverse impacts on nesting piping plovers. This seasonal restriction would be applicable to maintenance work that may be necessary in subsequent years. Associated work includes, but is not limited to: the placement, movement, or maintenance of pipelines; stockpiling of construction materials and equipment; and, the pumping, placement, or distribution of sand.

2. Establish protective zones in accordance with the Service's "Guidelines for Managing Recreational Activities in Piping Plover Breeding Habitat on the U.S. Atlantic Coast to Avoid Take Under Section 9 of the Endangered Species Act" (Guidelines), dated April 15, 1994. Protective zones for piping plover nests shall take precedence over all recreational activities (e.g., vehicle access, sunbathing, kite-flying, swimming, walking). In addition, other measures identified in the Guidelines shall be instituted, such as prohibiting dogs in the vicinity of protective zones or ensuring that all dogs are leashed. Establishment of the protective zones must be coordinated with the ENSP.

3. Maintain multiple access passages between the proposed beach and the existing freshwater wetlands and feeding areas (e.g., poorly vegetated areas) landward of the proposed dune to preserve freshwater wetland feeding areas for piping plovers (Jenkins, pers. comm., 1997). Access passages over the dunes are gently-sloping, wide, unvegetated corridors that provide access to relatively unvegetated flats adjacent to wetlands. The Service and New Jersey Endangered and Nongame Species Program (ENSP) would provide additional assistance in the maintenance or creation of these areas.

While the Corps briefly discusses these recommendations in Section 10 of the DEIS, the Corps does not address these recommendations in other appropriate sections (e.g., Section 7.5.1.6. Threatened and Endangered Species or Section 7.5.1.14. Mitigation Measures). In particular, the Corps does not discuss scheduling of the proposed project in order to accommodate the piping plover seasonal restriction. Several adverse impacts on piping plovers could occur as a result of the proposed project, including loss of overwash areas that provide wetland feeding opportunities for piping plovers and loss of food resources along the shoreline as a result of beach nourishment and renourishment activities. The Department recommends that the Corps discuss adverse impacts on piping plovers in the Final EIS and discuss mitigative measures to minimize such impacts. Additionally, the Department recommends that the Corps incorporate access passages between the proposed beach and the existing freshwater wetlands and feeding areas (e.g., poorly vegetated areas) landward of the proposed dunes to preserve freshwater

wetland feeding areas for piping plovers. Such multiple access passages should be incorporated into the project design and discussed in the Final EIS.

EXTRACTION FROM BORROW AREAS

The Corps is currently proposing to deepen the Delaware River Channel as identified in the Delaware River Main Channel Deepening Project (U.S. Army Corps of Engineers, 1997b). The Corps proposes to stockpile sand in two areas in the Delaware Bay resulting in the burial of 730 acres of subtidal habitat. As an alternative to sand stockpiling, the Department recommends that the Corps consider linking federal projects that involve beach nourishment (e.g., Lower Cape May Meadows) with the Delaware River Main Channel Deepening Project. Direct beach nourishment would eliminate double handling of dredged material and would eliminate or minimize adverse impacts on 730 acres of subtidal habitat. The Corps has identified that it may be possible to use material from the Delaware River Main Channel Deepening Project for the Lower Cape May Meadows project, depending on construction schedules and authorization.

If use of borrow material from the Delaware Main Channel Deepening Project is not feasible, the Department concurs with the Corps selection of Borrow Area P1 and P2 to provide borrow material. However, since Borrow Area P2 supports a lower proportion of large taxa than Borrow Area P1 and Borrow Area P2 had a lower biomass of surf clams than Borrow Area P1 (Scott, 1997), the Department recommends using Borrow Area P2 as the primary borrow source and only use Borrow Area P1 if Borrow Area P2 lacks adequate quantities of sand.

In order to minimize repeated impacts on benthic organisms within the borrow area, the Corps will make every effort to conduct each renourishment dredging phase in a limited portion of the borrow area and alternate locations for each subsequent renourishment cycle (U.S. Army Corps of Engineers, 1997a). This concept of rotational dredging minimizes frequent, repeated disturbance of a particular area, thereby allowing recolonization of benthic organisms to occur over a longer period of time.

In order to avoid anoxic conditions in the borrow area, the Corps proposes to avoid the creation of excessively deep, poorly flushed borrow sites. The Corps also proposes to schedule dredging during a period of low biological activity (November to January) to minimize impacts on benthic organisms, and use a hydraulic dredge with a pipeline delivery system to minimize turbidity and minimize impacts on benthic invertebrates (U.S. Army Corps of Engineers, 1997a). However, dredging operations between November to January may not be possible due to the potential of severe winter storms.

Finfish, including striped bass (*Morone saxatilis*) and bluefish (*Pomatomus saltatrix*), frequent shoals immediately offshore of the Meadows such as the Eph Shoal adjacent to Borrow Area P2. Dredging activities within these shoals could adversely impact use of these shoals by recreationally valuable finfish (McClain, pers. comm., 1997). The Corps has agreed to coordinate with the New Jersey Division of Fish, Game and Wildlife, Bureau of Marine

Fisheries and the Cape May Charter Boat Association to identify potential impacts on recreational fisheries and minimize adverse impacts on such fisheries (U.S. Army Corps of Engineers, 1997a).

BEACH NOURISHMENT

The proposed beach nourishment and subsequent renourishment will bury infaunal organisms and result in mortality within the shallow nearshore (littoral) zone. Most of the organisms inhabiting the extremely dynamic nearshore and intertidal zones are highly mobile and adapt quickly to significant changes in abiotic factors. However, the proposed project would likely reduce infaunal abundance and species diversity despite the resiliency of the intertidal benthic fauna. Reilly and Bellis (1983) determined that recovery of macrofauna is rapid after beach nourishment activities cease; however, the recolonized community may differ considerably from the original community. Differences in grain size from the original beach and sand provided for beach nourishment may adversely affect the rate of recolonization and community diversity. The Corps plan would minimize this impact since Borrow Area P1 and P2 have an average grain size (1.38 mm and 0.75 mm, respectively) similar to the existing average grain size at the Meadows (0.21 mm) and at Cape May Point (0.42 mm) (U.S. Army Corps of Engineers, 1997a).

Beach nourishment activities may also adversely affect the piping plover or other shorebirds, particularly if such activities occur during the nesting season. Conversely, beach nourishment may create suitable nesting habitat in areas that currently do not support shorebird nesting. Piping plovers and other beach nesting birds, such as black skimmers (*Rynchops niger*), least terns (*Sterna antillarum*), and common terns may benefit from such activities.

The proposed project would reclaim 35 acres of terrestrial habitat waterward of the existing shoreline. Beach reclamation would eliminate 35 acres of shallow water habitat adjacent to the Meadows; however, this area formerly provided beach habitat prior to construction of updrift jetties and groins (U.S. Army Corps of Engineers, 1997a). Shallow water habitat would be created waterward of the proposed berm and dune construction; therefore, no net loss in shallow water habitat is predicted.

ECOSYSTEM RESTORATION

The Department strongly supports the Corps proposal regarding ecosystem restoration at Lower Cape May Meadows. The proposed project would restore rare, unique, and valuable habitat for a variety of fish and wildlife resources, including federally and State-listed species.

The proposed water-control structures would allow for the management of water levels within the Meadows to maintain water during dry periods, maintain beneficial emergent wetland plants, and discourage the spread of common reed. The Corps has agreed to develop a water

level management plan for use by the Cape May State Park and The Nature Conservancy to identify appropriate water level objectives to maximize benefits for fish and wildlife resources within the Meadows. The Department recommends that the Corps coordinate with the Service, New Jersey Division of Parks and Forestry (NJDPF), ENSP, and The Nature Conservancy to develop a water level management plan. In addition, the Corps proposes to modify the existing outfall structure in Shallow Pond West (i.e., install a removable shield) to maintain adequate quantities of fresh water within Lower Cape May Meadows (U.S. Army Corps of Engineers, 1997a). Modification of the existing outfall structure would provide adequate saturation of freshwater emergent wetlands.

The proposed project provides an opportunity to substantially increase the habitat value of the Meadows for a variety of fish and wildlife resources. However, no monitoring program was developed to ensure that the goals and objectives of the Meadows Project are obtained. The Corps has agreed to develop a monitoring program to gather information on long-term beneficial (and adverse) impacts of the proposed project on fish and wildlife resources in cooperation with the Service, NJDPF, ENSP, and The Nature Conservancy. The monitoring program should also incorporate remedial actions that would take place if proposed goals and objectives are not attained. Monitoring should evaluate any spread of common reed, survival of planted emergent wetland vegetation, effectiveness of hydrologic connections between internal ponds, effectiveness of water level management, and recolonization of salt marsh vegetation in the 25-acre area on the eastern portion of the Meadows. Actual monitoring could be conducted by NJDPF and The Nature Conservancy.

DEPARTMENTAL POSITION

The Department has several outstanding concerns regarding potential adverse impacts on fish and wildlife resources. In order to minimize adverse impacts to fish and wildlife, the Department recommends the following measures.

1. Complete formal consultation with the Service pursuant to Section 7(c) of the ESA regarding piping plovers, prior to initiation of any construction activities.

2. Address adverse impacts on piping plovers in the Final EIS and discuss mitigative measures to minimize such impacts.

3. Incorporate access passages between the proposed beach and the existing freshwater wetlands and feeding areas (e.g., poorly vegetated areas) landward of the proposed dunes to preserve freshwater wetland feeding areas for piping plovers. Such multiple access passages should be incorporated into the project design and discussed in the Final EIS.

1. Concur. A Biological Assessment is being prepared for piping plovers for the Philadelphia Districts New Jersey coastal projects. The Assessment will be forwarded to USFWS when complete.

2. Other than potential temporary impacts during construction, the piping plover will be favorably impacted by the proposed plan. The addition of plover "walkovers" over the dune will ensure that the plovers will be able to access and utilize the backwater feeding habitat located within the wetlands behind the dune. In addition, the Corps is investigating the possibility of creating an overwash area for plover usage within the tidal portion of the site. Discussions on these issues will be included in the Final EIS.

3. As stated above, plover "walkovers" have been added to the selected plan. The walkovers will be approximately 100' wide and be positioned along the length of the project approximately every 600'. The walkovers will be sparsely vegetated and most likely enclosed with sand fencing to discourage public usage.

4. Use the material from the Delaware River Main Channel Deepening Project for direct beneficial uses (e.g., Meadows) consistent with Section 207 of the Water Resources Development Act of 1996.

5. Use Borrow Area P2 as the primary source of borrow material and only use Borrow Area P1 if Borrow Area P2 does not have adequate quantities of sand.

6. Coordinate with the Service, NJDPF, ENSP, and The Nature Conservancy and develop a water level management plan to identify appropriate water level objectives that will maximize benefits for fish and wildlife resources within the Meadows.

7. Coordinate with the Service, NJDPF, ENSP, and The Nature Conservancy to develop a monitoring program to gather information on long-term beneficial (and adverse) impacts of the proposed project on fish and wildlife resources, including beach nesting birds. The monitoring program should also incorporate remedial actions that would take place if proposed goals and objectives are not attained.

The Department encourages the Corps to resolve the above-mentioned concerns and incorporate Departmental recommendations in the final project design and Final EIS. The Department and the Service will continue to cooperate fully to resolve these aforementioned concerns.

If you have any questions regarding these comments or require further assistance on issues regarding fish and wildlife resources related to the proposed project, including federally listed threatened or endangered species, please contact the Service at the following address:

Supervisor
U.S. Fish and Wildlife Service
New Jersey Field Office
Ecological Services
927 N. Main Street, Building D-1
Pleasantville, New Jersey 08232
(609) 646-9310

Thank you for the opportunity to provide these comments.

Sincerely,

Andrew L. Raddant
Regional Environmental Officer

4. If construction schedules allow, the material to be dredged from the Delaware River Main Channel will be investigated for use for this project. If using this material is a feasible option, all efforts will be made to use this material in a beneficial manner, either at The Meadows or an alternative location. In the meantime however, The Meadows project must be able to stand on its own and not rely on another project which may, or may not be constructed.

5. Due to coordination with the NJDEP, it will not be possible to utilize the proposed borrow areas in this manner. NJDEP has requested that P2 not be used at all and that P1 be reconfigured in an effort to minimize impacts on surf clams and prime fishing areas. The Corps is currently investigating these changes to the borrow areas, as well as the possibility of using sand from Cape May Inlet for nourishment activities to further reduce potential impacts to marine species. Any permanent changes to the borrow areas will be coordinated with the USFWS as well as other pertinent agencies/organizations.

6. Concur. A water level management plan will be developed during the next phase of the study (PED) to ensure that benefits to fish and wildlife are maximized.

7. Concur. The Corps will be actively monitoring all aspects of the restoration project for at least 5 years following construction activities. All pertinent agencies will be contacted in order to obtain input on the development of a comprehensive monitoring plan.

REFERENCES

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Personal Communications

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McClain, J. 1997. Fisheries Biologist. Bureau of Marine Fisheries, New Jersey Division of Fish, Game and Wildlife, New Jersey Department of Environmental Protection. Nacote Creek Research Station. Port Republic, New Jersey.

FISH AND WILDLIFE COORDINATION ACT
SECTION 2(b) REPORT

ASSESSMENT OF THE LOWER CAPE MAY MEADOWS - CAPE MAY POINT FEASIBILITY STUDY, CAPE MAY COUNTY, NEW JERSEY

Prepared by:

U.S. Fish and Wildlife Service
Ecological Services, Region 5
New Jersey Field Office
Pleasantville, New Jersey 08232

May 1998

United States Department of the Interior
FISH AND WILDLIFE SERVICE
Ecological Services
927 North Main Street (Bldg. D1)
Pleasantville, New Jersey 08232

Tel: 609-646-9310
FAX: 609-646-0352

IN REPLY REFER TO:
FP-98/32

May 5, 1998

Lt. Colonel Robert B. Keyser
District Engineer, Philadelphia District
U.S. Army Corps of Engineers
Wanamaker Building
100 Penn Square East
Philadelphia, Pennsylvania 19107-3390

Dear Lt. Colonel Keyser:

This is the final report of the U.S. Fish and Wildlife Service (Service) on anticipated impacts to fish and wildlife resources from the U.S. Army Corps of Engineers (Corps) proposed Lower Cape May Meadows - Cape May Point Project (Meadows Project), Cape May County, New Jersey. This report was prepared pursuant to Section 2(b) of the Fish and Wildlife Coordination Act (FWCA) (48 Stat. 401; as amended; 16 U.S.C. 661 *et seq.*).

This final report is provided in accordance with our Fiscal Year-1997 scope-of-work agreement and is based on plans and information provided in the Corps Lower Cape May Meadows - Cape May Point Feasibility Report and Integrated Environmental Impact Statement. The Service previously provided the Corps with a Planning Aid Letter (PAL) dated September 7, 1994 that included information on federally listed and State-listed threatened and endangered species relevant to the Meadows Project and comments regarding the Habitat Evaluation Procedures study conducted during the reconnaissance phase of the Meadows Project.

The Meadows Project represents a unique opportunity to protect and enhance fish and wildlife habitat in an area that is especially critical to migratory birds. The Lower Cape May Meadows is an internationally significant coastal wetland complex that provides a critical stopover for these migratory birds. Migratory birds are a federal trust resource responsibility of the Service. Even with the current degradation of the Lower Cape May Meadows due to common reed (*Phragmites australis*) invasion and frequent inundation by storm events, the project area provides critical habitat for fish and wildlife resources. Continuing erosion of the Lower Cape May Meadows compromises both the quantity and quality of fish and wildlife habitat within this unique area. The Service ardently supports fish and wildlife restoration projects, particularly in areas subject to continuing degradation (e.g., erosion of the shoreline, common reed expansion, salt water inundation).

The federally listed (threatened) piping plover (*Charadrius melodus*) nests within the Lower Cape May Meadows area. Lower Cape May Meadows was one of the most productive piping plovers nesting areas in southern New Jersey in 1996 and 1997. Despite continuing erosion, which has reduced the beach width of the Meadows Project area, piping plovers continue to use this area. Piping plovers nest on sandy beaches above the high tide line on mainland coastal beaches, sand flats, and barrier island coastal beaches. Potential and historic nesting areas change over time as a result of coastal storms and littoral drift affecting beach erosion and accretion. Consequently, some documented piping plover nesting areas may become unsuitable over time, while new nesting areas may be formed as a result of accretion or the proposed beach nourishment.

The lead federal agency for a project has the responsibility under Section 7(c) of the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*) to prepare a Biological Assessment, if the proposal is a major construction project that requires an Environmental Impact Statement and if the proposal may affect a federally listed species. Therefore, the Corps must prepare a Biological Assessment to address potential project-related impacts to the piping plover. The assessment should contain information concerning the piping plover within the action area and an analysis of any potential effect of the proposed action on this species. The Biological Assessment may be incorporated in the Corps National Environmental Policy Act (83 Stat. 852; 42 U.S.C. 4321 *et seq.*) document.

Other than the piping plover and an occasional transient peregrine falcon (*Falco peregrinus*) or bald eagle (*Haliaeetus leucocephalus*), no other federally listed or proposed endangered or threatened flora or fauna under Service jurisdiction are known to occur within the project area.

The federally listed (endangered) Kemp's Ridley turtle (*Lepidochelys kempii*), hawksbill turtle (*Eretmochelys imbricata*), leatherback turtle (*Dermochelys coriacea*) and the federally listed (threatened) green turtle (*Chelonia midas*) and loggerhead turtle (*Caretta caretta*) occur in the Atlantic Ocean immediately adjacent to the proposed project area. Except for nesting habitat for sea turtles, principal responsibility for marine turtles and marine mammals is under the jurisdiction of the National Marine Fisheries Service.

Additional information regarding this final report can be provided by John Staples or Eric Schrading of my staff.

Sincerely,

Clifford G. Day
Supervisor

Enclosure

FISH AND WILDLIFE COORDINATION ACT
SECTION 2(b) REPORT

ASSESSMENT OF THE LOWER CAPE MAY MEADOWS - CAPE MAY POINT FEASIBILITY STUDY, CAPE MAY COUNTY, NEW JERSEY

Prepared for:

U.S. Army Corps of Engineers
Philadelphia District
Philadelphia, Pennsylvania 19107-3390

Prepared by:

U.S. Fish and Wildlife Service
Ecological Services, Region 5
New Jersey Field Office
Pleasantville, New Jersey 08232

Preparer: Eric P. Schrading
Assistant Project Leader: John C. Staples
Project Leader: Clifford G. Day

May 1998

EXECUTIVE SUMMARY

The U.S. Army Corps of Engineers, Philadelphia District (Corps) initiated the New Jersey Shore Protection Study, incorporating the Lower Cape May Meadows - Cape May Point Project (Meadows Project), under the authority of resolutions adopted by the Committee on Public Works and Transportation of the U.S. House of Representatives and the Committee on Environment and Public Works of the U.S. Senate in December 1987. The project area extends approximately 1.9 miles along the Atlantic Ocean coast, within the Borough of Cape May Point and the Borough of West Cape May, Cape May County, New Jersey.

Shoreline erosion has resulted in a reduction of approximately 124 acres of valuable fish and wildlife habitat since 1955. Shoreline erosion within the Lower Cape May Meadows has been exacerbated as a result of the construction of the Cape May Harbor jetties in 1911. The construction of these jetties has acted as a near total littoral barrier and has resulted in substantial downdrift erosion by preventing new littoral material from entering the longshore transport system from updrift. An estimated additional 138 acres of habitat will be lost by 2050 if existing conditions continue. Additionally, habitat quality within the remaining Lower Cape May Meadows will continue to degrade without corrective measures, due to invasion of salt water into freshwater wetlands. Continual inundation by salt water will eliminate the remaining freshwater wetland plants, including several rare and State-listed plants, and will provide an opportunity for the continued expansion of common reed (*Phragmites australis*) within the Lower Cape May Meadows.

The Meadows Project is designed to protect and restore valuable beach and freshwater wetland habitats, improve water quality and hydrology within the subject wetland / upland complex, and eliminate invasive plant species (i.e., common reed). The Meadows Project also provides incidental benefits to the Borough of Cape May Point by providing shore protection from storm damage. Specifically, the project involves the construction of a berm and dune, in addition to dune grass plantings and installation of sand fence for dune stability. Renourishment is proposed every 4 years to compensate for expected losses of 15 feet per year due to erosion. The Corps also proposes to reclaim 7 acres of overwash area to emergent wetlands; restore 25 acres of salt marsh; eliminate 95 acres of common reed by herbicide and burn treatment; replant native, beneficial emergent and scrub / shrub wetland vegetation; reconnect the hydrologic link between internal ponds; establish 2 water control structures; and excavate 6 new fish reservoirs within existing ponds. The Corps is also proposing to move the shoreline waterward, reclaiming 35 acres of emergent wetlands.

The U.S. Fish and Wildlife Service (Service) considers the proposed ecosystem restoration as a beneficial project that would restore and enhance beach and dune habitat and improve the adjacent wetland / upland complex of Lower Cape May Meadows for fish and wildlife resources. Therefore, the Service fully supports the Corps proposed Lower Cape May Meadows project. Restoration and / or enhancement of 333 acres of valuable migratory bird habitat would improve this critical stopover location on the Cape May Peninsula. However, water level management and monitoring would be required to ensure that the goals and objectives of the proposed project are achieved and maintained. In addition, mitigative measures to minimize adverse impacts on piping plovers and other shorebirds would be necessary.

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APPENDICES

Appendix A. Coordination with the New Jersey Division of Fish, Game and Wildlife

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I. INTRODUCTION

This constitutes the U.S. Fish and Wildlife Service's (Service) final Fish and Wildlife Coordination Act, Section 2(b) report describing the fish and wildlife resources and supporting ecosystems in the area of the U.S. Army Corps of Engineers (Corps) proposed Lower Cape May Meadows - Cape May Point Project (Meadows Project). This report is provided in accordance with a Fiscal Year-1997 scope-of-work agreement between the Service and the Corps Philadelphia District. The information presented in this report: documents the fish and wildlife resources in the project area; identifies potential beneficial and adverse impacts to those resources; and, provides recommendations to minimize adverse impacts and maximize beneficial impacts. The project area is approximately 1.9 miles in length, and includes Cape May Point State Park (State Park) and The Nature Conservancy's Cape May Migratory Bird Refuge (TNC Refuge). The project area is within the Borough of Cape May Point and the Borough of West Cape May, Cape May County, New Jersey (Figure 1).

The New Jersey Shore Protection Study, which incorporates the Meadows Project, was authorized by resolutions adopted by the Committee on Public Works and Transportation of the U.S. House of Representatives and the Committee on Environment and Public Works of the U.S. Senate in December 1987. The authorization calls for defining coastal area problems associated with erosion and identifying potential solutions; identifying costs, environmental, and social impacts of potential solutions; and, presenting an optimized National Economic Development (NED) Plan. However, unlike traditional civil works water resource projects, ecosystem protection and restoration projects need not exhibit net NED benefits.

The Service requests that no part of this report be used out of context and if reproduced, the report should appear in its entirety. Furthermore, any data, opinions, figures, recommendations, or conclusions that are excerpted from the report should be properly cited and include the page number from which the information was taken. This report should be cited as follows:

Schrading, E.P. 1998. Assessment of the Lower Cape May Meadows - Cape May Point Feasibility Study, Cape May County, New Jersey. Final Fish and Wildlife Coordination Act Section 2(b) Report. U.S. Department of the Interior, Fish and Wildlife Service, New Jersey Field Office. Pleasantville, New Jersey. 25 pp. + appendices.

Questions or comments regarding this report are welcomed by the Service. Written inquiries should be addressed to:

Supervisor
U.S. Fish and Wildlife Service
New Jersey Field Office, Ecological Services
927 North Main Street, Building D-1
Pleasantville, New Jersey 08232

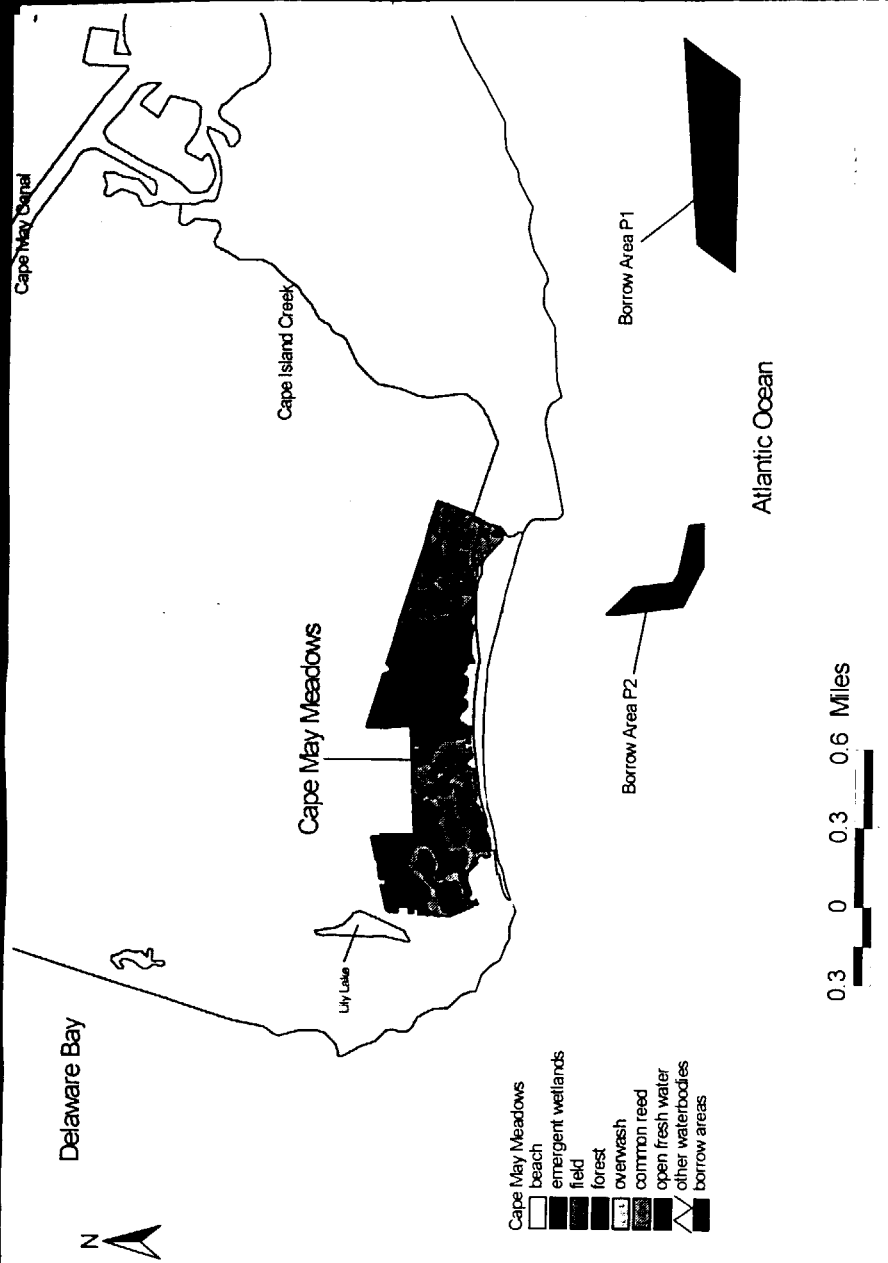

Figure 1. Lower Cape May Meadows Project Area.

II. PROJECT DESCRIPTION

The objectives of the Meadows Project are to:

(1) protect and restore beach and freshwater wetland habitat;

(2) improve water quality within the project area;

(3) eliminate / control nuisance plant species;

(4) increase availability of freshwater within the project area;

(5) reduce oceanwater inundation via the Lower Cape May Meadows to the towns of Cape May Point and West Cape May; and,

(6) reduce storm damage vulnerability along Cape May Point oceanfront.

The proposed project was developed based on comments and input from the landowners of the Meadows (i.e., New Jersey Division of Parks and Forestry and The Nature Conservancy), in addition to the Service and the Borough of Cape May Point.

The proposed project involves a complex array of alternatives that would enhance or restore habitat within the Meadows. Most of the alternatives involve work landward of the existing dune, in the wetland / upland complex of the Meadows, and are dependent on berm and dune creation. Most of the alternatives can be accomplished independently or can be initiated in combination with other alternatives. However, restoration and enhancement within the Meadows would not be practical if the remaining freshwater wetland complex is not protected from the ocean by a suitable berm and dune. Therefore, creation of a berm and dune is critical to the restoration of the Meadows complex. The Corps proposes to construct a 157-foot-wide berm, as measured from the waterward toe of the dune to the mean high water line. The berm would have a top elevation of +8 feet National Geodetic Vertical Datum (NGVD). In addition, the Corps proposes a dune with a top elevation of 18 feet NGVD and a top width of 25 feet. Dune side slopes would be 1V:5H (i.e., 1 vertical on 5 horizontal) waterward and 1V:3H landward. The proposed berm and dune construction would provide an additional 10 acres of beach and dune habitat to the existing 60 acres adjacent to the Meadows. The proposed berm and dune construction would extend along the Meadows and beach areas of Cape May Point. Storms impacting Cape May Point flood the residential areas adjacent to the Meadows. These flood waters follow existing contours into the Meadows, thus inundating the Meadows with salt water. Thus, beach nourishment along Cape May Point is critical to protecting the Meadows from inundation damage. Dune areas

(approximately 18 acres) would be planted with American beach grass (*Ammophila breviligulata*), coastal panic grass (*Panicum amarum*), and Japanese sedge (*Cyperus* spp.). In addition, approximately 7 acres along the landward toe of the dune would be planted with a combination of bayberry (*Myrica heterophylla*), wax myrtle (*Myrica cerifera*), beach plum (*Prunus maritima*), and shore juniper (*Juniperus* spp.). Approximately 15,000 linear feet of sand fence would be installed along the dunes for stability. Renourishment would occur every 4 years to compensate for expected losses of 15 feet per year due to erosion (U.S. Army Corps of Engineers, 1997a).

The Corps has identified two offshore borrow areas in the Atlantic Ocean: Borrow Area P1 (250 acres) and Borrow Area P2 (150 acres) (Figure 1). The Corps proposes to use both borrow areas, removing 1,724,000 cubic yards from Borrow Area P1 and 588,000 cubic yards from Borrow Area P2 during initial construction. Dredging activities would impact approximately 138 acres of Borrow Area P1 to a depth of 10 feet below existing grade and 99 acres of Borrow Area P2 to a depth of 6.5 feet below existing grade (U.S. Army Corps of Engineers, 1997a). The average grain size for Borrow Area P1 and P2 (1.38 mm and 0.75 mm, respectively) approximate the existing average grain size at the Meadows (0.21 mm) and at Cape May Point (0.42 mm).

The Corps is proposing to convert 7 acres of overwash area to emergent wetlands in an area immediately behind an existing dune. The Corps is also proposing to move the existing shoreline waterward to reclaim 35 acres of habitat that was terrestrial and is now subtidal. This would move the mean high water line seaward approximately 280 feet and would maintain the proposed beach acreage of 70 acres, converting the reclaimed area to freshwater emergent marsh landward of the proposed dune.

The Corps is also proposing to eliminate or control invasive plant species, specifically common reed by herbicide and burning treatments. An herbicide (e.g., glyphosate) would be applied in the fall aerially, followed by a winter or spring burn of the common reed areas. A second herbicide treatment would likely be applied the following fall. Maintenance would be required to ensure that common reed does not recolonize these areas. Following elimination of approximately 95 acres of common reed, the Corps proposes to plant 105 acres of beneficial freshwater emergent plants to revegetate areas formerly colonized by common reed. The Corps is also proposing to restore 25 acres of salt marsh on the extreme eastern portion of the Meadows. This area was originally the headwaters of Cape Island Creek; however, due to residential development, a 2,000-foot-long pipe under various houses is the only connection between Cape Island Creek and the Meadows. This area is dominated by common reed due to restricted water movement from a closed flap gate on the pipe. The Corps is proposing to restore tidal flushing to the 25-acre area to enhance wetlands and provide increased wetland diversity in the Meadows. Tidal inundation throughout the 25-acre restoration site would eliminate common reed and promote conditions for establishment of salt marsh vegetation such as *Spartina alterniflora* and *Spartina patens*. The proposed salt marsh restoration would be separated from the adjacent freshwater wetlands by constructing a dike and providing a hydrologic connection via a water-control structure.

The Corps proposes to improve water quality and increase the availability of freshwater by re-establishing the hydrologic connection between ponds within the Meadows. Currently internal ponds in the Meadows are not connected resulting in stagnant water, which encourages eutrophication. The Corps proposes to provide a hydrologic linkage between most of the ponds to improve water quality and restore hydrologic flow through the Meadows. Associated with this proposal is construction of two water-control structures between the State Park and TNC Refuge and between the freshwater wetlands and the proposed salt marsh. Water-control structures are essential to controlling the spread of common reed and providing habitat enhancement opportunities for a variety of migratory birds. The Corps is also proposing the construction of six fish reservoirs within four ponds in the Meadows. The fish reservoirs would not be deeper than 36 inches and would be approximately 0.002 acre in size. The purpose of the fish reservoirs is to provide refuge for fish and other aquatic organisms during dry seasons (e.g., late summer). By creating fish reservoirs, abundance of fish within the Meadows may be sufficient to consume enough mosquito (*Culicidae*) larvae to reduce the need for the Cape May County Mosquito Extermination Commission to apply pesticides in the Meadows.

III. METHODS AND PROCEDURES

The information and findings presented in this report are based on review of the November 1997 Lower Cape May Meadows - Cape May Point Feasibility Report and Integrated Environmental Impact Statement (U.S. Army Corps of Engineers, 1997a) and review of additional information made available to the Service by the Corps. The content of this report is also based on review of Service files and library material; coordination with the NJDPF, The Nature Conservancy, New Jersey Division of Fish, Game and Wildlife's (NJDFGW) Bureau of Marine Fisheries, Bureau of Shellfisheries, and Endangered and Nongame Species Program (ENSP); and, site visits conducted by Service biologists in October and December 1993, April 1994, and August, September, and October 1997.

IV. PHYSICAL CHARACTERISTICS

The Meadows Project area is 1.9 miles long and bordered with a relatively narrow beach, man-made dunes, and shallow subtidal waters along the Atlantic Ocean. The Meadows Project area is 343 acres and is divided between the Park (153 acres) managed by the NJDPF and the Refuge (190 acres) owned by The Nature Conservancy. The Meadows is in the Boroughs of Cape May Point and West Cape May, Cape May County, New Jersey. The ground in the Meadows slopes down from west to east, with an average elevation of 5 feet-

NGVD in the Park to 1.5 feet-NGVD in the Refuge. Currently, the Meadows is comprised of the following cover types: forest (75 acres), field (24 acres), palustrine emergent wetlands (42 acres), common reed-dominated wetlands (93 acres), palustrine open water (49 acres), and beach / dune (60 acres). Forest and field cover types are landwardmost on the Meadows (Figure 1). The erosion rate of the Meadows is 15 feet / year and by 2050 an estimated 138 acres of habitat will be lost. The entire Meadows is protected in perpetuity by the State of New Jersey and The Nature Conservancy. Areas surrounding the Meadows include moderate to high density residential development and some agricultural land. Groin fields occur along the coast on the eastern and western sides of the Meadows and may be partly responsible for sand starvation of beaches in the Meadows.

Hydrology within the Meadows is palustrine and generally follows the topography from west to east, despite the lack of hydrologic connections between internal ponds. Lake Lily located in the Borough of Cape May Point is a freshwater lake fed by groundwater and storm runoff and is surrounded by 113 acres of residential development. Lake Lily is hydrologically connected with the western portion of the Meadows by a 1,200-foot-long 18-inch-diameter pipe, which runs to Lighthouse Pond West. Shallow Pond West within the Park is connected to the Atlantic Ocean via an outfall structure. This outfall structure was installed after the March 1992 northeaster, which inundated Lighthouse Avenue in the Borough of Cape May Point for months. The outfall structure, with an invert of 3.5 feet-NGVD was installed to prevent flooding of Lighthouse Avenue. The eastern portion of the project is the former headwaters of Cape Island Creek. Currently little to no hydrologic connection occurs between the Meadows and Cape Island Creek and between the internal ponds within the Meadows. Storm events such as northeasters and hurricanes severely impact the quality of the habitat within the Meadows. Salt water inundation and erosion result in habitat loss and reduce the quality of palustrine wetlands. Storm events may (depending on frequency and duration) destroy freshwater wetland vegetation not tolerant of salinity. In addition, the periodic disturbance from storm events coupled with the loss of freshwater wetland vegetation, provide opportunities for common reed to continue to spread and colonize the Meadows.

V. FISH AND WILDLIFE RESOURCES

The Service's September 7, 1994 Planning Aid Letter (PAL) identifies federally listed and State-listed threatened and endangered species relevant to the Meadows Project. Additionally, the Corps (1997a) identifies numerous fish and wildlife resources including finfish, shorebirds, wading birds, waterfowl, raptors, and other terrestrial wildlife that occur in the project area. The project area provides valuable open water, intertidal beach, freshwater wetlands, and upland areas for a variety of finfish, migratory birds, and other wildlife. Furthermore, the project area serves as a critical migratory stopover for raptors, shorebirds, and neotropical birds.

The Corps assessed the status of benthic organisms for each proposed sand borrow site. The studies were initiated to establish a baseline for the benthic macroinvertebrate assemblages within the proposed borrow sites and to identify the presence of commercial and / or recreationally important benthic macroinvertebrates. Borrow Area P1 and P2 had species diversity (mean = 27.4 and 21.8, respectively) similar to reference sites (Scott, 1997). Borrow Area P1 had higher macroinvertebrate abundance (19,430) than P2 (6,462), but differences were not significant. Surf clams (*Spisula solidissima*) were more abundant in Borrow Area P2 than P1 (though not significantly), but the biomass of this species was extremely low in P2 and was significantly lower than P1. Borrow Area P1 had significantly higher polychaete abundance than P2 and Borrow Area P2 had a significantly higher Shannon-Wiener Index and Simpson's Diversity Index than P1. However, Scott (1997) concluded that the differences were attributable to the high abundance of two polychaete taxa (*Polycirrus eximius* and *Polygordius* spp.) in Borrow Area P1. Scott (1997) summarized that the differences between borrow areas P1 and P2 would not preclude the selection of either site as a source for borrow material.

The shallow-water areas, particularly shoals adjacent to the Meadows support a productive commercial and recreational fishery. The internal ponds of the Meadows also support finfish including: mummichog (*Fundulus heteroclitus*), banded killifish (*F. diaphanus*), sheepshead minnow (*Cyprinodon variegatus*), tidewater silversides (*Menidia beryllina*), and mosquitofish (*Gambusia affinis*). Finfish and other aquatic organisms occurring in ponds in the Meadow provide important food resources for wading birds such as the great blue heron (*Ardea herodias*), snowy egret (*Egretta thula*), little blue heron (*Egretta caerulea*), great egret (*Casmerodius albus*), glossy ibis (*Plegadis falcinellus*), black-crowned night heron (*Nycticorax nycticorax*), and yellow-crowned night heron (*Nycticorax violaceus*) (New Jersey Division of Fish, Game and Wildlife, 1994). While wading birds feed regularly in the Meadows, the nearest nesting colony is north of Cape May Canal, more than two miles from the Meadows (Andrews, 1990).

The Meadows provides important habitat for waterfowl and shorebirds, particularly during spring and fall migration. Waterfowl, including blue-winged teal (*Anas discors*), green-winged teal (*Anas crecca*), American widgeon (*Anas americana*), lesser scaup (*Aythya affinis*), black duck (*Anas rubripes*), and mallard (*Anas platyrhynchos*), are commonly seen in the ponds of the Meadows (New Jersey Division of Fish, Game and Wildlife, 1994). Coastal wetlands are particularly important overwintering habitat for black ducks. Shorebirds also use habitat within the Meadows during spring and fall migration. Red knot (*Calidris canutus*), ruddy turnstone (*Arenaria interpres*), sanderling (*Calidris alba*), and semipalmated sandpiper (*Calidris pusilla*) are common shorebirds of the Meadows (New Jersey Division of Fish, Game and Wildlife, 1994).

Migratory raptors concentrate along the southern tip of New Jersey prior to crossing the Delaware Bay. In the fall, regular observations by the Cape May Bird Observatory record an average of 60,000 raptors a year. Common migrating raptors include Cooper's hawk (*Accipiter cooperii*), sharp-shinned hawk (*A. striatus*), broad-winged hawk (*Buteo*

platypterus), red-shouldered hawk (*B. lineatus*), red-tailed hawk (*B. jamaicensis*), northern harrier (*Circus cyaneus*), American kestrel (*Falco sparverius*), and merlin (*F. columbarius*). The barn owl (*Tyto alba*), long-eared owl (*Asio otus*), short-eared owl, and northern saw-whet owl (*Aegolius acadicus*) undertake similar migrations (Dunne and Sutton, 1986).

A variety of other wildlife species inhabit the Meadows area, including cottontail rabbit (*Sylvilagus floridanus*), muskrat (*Ondatra zibethicus*), raccoon (*Procyon lotor*), diamondback terrapin (*Malaclemys terrapin*), Fowler's toad (*Bufo woodhousii*), and spring peeper (*Hyla crucifer*) (New Jersey Division of Fish, Game and Wildlife, 1994). The spring peeper was once very common within both the Park and the Refuge; however, no spring peepers have been observed or heard in the Meadows in the last several years. Saltwater intrusion is believed to be the cause of their disappearance (U.S. Army Corps of Engineers, 1997a).

The Meadows have been designated by the U.S. Environmental Protection Agency (EPA) as a "priority" wetland because the area provides significant habitat for migratory birds and is threatened by development in adjacent communities. The adjacent Cape Island Creek wetlands have been designated by the Service as "priority" wetlands, pursuant to the Emergency Wetlands Resources Act of 1986 (100 Stat. 3582), because of their national ecological significance. In addition, the wetlands in the Meadows are internationally significant in being distinguished in the Ramsar List of Wetlands of International Importance and as part of the Western Hemisphere Shorebird Reserve Network (sponsored by World Wildlife Fund, the International Association of Fish and Wildlife Agencies, and the Academy of Natural Sciences of Philadelphia), the Delaware Estuary Program (sponsored by EPA), and the Coastal Ecosystem Program (sponsored by the Service).

VI. ENDANGERED AND THREATENED SPECIES

A review of Service records indicates that the Meadows supported the most productive piping plover (*Charadrius melodus*) nesting area in 1996 and 1997 in southern New Jersey. The piping plover is a federally listed (threatened) species and regularly nests on beaches adjacent to the Meadows. Piping plovers nest on sandy beaches above the high tide line on mainland coastal beaches, sand flats, and barrier island coastal beaches. The nesting sites are typically located on gently sloping foredunes, blowout areas behind primary dunes, washover areas cut into or between dunes, ends of sandspits, and on sites with deposits of suitable dredged or pumped sand.

Food for adult plovers and chicks consists of invertebrates such as marine worms, fly larvae, beetles, crustaceans, and mollusks. Feeding areas include intertidal portions of ocean beaches, ocean washover areas, mudflats, sandflats, wrack lines (organic ocean material left by high tide), shorelines of coastal ponds, lagoons, and salt marshes.

Development along the coastal shoreline for residential and commercial uses, and the subsequent stabilization of the once-shifting and dynamic beach ecosystem via seawalls, breakwaters, jetties, and groins have resulted in the deterioration and alteration of natural beaches. The above activities have occurred to such an extent along the Atlantic coast that many beaches no longer provide suitable habitat for the piping plover.

The Service expects that piping plovers will continue to nest on the beaches within the project area between now and the initiation of project construction. Potential and historic nesting areas change over time as a result of coastal storms and littoral drift, which affect beach erosion and accretion. Consequently, some current piping plover nesting areas may become unsuitable over time, while new nesting areas may be formed as a result of accretion or the proposed beach nourishment.

Project-related activities could adversely affect the piping plover. The proposed beach nourishment project would create an extensive and continuous dune that would eliminate currently existing overwash areas. These overwash areas provide avenues for piping plovers to move between internal freshwater feeding areas and feeding areas within the intertidal surf zone. In addition, initial beach nourishment and subsequent renourishment on a four year schedule may temporarily eliminate food resources for the piping plover within the intertidal area. Reilly and Bellis (1983) determined that recovery of macrofauna is rapid after beach nourishment activities cease; however, during that recovery period (e.g., one year) food resources for piping plovers within the Meadows will be diminished.

The lead federal agency for a project has the responsibility under Section 7(c) of the Endangered Species Act of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*) to prepare a Biological Assessment if the project is a construction project that requires an Environmental Impact Statement (EIS) and the project may affect listed species. Therefore, the Corps must prepare a Biological Assessment to address potential project-related adverse impacts to the piping plover.

The Biological Assessment should contain information concerning listed or proposed species, which may be present in the action area, and an analysis of any potential effects of the proposed action on such species. The following may be considered for inclusion in a Biological Assessment of the proposed project, although actual contents are at the discretion of the federal authorizing agency:

(1) results of field surveys to determine if listed species are present or occur seasonally;

(2) views of recognized experts on the species;

(3) literature review;

(4) analysis of direct, indirect, and cumulative effects of the action on the species; and,

(5) analysis of alternative actions.

Specifically, the Biological Assessment should include potential adverse impacts on piping plovers associated with proposed beach nourishment and renourishment activities for the project life (i.e., 50 years). Biological Assessments may be consolidated with procedures for interagency cooperation required by other statutes such as the Fish and Wildlife Coordination Act or the National Environmental Policy Act of 1969, as amended (83 Stat. 852; 42 U.S.C. 4321 *et seq.*). However, satisfying the requirements of these other statutes does not in itself relieve a federal agency of its obligation to comply with the Biological Assessment procedures of the Endangered Species Act. The results of a Biological Assessment may be incorporated in an EIS. If the Biological Assessment indicates that no listed or proposed species are present or will be affected, and the Service concurs in writing with the assessment, then no formal consultation pursuant to Section 7 will be required.

To ensure the continued protection of the piping plover over the life of the project, the Service recommends that the Corps reinitiate consultation:

- at least 135 days (90 days for formal consultation, 45 days for issuance of a Biological Opinion) prior to beginning any beach nourishment associated with the Meadows Project; and,
- at least 135 days prior to any beach maintenance activities (e.g., beach renourishment) for the life of the project (i.e., 50 years).

To reduce impacts associated with proposed beach nourishment and renourishment activities, the Service suggests the following project modifications.

1. Avoid all work in the project area between April 1 and August 15 in order to avoid potential adverse impacts on nesting piping plovers. This seasonal restriction would be applicable to maintenance work that may be necessary in subsequent years. Associated work includes, but is not limited to: the placement, movement, or maintenance of pipelines; stockpiling of construction materials and equipment; and, the pumping, placement, or distribution of sand.

2. Establish protective zones in accordance with the Service's "Guidelines for Managing Recreational Activities in Piping Plover Breeding Habitat on the U.S. Atlantic Coast to Avoid Take Under Section 9 of the Endangered Species Act" (Guidelines), dated April 15, 1994 (Appendix B). Protective zones for piping plover nests shall take

precedence over all recreational activities (e.g., vehicle access, sunbathing, kite-flying, swimming, walking). In addition, other measures identified in the Guidelines shall be instituted, such as prohibiting dogs in the vicinity of protective zones or ensuring that all dogs are leashed. Establishment of the protective zones must be coordinated with the ENSP.

3. Maintain multiple access passages between the proposed beach and the existing freshwater wetlands and feeding areas (e.g., poorly vegetated areas) landward of the proposed dune to preserve freshwater wetland feeding areas for piping plovers (Jenkins, pers. comm., 1997). Access passages over the dunes are areas gently-sloping, wide, unvegetated corridors over the dunes that provide access to relatively unvegetated flats adjacent to wetlands. The Service and ENSP would provide additional assistance in the maintenance or creation of these areas.

Access passages for piping plovers should be designed to be sparsely vegetated (i.e., <10 percent coverage in a scattered distribution). Access passages should also be either 50 feet wide and located every 300 feet or 100 feet wide and located every 600 feet. Access passages should have gradual slopes (e.g., 1 vertical: 7 horizontal) on the seaward and landward side of the dune. Finally, access passages should be covered with shells (e.g., clam shells) to reduce vegetation encroachment and to help stabilize unvegetated dune.

The Corps has agreed to initiate formal consultation with the Service regarding the piping plover and is currently preparing a Biological Assessment for piping plovers for all Philadelphia District projects in New Jersey that have the potential to impact piping plovers (U.S. Army Corps of Engineers, 1997a). Additionally, the Corps agrees to do everything possible to minimize impacts to the piping plover during construction and renourishment activities. The Corps anticipates that project specific mitigative measures will be developed during the preparation of the Biological Assessment and Biological Opinion. The Service concurs; however, in the meantime, the Service recommends that the Corps incorporate the suggested project modifications noted above (e.g., seasonal restriction, Guidelines, access passages) into the project design and discuss minimization of adverse impacts and mitigative measures within the Feasibility Report and Environmental Impact Statement.

Other than the piping plover and an occasional transient bald eagle (*Haliaeetus leucocephalus*) or peregrine falcon (*Falco peregrinus*), no other federally listed or proposed threatened or endangered flora or fauna under Service jurisdiction are known to occur in the vicinity of the project.

The federally listed Kemp's Ridley turtle (*Lepidochelys kempii*), green turtle (*Chelonia mydas*), hawksbill turtle (*Eretmochelys imbricata*), leatherback turtle (*Dermochelys coriacea*), and loggerhead turtle (*Caretta caretta*) are known to occur in the vicinity of the project. Except for nesting habitat for sea turtles, principal responsibility for marine turtles and marine mammals is under the jurisdiction of the National Marine Fisheries Service (NMFS).

The Service understands that the Corps has contacted the NMFS regarding potential impacts to federally listed species, under NMFS jurisdiction, that may result from dredging projects and would comply with conditions identified in the NMFS Biological Opinion regarding listed species.

Nesting populations of the State-listed endangered least tern (*Sterna antillarum*) occur within the project area. The State-listed black skimmer (*Rynchops niger*) has also nested within the project area and on adjacent beaches. The State-listed threatened American bittern (*Botaurus lentiginosus*) occurs within wetlands adjacent to the Meadows (New Jersey Division of Fish, Game and Wildlife, 1994). The State-listed endangered southern gray treefrog (*Hyla chrysoscelis*) and eastern tiger salamander (*Ambystoma tigrinum*) occur within southern Cape May and may have occurred in the Meadows; however, it is unlikely that these species currently exist in the Meadows due to saltwater intrusion. Several birds-of-prey occur in the vicinity of the project area, including the State-listed endangered Cooper's hawk (*Accipiter cooperii*), and the State-listed threatened northern goshawk (*Accipiter gentilis*), osprey (*Pandion haliaetus*), and barred owl (*Strix varia*). The State-listed endangered sedge wren (*Cistothorus platensis*) also occurs in the vicinity of the Meadows and inhabits freshwater emergent and scrub / shrub wetlands (New Jersey Division of Fish, Game and Wildlife, 1994). Provided construction does not occur between April 1 and August 15, it is unlikely that the proposed Meadows Project would adversely affect the abovementioned State-listed species; however, it is likely that the Meadows Project would enhance habitat for several State-listed species, including the least tern, black skimmer, and sedge wren. A summary of federally listed and State-listed species in New Jersey is included as Appendix C.

The Meadows also supports several State-listed endangered plants including the butterfly pea (*Clitoria mariana*), awl-leaved rush (*Juncus coriaceus*), and fog fruit (*Phyla lanceolata*) (New Jersey Division of Parks and Forestry, 1986). Additionally, several rare plants also occur in the Meadows, including the narrow-leaved wild crab apple (*Pyrus angustifolia*), whorled marsh-pennywort (*Hydrocotyle verticillata*), and blue boneset (*Eupatorium coelestinum*) (Biohabitats, Incorporated, 1995). A follow-up plant survey by Biohabitats, Incorporated (1996) also identified dodder (*Cuscuta indecora*), which is considered rare in New Jersey. The proposed control measures for common reed, spraying herbicides (e.g., glyphosate-based herbicides) and burning, could adversely affect State-listed and rare plants. Therefore, the Corps has agreed to conduct an updated survey of all State-listed and rare plants prior to any construction activities. The Corps has also agreed to take all necessary precautions to protect State-listed and rare plants within the Meadows from activities intended to control common reed (U.S. Army Corps of Engineers, 1997a). All activities involving potential impacts to State-listed and rare plants will be coordinated with the New Jersey Natural Heritage Program and ENSP.

VII. IDENTIFICATION OF BENEFICIAL AND ADVERSE IMPACTS, AND MITIGATIVE MEASURES

A. BENEFICIAL AND ADVERSE IMPACTS

Restoration efforts have the potential to recreate, restore, and protect valuable areas for use by fish and wildlife resources. Additionally, enhancement activities within the Meadows such as common reed control, hydrologic improvements, and revegetation would significantly improve the Meadows for fish and wildlife resources. However, restoration efforts that include extraction of materials from offshore borrow areas and related beach nourishment operations may result in adverse impacts to benthic organisms, finfish, and wildlife. In particular, beach nourishment activities result in the conversion of shallow water cover types to beach and dune cover types. Enhancement activities may also result in temporary adverse impacts on freshwater wetlands within the Meadows.

1. Extraction from Borrow Areas

Dredging borrow areas results in the removal of sediment and organisms from the borrow areas and adversely impacts water quality. Beach nourishment at the Meadows would adversely impact approximately 237 acres of benthic habitat, resulting in mortality of benthic organisms. Long-term impacts on borrow areas include potential changes in circulation patterns and the pattern of sediment deposition. Extraction from borrow areas may create bottom depressions with reduced flushing, which can create anoxic conditions slowing the recovery of benthic populations. However, most benthic organisms within the Delaware Bay's dynamic ecosystem have adapted to periodic changes in habitat that occur as a result of northeasters, hurricanes, and other storms. As a result, benthic organisms typically recolonize an area quickly, provided the habitat is still suitable. Saloman *et al.* (1982) concluded that benthic organisms recover from dredging events in approximately 1 year, with minor sedimentological changes, and a small decline in diversity and abundance within the benthic community. The Corps has also determined that recolonization of the proposed borrow areas would occur within 1 to 2 years of dredging (U.S. Army Corps of Engineers, 1997a). However, disturbances within the borrow areas every 4 years for the life of the project (i.e., 50 years) would likely limit recolonization, thereby maintaining low infaunal abundance and low species diversity.

The type of equipment used and the time of year extraction occurs may greatly influence the nature and extent of adverse impacts related to dredging. For example, dredging with a hydraulic dredge may reduce short-term adverse impacts on water quality, but may impact eggs, young fish, and other slow-moving organisms unable to avoid entrainment. The timing of dredging is also important in that if initiated concurrently with a period of low biological activity (November-January), adverse impacts on fish and wildlife resources could be minimized.

2. Beach Nourishment

The proposed beach nourishment and subsequent renourishment will bury infaunal organisms and result in mortality within the shallow nearshore (littoral) zone. Most of the organisms inhabiting the extremely dynamic nearshore and intertidal zones are highly mobile and adapt quickly to significant changes in abiotic factors. However, the proposed project would likely reduce infaunal abundance and species diversity despite the resiliency of the intertidal benthic fauna. Reilly and Bellis (1983) determined that recovery of macrofauna is rapid after beach nourishment activities cease; however, the recolonized community may differ considerably from the original community. Differences in grain size from the original beach and sand provided for beach nourishment may also affect the rate of recolonization and community diversity. Borrow Area P2 has an average grain size (0.75 mm) similar to the existing average grain size at the Meadows (0.21 mm) and at Cape May Point (0.42 mm) (U.S. Army Corps of Engineers, 1997a).

Beach nourishment activities may also adversely affect the piping plover or other shorebirds, particularly if such activities occur during the nesting season. Additionally, initial beach nourishment and subsequent renourishment on a four-year schedule may temporarily eliminate food resources for the piping plover within the intertidal area. Conversely, beach nourishment may create suitable nesting habitat in areas that currently do not support shorebird nesting. Piping plovers and other beach nesting birds, such as black skimmers, least terns, and common terns (*Sterna hirurdo*) may benefit from such activities.

The proposed project would reclaim 35 acres of terrestrial habitat waterward of the existing shoreline. Obviously, this would eliminate 35 acres of shallow water habitat adjacent to the Meadows. However, this area was formerly beach habitat prior to construction of updrift jetties and groins (U.S. Army Corps of Engineers, 1997a). Shallow water habitat would be created waterward of the proposed berm and dune construction, therefore, no net loss in shallow water habitat is predicted.

3. Ecosystem Restoration

The proposed project is critical to protecting freshwater wetlands within the Meadows. Without protection of the Meadows via berm and dune construction, the Meadows would eventually lose 138 acres of habitat by year 2050 and continue to be inundated by salt water during storm events. Inundation would eliminate freshwater wetland emergent plants and promote the continued spread of common reed within the Meadows.

Ecosystem restoration at the Meadows would create an additional 10 acres of dune, upland beach, and intertidal habitat that is continuing to decline along the Meadows. The currently proposed Meadows Project would also create 31 acres of freshwater emergent wetlands and 4 acres of freshwater ponds landward of the proposed dune. In addition, the proposed restoration may create additional habitat for federally listed and State-listed species, including the piping plover.

a. Habitat evaluation procedures

A Habitat Evaluation Procedures (HEP) study was initiated by the Corps, the Service, the NJDPF and The Nature Conservancy in fall 1993, spring 1994, and summer 1997 to provide a qualitative and quantitative assessment of fish and wildlife habitat on the Meadows and to determine the potential benefits of ecosystem restoration (U.S. Army Corps of Engineers, 1994).

Habitat quality for selected evaluation species is documented with an index referred to as the "Habitat Suitability Index" (HSI). Each evaluation species' HSI Model is applied to the project area(s) to evaluate the life requisite factors (primarily food, water, and breeding and escape cover). Each component is given a numerical rating (using a 0 to 1 scale in increments of 0.1) that determines the life requisite value (Suitability Index). The overall relationship of the suitability indices are calculated mathematically to yield the HSI value for an individual species at a given site and point in time. "Habitat Units" (HU) identify the relative habitat value of an area for a given species by incorporating the quality (i.e., HSI) and quantity (i.e., acres) of the habitat into a product value. HUs are created using the following expression: HSI x acres = HU.

Twelve evaluation species were selected to represent the guild of species that use the different cover types within the Meadows. The sharp-shinned hawk (*Accipiter striatus*) and wood thrush (*Hylocichla mustelina*) represent forested areas. The American kestrel (*Falco sparverius*) and the field sparrow (*Spizella pusilla*) represent the field. The green heron (*Butorides virescens*) and clapper rail (*Rallus longirostris*) represent emergent wetlands. The sanderling (*Calidris alba*) and the least tern represent the beach. The marsh wren (*Cistothorus palustris*) and the muskrat (*Ondatra zibethicus*) represent wetlands dominated by common reed. The black duck and the spring peeper represent open water areas within the Meadows.

As of 1997, the Meadows provided 45 HUs for sharp-shinned hawk, 37.5 HUs for wood thrush, 19.2 HUs for American kestrel, 14.4 HUs for field sparrow, 25.2 HUs for green heron, 33.6 HUs for clapper rail, 48 HUs for sanderling, 60 HUs for least tern, 38 HUs for marsh wren, 28.5 HUs for muskrat, 34.3 HUs for black duck, and 0 HUs for spring peeper.

The Corps selected ecosystem restoration plan (including beach nourishment, common reed control, salt marsh creation, and hydrologic modifications) would protect the existing Meadows habitats and the HUs provided within the Meadows. In addition, the proposed plan would create an additional 12.6 HUs for sharp-shinned hawk, 77 HUs for green heron, 113.4 HUs for clapper rail, 11.2 HUs for sanderling, 14 HUs for least tern, 7.1 HUs for black duck, and 17.5 HUs for spring peeper by year 2050 compared to the baseline HUs in 1997. These HU gains would be significantly higher when compared to HU values for the project area at year 2050 if no project activities occur. Minor losses would occur with the project for wood thrush (-1.5

HUs), American kestrel (-0.8 HUs), and field sparrow (-0.6 HUs) habitat by year 2050 compared to the baseline HUs in 1997, primarily due to changes that would occur between the baseline year (i.e., 1997) and the year of construction (i.e., 2000). Without any project activities within the Meadows, the current erosion rate of 15 feet / year is assumed to continue, which would eliminate 138 acres of terrestrial habitats from the Meadows. Therefore, the HU gains for the evaluation species are significantly higher when the with-project HUs are compared to the without-project HUs for year 2050.

Since common reed would be virtually eliminated, the representative species for this cover type (i.e., marsh wren and muskrat) would technically lose HUs (38 HUs and 28.5 HUs, respectively). However, marsh wren and muskrat also inhabit freshwater and saltwater emergent wetlands dominated by native vegetation and the same if not more HUs would still exist within the Meadows for marsh wren and muskrat with the proposed project.

The Corps has completed the cost:benefit analysis for the Meadows Project for all of the species HUs combined. The Service recommends that the Corps analyze each HEP evaluation species independently in the cost:benefit analysis for the Meadows Project. There is no biological basis for adding HUs of different species, although they may appear to be the same units. As such, analyzing HEP evaluation species independently, rather than adding all the HUs in the cost:benefit analysis, is the only valid cost:benefit analysis that can be conducted using HEP data. The Corps has agreed to evaluate each evaluation species separately using the incremental cost analysis procedures and provide such analysis to the Service for review (U.S. Army Corps of Engineers, 1997a).

b. Common reed control

Common reed control would involve spraying herbicides (e.g., glyphosate-based herbicides) and burning, potentially multiple times. These activities would eliminate common reed and some beneficial emergent vegetation. Glyphosate-based herbicides are regularly used by the Service on National Wildlife Refuges and, provided EPA guidelines are followed, impacts on fish and wildlife resources are minimal. Glyphosate is a water-soluble chemical with a short half-life and has no significant impact on macroinvertebrates, fish, or wildlife. Glyphosate is also approved for use in wetland and other aquatic areas. Common reed control will have temporary impacts to non-target plants; however, with follow-up revegetation (e.g., plantings) of beneficial emergent vegetation and water-level control, habitat within impacted areas would be improved over time and the spread of common reed (and the need for follow-up herbicide treatment) would be reduced. As noted above, the Service recommends surveying for rare plant species (after coordination with the State Natural Heritage Program and ENSP) to avoid adverse impacts to such species during control of common reed.

Reintroducing tidal inundation to 25 acres on the eastern portion of the Meadows would eliminate common reed in this area and provide increased diversity of wetlands within the Meadows. The subject area is the headwaters of Cape Island Creek and was traditionally salt marsh prior to development. To avoid flooding of adjacent developed areas, a self-regulating tide gate would be installed to allow twice-daily tidal inundation to the salt marsh but limit the entry of water during extreme tides. Restoring salt marsh in this area would replace 25 acres of freshwater wetlands with 25 acres of salt marsh; however, the existing freshwater wetlands are saturated with common reed and have low habitat value for fish and wildlife resources. Therefore, the proposed wetland conversion would improve the habitat value of the subject 25-acre area.

c. Freshwater pond enhancement

Connecting the freshwater ponds within the Meadows would involve excavating channels between the ponds. Many of these channels previously existed prior to being filled by sediment or overwash. Excavation would require disturbance of less than 1 acre of common-reed dominated wetlands. In addition, two water-control structures would be created between the Park and Refuge and between the freshwater marsh and salt marsh. The water-control structures would provide the ability to manage water levels within the Meadows based on management objectives. Control of water levels is also important in controlling the spread of common reed. Six fish reservoirs would also be constructed within existing freshwater ponds. Reservoirs would be no deeper than 36 inches and would be on average 0.002 acre. Creation of fish reservoirs provides a refuge for obligate aquatic species during dry periods. The construction of fish reservoirs is consistent with Open Marsh Water Management and provides habitat for mosquito-eating fish (even during dry periods) to allow biological control of mosquitos. Currently, the Cape May County Mosquito Extermination Commission sprays the Meadows regularly during the summer to control mosquitos. Construction of fish reservoirs would reduce or eliminate the need to spray insecticides on the Meadows. All of the hydrologic impacts (e.g., channels, water-control structures, fish reservoirs) would result in minor, temporary adverse impacts on the Meadows, but would provide significant long-term improvements to habitat quality within the Meadows.

B. MITIGATIVE MEASURES

1. Extraction from Borrow Areas

The Corps is currently proposing to deepen the Delaware River Channel as identified in the Delaware River Main Channel Deepening Project (U.S. Army Corps of Engineers, 1997b). The Corps proposes to stockpile sand in two areas in the Delaware Bay resulting in the burial of 730 acres of subtidal habitat. As an alternative to sand stockpiling, the Service recommends that the Corps consider linking federal projects that involve beach nourishment (e.g., Meadows) with the Delaware River Main Channel Deepening Project. Direct beach nourishment would eliminate double handling of dredged material and would eliminate or minimize adverse impacts on 730 acres of subtidal habitat.

The Water Resources Development Act (33 U.S.C. 2201 *et seq.*; 100 Stat. 4082) (WRDA) directs the Corps to place a greater emphasis on the use of dredged material for beneficial uses, including beach nourishment. Section 207 of WRDA of 1996 specifically allows the Corps to select a disposal method other than the least-cost option, if the incremental costs are reasonable in relation to the environmental benefits. As stated above, the Service recommends that the Corps use the material from the Delaware River Main Channel Deepening Project for direct beneficial uses (e.g., Meadows) consistent with Section 207 of the WRDA of 1996. The Corps identified that it is currently not possible to link the Meadows Project with the Delaware River Main Channel Deepening Project. However, depending on construction schedules and authorization, it may be possible to use some material from the Delaware River Main Channel Deepening Project for Lower Cape May Meadows (U.S. Army Corps of Engineers, 1997a).

If use of borrow material from the Delaware Main Channel Deepening Project is not feasible, the Service concurs with the Corps selection of Borrow Area P1 and P2 to provide borrow material. However, since Borrow Area P2 supports a lower proportion of large taxa than Borrow Area P1 and Borrow Area P2 had a lower biomass of surf clams than Borrow Area P1, the Service recommends that Borrow Area P2 be used primarily as a borrow source and only use Borrow Area P1 if Borrow Area P2 does not have adequate quantities of sand.

The Service is concerned that the sampling within the borrow areas was not adequate for evaluation of adult surf clam impacts. Specifically, Scott (1997) sampled the proposed borrow area with a Young-modified Van Veen grab-sampler, which is inappropriate for sampling adult surf clams. The Corps has agreed to coordinate with the NJDFGW, Bureau of Shellfisheries to determine if further sampling for adult surf clams is necessary. If the NJDFGW, Bureau of Shellfisheries determines that further sampling is warranted, the Corps will conduct such sampling prior to construction activities (U.S. Army Corps of Engineers, 1997a).

In order to minimize repeated impacts on benthic organisms within the borrow area, the Service recommends conducting each renourishment dredging phase in a limited portion of the borrow area and alternate locations for each subsequent renourishment cycle. This concept of rotational dredging minimizes frequent, repeated disturbance of a particular area, thereby allowing recolonization of benthic organisms to occur over a longer period of time. The Corps has agreed to make every effort to utilize rotational dredging techniques during renourishment activities.

In order to avoid anoxic conditions in the borrow area, the Corps would avoid the creation of excessively deep, poorly flushed borrow sites. The Corps also proposes to minimize impacts on benthic organisms by dredging during a period of low biological activity (November to January). However, due to the possibility of severe winter storms, dredging during such time may not be feasible. To further minimize impacts, the Corps proposes to use a hydraulic dredge with a pipeline delivery system to minimize turbidity and minimize impacts on benthic invertebrates (U.S. Army Corps of Engineers, 1997a).

Finfish such as striped bass (*Morone saxatilis*) and bluefish (*Pomatomus saltatrix*) frequent shoals immediately offshore of the Meadows such as the Eph Shoal adjacent to Borrow Area P2. Dredging activities within these shoals could adversely impact use of these shoals by recreationally valuable finfish (McClain, pers. comm., 1997). Therefore, the Service recommends that the Corps coordinate with the New Jersey Division of Fish, Game and Wildlife, Bureau of Marine Fisheries and the Cape May Charter Boat Association to identify and minimize potential impacts on recreational fisheries. The Corps has agreed to coordinate with the subject organizations through distribution of the draft Feasibility Report and Integrated Environmental Impact Statement.

2. Beach Nourishment

Revegetation and fencing are proposed to stabilize the constructed dune. Dune stabilization plans should account for beach nesting birds (including piping plovers) and diamondback terrapins (*Malaclemys terrapin*), which travel over and use dune areas. Specifically, the Service recommends minimizing dune plantings to the extent possible without compromising dune stabilization. Additionally, the Service recommends against using Japanese sedge (as proposed) for dune stabilization. Establishment of Japanese sedge can act as a significant barrier of movement for beach nesting birds (Jenkins, pers. comm., 1997). The Service also recommends a broken configuration of sand fencing using a zig-zag pattern parallel to the shore or a Y-type design perpendicular to the shore to avoid or reduce any barriers to wildlife movement to and from the shoreline. The Corps agrees to plant dune vegetation and install dune fencing to allow wildlife movement between the dunes and the shore will not be impeded (U.S. Corps of Engineers, 1997a).

3. Ecosystem Restoration

The proposed water-control structures would allow for the management of water levels within the Meadows to maintain water in the Meadows during dry periods, maintain beneficial emergent wetland plants, and discourage the spread of common reed. However, detailed water level management plans have not yet been developed by the Corps. The Corps proposes to coordinate with the Service, NJDPF, ENSP, and The Nature Conservancy to develop a water level management plan to identify appropriate water level objectives to maximize benefits for fish and wildlife resources within the Meadows (U.S. Army Corps of Engineers, 1997a). The Management Plan would include management goals, dispute resolution, and adaptive management strategies. Additionally, the Corps currently proposes to place a removable shield over the outfall structure in Shallow Pond West to prevent loss of freshwater from the Meadows at this location.

The proposed project provides an opportunity to significantly increase the habitat value of the Meadows for a variety of fish and wildlife resources. In order to monitor benefits to fish and wildlife and to ensure that the goals and objectives of the Meadows Project are obtained, the Corps proposes to initiate an environmental monitoring program. The Corps would coordinate with the Service, NJDPF, ENSP and The Nature Conservancy to develop a monitoring program to gather information on long-term beneficial (and adverse) impacts of the proposed project on fish and wildlife resources. The monitoring program would also incorporate remedial actions that would take place if proposed goals and objectives are not attained. Monitoring would include the: spread of common reed, survival of planted emergent wetland vegetation, effectiveness of hydrologic connections between internal ponds, effectiveness of water level management, and recolonization of salt marsh vegetation in the 25-acre area on the eastern portion of the Meadows. Actual monitoring could be conducted by NJDPF and The Nature Conservancy staff. The Corps does not propose to include monitoring activities of beach nesting birds within the project area because the NJDFGW currently undertakes this activity. The Service continues to recommend that the Corps include beach-nesting bird surveys in cooperation with the ENSP as part of the proposed overall monitoring program.

The Service provided a list of suggested plantings, transplants, or revegetation for the Meadows to the Corps in September 1997 (Appendix D). As planned, revegetation of freshwater emergent wetlands would occur following common reed eradication. The Corps used the suggested plantings to develop a revegetation plan that would be implemented following common reed control. The Service has not had an opportunity to review the subject revegetation plan; therefore, we recommend that the Corps incorporate the subject revegetation plan into the Feasibility Report and Final Environmental Assessment. Several scrub / shrub species are included in the Service's list of suggested plantings. These species could be planted along the landward toe of the proposed dune, provided that access between the beach and the wetlands is maintained for piping plovers.

VIII. CONCLUSIONS AND RECOMMENDATIONS

The Service strongly supports the Corps proposed ecosystem restoration at the Meadows and views the proposed project as beneficial to fish and wildlife by restoring and enhancing beach and dune areas that support valuable fish and wildlife habitats. Additionally, the proposed project would restore critical freshwater wetland areas within the Meadows, providing valuable habitat for a variety of fish and wildlife resources including the 12 HEP evaluation species and the species guilds that they represent. The proposed project has the potential to provide additional habitat for federally listed and State-listed threatened and endangered species (e.g., piping plover). However, water level management and monitoring would be required to fully achieve and maintain the proposed project's goals and objectives for fish and wildlife.

It is the view of the Service that potential project-related adverse impacts to fish and wildlife could be minimized and project-related beneficial impacts could be maximized by incorporating the following recommendations into the final project design.

1. Prepare a Biological Assessment to address potential project-related adverse impacts to the piping plover.

2. Reinitiate consultation with the Service to ensure the continued protection of the piping plover:

   - at least 135 days (90 days for formal consultation, 45 days for issuance of a Biological Opinion) prior to beginning any initial beach nourishment associated with the Meadows Project; and,

   - at least 135 days prior to any beach maintenance activities (e.g., beach renourishment) for the life of the project (i.e., 50 years).

3. Incorporate the following project modifications to minimize impacts on piping plovers and discuss these issues within the Feasibility Report and Environmental Impact Statement:

   a. Avoid all work in the project area between April 1 and August 15 in order to avoid potential adverse impacts on nesting piping plovers. This seasonal restriction would be applicable to maintenance work that may be necessary in subsequent years. Associated work includes, but is not limited to: the placement, movement, or maintenance of pipelines; stockpiling of construction materials and equipment; and, the pumping, placement, or distribution of sand.

1. Concur. A Biological Assessment is being prepared for piping plovers for the Philadelphia Districts New Jersey coastal projects. The Assessment will be forwarded to USFWS when complete.

2. Concur. Consultation will be reinitiated prior to any initial construction or maintenance activities at The Meadows.

3a. Concur. It is currently anticipated that all beachfill activities can be conducted outside of the season restrictions to avoid impacting piping plovers.

b. Establish protective zones in accordance with the Service's "Guidelines for Managing Recreational Activities in Piping Plover Breeding Habitat on the U.S. Atlantic Coast to Avoid Take Under Section 9 of the Endangered Species Act" (Guidelines), dated April 15, 1994 (Appendix B). Protective zones for piping plover nests shall take precedence over all recreational activities (e.g., vehicle access, sunbathing, kite-flying, swimming, walking). In addition, other measures identified in the Guidelines shall be instituted, such as prohibiting dogs in the vicinity of protective zones or ensuring that all dogs are leashed. Establishment of the protective zones must be coordinated with ENSP.

c. Maintain multiple access passages between the proposed beach and the existing freshwater wetlands and feeding areas (e.g., poorly vegetated areas) landward of the proposed dune to preserve freshwater wetland feeding areas for piping plovers.

4. Use Borrow Area P2 as the primary borrow source and only use Borrow Area P1 if Borrow Area P2 does not have adequate quantities of sand.

5. Include beach-nesting bird surveys in cooperation with the ENSP as part of the proposed overall monitoring program.

6. Incorporate the proposed revegetation plan in the Feasibility Report and Final Environmental Assessment.

The Corps has agreed to incorporate the following mitigative measures (recommended in the Service's draft Fish and Wildlife Coordination Act 2(b) Report) into the final project design:

1. Identify the location of all State-listed and rare plants within the Meadows and take appropriate measures to protect these areas from common reed control activities. Additionally, contact the New Jersey Natural Heritage Program and ENSP regarding the protection of State-listed plant species.

2. Analyze each HEP evaluation species independently in the cost:benefit analysis for the Meadows Project.

3. Use the material from the Delaware River Main Channel Deepening Project for direct beneficial uses (e.g., Meadows) consistent with Section 207 of the WRDA of 1996.

3b. The Corps will establish protective zones during construction and maintenance activities. Once construction is completed, the normal maintenance (other than nourishment activities) are the responsibility of the local sponsor (NJDEP) and the property owners. NJDEP currently is responsible for establishing protective zones for plovers along the entire coast and we anticipate that this will also be the case within The Meadows.

3c. Concur. Plover "walkovers" have been added to the selected plan to allow plovers access to the backwater feeding habitats.

4. Due to coordination with the NJDEP, it will not be possible to utilize the proposed borrow areas in this manner. NJDEP has requested that P2 not be used at all and that P1 be reconfigured in an effort to minimize impacts on surf clams and prime fishing areas. The Corps is currently investigating these changes to the borrow areas, as well as the possibility of using sand from Cape May Inlet for nourishment activities to further reduce potential impacts to marine species. Any permanent changes to the borrow areas will be coordinated with the USFWS as well as other pertinent agencies/organizations.

5. The Corps may be able to aid in the beach-nesting bird surveys during the 5 year monitoring cycle, if appropriate, but following that time, this responsibility would continue to be carried out by NJDEP.

6. Due to coordination with NJDEP and the Natural Areas Council, it has been decided that more coordination will be necessary before finalizing a planting plan. It has been proposed that a working group be developed during the PED phase to coordinate these and other details of the selected plan. It is hoped that USFWS will be able to provide support for this working group and be able to aid in the development of the final planting plan and other details.

4. Conduct a clam survey using appropriate methodology to estimate the adult population of surf clams in the proposed borrow areas if NJDFGW, Bureau of Shellfisheries determines that such a survey is warranted.

5. Conduct each renourishment dredging phase in a limited portion of the borrow area and alternate locations for each subsequent renourishment cycle (i.e., rotational dredging).

6. Avoid the creation of excessively deep, poorly flushed borrow sites; attempt to dredge during a period of low biological activity (November to January) depending on feasibility related to storm events; and, use a hydraulic dredge with a pipeline delivery system to minimize impacts on benthic invertebrates.

7. Coordinate with the New Jersey Division of Fish, Game and Wildlife, Bureau of Marine Fisheries and the Cape May Charter Boat Association to minimize adverse impacts on recreational fisheries from dredging activities.

8. Minimize dune plantings and install sand fencing in a broken configuration, using a zig-zag pattern parallel to the shore or a Y-type design perpendicular to the shore, to avoid or reduce restrictions on wildlife movement between the dunes and the shore. Additionally, avoid using Japanese sedge in plantings for dune stabilization.

9. Coordinate with the Service, NJDPF, ENSP. and The Nature Conservancy to develop a water level management plan to identify appropriate water level objectives to maximize benefits for fish and wildlife resources within the Meadows.

10. Coordinate with the Service, NJDPF, ENSP and The Nature Conservancy to develop a monitoring program to gather information on long-term beneficial (and adverse) impacts of the proposed project on fish and wildlife resources, including beach nesting birds. The monitoring program should also incorporate remedial actions that would take place if proposed goals and objectives are not attained.

11. Revegetate the freshwater wetlands within the Meadows following common reed control using the suggested plantings listed in Appendix D.

These 11 recommendations are discussed in Section 10 of the Feasibility Report and have been included in the selected plan as detailed in the final report.

IX. REFERENCES

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B. PERSONAL COMMUNICATIONS

Jenkins, D. 1997. Biologist. Endangered and Nongame Species Program, New Jersey Division of Fish, Game and Wildlife, New Jersey Department of Environmental Protection. Nacote Creek Research Station. Port Republic, New Jersey.

McClain, J. 1997. Fisheries Biologist. Bureau of Marine Fisheries, New Jersey Division of Fish, Game and Wildlife, New Jersey Department of Environmental Protection. Nacote Creek Research Station. Port Republic, New Jersey.

APPENDIX A

Coordination with the
New Jersey Division of Fish, Game and Wildlife

State of New Jersey

Christine Todd Whitman
Governor

Department of Environmental Protection

Robert C
Cor

Division of Fish, Game and Wildlife
PO Box 400
Trenton, New Jersey 08625-0400

December 29, 1997

Clifford G. Day, Administrator
US Fish and Wildlife Service
927 North Main Street (Bldg. D1)
Pleasantville, NJ 08232

Dear Mr. Day:

This serves to inform you that the NJ Division of Fish, Game and Wildlife concurs with the USFWS Draft Fish and Wildlife Coordination Act Report entitled, "Assessment of the Lower Cape May Meadows - Cape May Point Feasibility Study, Cape May County, New Jersey". The assessment constitutes the Service's report on fish and wildlife impacts that can be expected to result from the US Army Corps of Engineers' proposed plan to construct the Lower Cape May Meadows - Cape May Point Project, and was prepared pursuant to Section 2(b) of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 USC 661 et seq.).

Thank you for the opportunity to comment.

Sincerely,

Robert McDowell
Director

LW/slw

c: Andy Didun
Lee Widjeskog

DOCUMENT: DAY3.DOC

APPENDIX B

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

United States Department of the Interior

FISH AND WILDLIFE SERVICE
300 Westgate Center Drive
Hadley, MA 01035-9589

TAKE PRIDE IN AMERICA

In Reply Refer To:
FWS/Region 5/ES-TE

APR 21 1994

Mr. John H. Spencer
Bureau of Natural Resources
Department of Environmental Protection
79 Elm Street
Hartford, Connecticut 06106-5127

Dear Mr. Spencer:

Enclosed are the U.S. Fish and Wildlife Service's Guidelines for Managing Recreational Activities in Piping Plover Breeding Habitat on the U.S. Atlantic Coast to Avoid Take Under Section 9 of the Endangered Species Act. This is the final version of the draft guidelines sent to you for review and comment on March 18, 1994.

These guidelines, based on the best available biological information, provide a flexible approach to protecting piping plovers, while minimizing impacts on beach recreation on non-Federal lands. Management techniques recommended in these guidelines will generally facilitate pedestrian access to the shoreline throughout the plover's breeding cycle. Recommended management options that include intensive monitoring will, in most cases, also allow use of motorized vehicles except when flightless chicks are present.

Please contact Anne Hecht at 508-443-4325 or Paul Nickerson at 413-253-8615 if you have questions about these guidelines or other aspects of the piping plover recovery effort.

Sincerely,

Donald E. Lambertson

Regional Director

Enclosure

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

Northeast Region, U.S. Fish and Wildlife Service
April 15, 1994

The following information is provided as guidance to beach managers and property owners seeking to avoid potential violations of Section 9 of the Endangered Species Act (16 U.S.C. 1538) and its implementing regulations (50 CFR Part 17) that could occur as the result of recreational activities on beaches used by breeding piping plovers along the Atlantic Coast. These guidelines were developed by the Northeast Region, U.S. Fish and Wildlife Service (Service), with assistance from the U.S. Atlantic Coast Piping Plover Recovery Team. The guidelines are advisory, and failure to implement them does not, of itself, constitute a violation of the law. Rather, they represent the Service's best professional advice to beach managers and landowners regarding the management options that will prevent direct mortality, harm, or harassment of piping plovers and their eggs due to recreational activities.

Some land managers have endangered species protection obligations under Section 7 of the Endangered Species Act (see section I below) or under Executive Orders 11644 and 11989[1] that go beyond adherence to these guidelines. Nothing in this document should be construed as lack of endorsement of additional piping plover protection measures implemented by these land managers or those who are voluntarily undertaking stronger plover protection measures.

This document contains four sections: (I) a brief synopsis of the legal requirements that afford protection to nesting piping plovers; (II) a brief summary of the life history of piping plovers and potential threats due to recreational activities during the breeding cycle; (III) guidelines for protecting piping plovers from recreational activities on Atlantic Coast beaches; and (IV) literature cited.

[1] Executive Order 11644, Use of Off-Road Vehicles on the Public Lands and Executive Order 11989, Off-Road Vehicles on Public Lands pertain to lands under custody of the Secretaries of Agriculture, Defense, and Interior (except for Indian lands) and certain lands under the custody of the Tennessee Valley Authority.

I. LEGAL CONSIDERATIONS

Section 9 of the Endangered Species Act (ESA) prohibits any person subject to the jurisdiction of the United States from harassing, harming, pursuing, hunting, shooting, wounding, killing, trapping, capturing, or collecting listed wildlife species. It is also unlawful to attempt such acts, solicit another to commit such acts, or cause such acts to be committed. A "person" is defined in Section 3 to mean "an individual, corporation, partnership, trust, association, or any other private entity; or any officer, employee, agent, department, or instrumentality of the Federal Government, of any State, municipality, or political subdivision of a State, or of any foreign government; any State, municipality, or political subdivision of a State; or any other entity subject to the jurisdiction of the United States." Regulations implementing the ESA (50 CFR 17.3) further define "harm" to include significant habitat modification or degradation that results in the killing or injury of wildlife by significantly impairing essential behavioral patterns including breeding, feeding, or sheltering. "Harass" means an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering. Penalties for violations of Section 9 are provided in Section 11 of the ESA; for threatened species, these penalties include fines of up to $25,000, imprisonment for not more than six months, or both.

Section 10 of the ESA and related regulations provide for permits that may be granted to authorize acts prohibited under Section 9, for scientific purposes or to enhance the propagation or survival of a listed species. States that have Cooperative Agreements under Section 6 of the ESA, may provide written authorization for take that occurs in the course of implementing conservation programs. For example, State agencies have authorized certain biologists to construct predator exclosures for piping plovers. It is also legal for employees or designated agents of certain Federal or State agencies to take listed species without a permit, if the action is necessary to aid sick, injured, or orphaned animals or to salvage or dispose of a dead specimen.

Section 10 also allows permits to be issued for take that is "incidental to, and not the purpose of, carrying out an otherwise lawful activity" if the Service determines that certain conditions have been met. An applicant for an incidental take permit must prepare a conservation plan that specifies the impacts of the take, steps the applicant will take to minimize and mitigate the impacts, funding that will be available to implement these steps, alternative actions to the take that the applicant considered, and the reasons why such alternatives are not being utilized.

Section 7 of the ESA may be pertinent to beach managers and landowners in situations that have a Federal nexus. Section 7 requires Federal agencies to consult with the Service (or National Marine Fisheries Service for marine species) prior to authorizing, funding, or carrying out activities that may affect listed species. Section 7 also requires that these agencies use their authorities to further the conservation of listed species. Section 7 obligations have caused Federal land management agencies to implement piping plover protection measures that go beyond those required to avoid take, for example by conducting research on threats to piping plovers. Other examples of Federal activities that may affect piping plovers along the Atlantic Coast, thereby triggering Section 7 consultation, include permits for beach nourishment or disposal of dredged material (U.S. Army Corps of Engineers) and funding of beach restoration projects (Federal Emergency Management Authority).

Piping plovers, as well as other migratory birds such as least terns, common terns, American oystercatchers, laughing gulls, herring gulls, and great black-backed gulls, their nests, and eggs are also protected under the Migratory Bird Treaty Act of 1918 (16 U.S.C. 703-712). Prohibited acts include pursuing, hunting, shooting, wounding, killing, trapping, capturing, collecting, or attempting such conduct. Violators may be fined up to $5000 and/or imprisoned for up to six months.

Almost all States within the breeding range of the Atlantic Coast piping plover population list the species as State threatened or endangered (Northeast Nongame Technical Committee 1993). Various laws and regulations may protect State-listed species from take, but the Service has not ascertained the adequacy of the guidelines presented in this document to meet the requirements of any State law.

II. LIFE HISTORY AND THREATS FROM HUMAN DISTURBANCE

Piping plovers are small, sand-colored shorebirds that nest on sandy, coastal beaches from South Carolina to Newfoundland. Since 1986, the Atlantic Coast population has been protected as a threatened species under provisions of the U.S. Endangered Species Act of 1973 (U.S. Fish and Wildlife Service 1985). The U.S. portion of the population was estimated at 875 pairs in 1993 (U.S. Fish and Wildlife Service 1993). Many characteristics of piping plovers contribute to their susceptibility to take due to human beach activities.

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). Eggs may be present on the beach from mid-April through late July. Clutch size is generally four eggs, and the incubation period[2] usually lasts for 27-28 days. Piping plovers fledge only a single brood per season, but may renest several times if previous nests are lost. Chicks are precocial[3] (Wilcox 1959, Cairns 1982). They may move hundreds of yards from the nest site during their first week of life (see Table 1, Summary of Chick Mobility Data). Chicks remain together with one or both parents until they fledge (are able to fly) 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).

Piping plover nests are situated above the high tide line on coastal beaches, sand flats at the ends of sandspits and barrier islands, gently sloping foredunes, blowout areas behind primary dunes, and washover areas cut into or between dunes. They 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 1987a, Cairns 1982, Patterson 1988, Flemming et al. 1990, MacIvor 1990,

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[2] "Incubation" refers to adult birds sitting on eggs, to maintain them at a favorable temperature for embryo development.

[3] "Precocial" birds are mobile and capable of foraging for themselves within several hours of hatching.

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 6-7 day egg-laying phase when the birds generally do not incubate (Goldin 1994).

Plover foods consist of invertebrates such as marine worms, fly larvae, beetles, crustaceans or mollusks (Bent 1929, Cairns 1977, Nicholls 1989). Feeding areas include intertidal portions of ocean beaches, washover areas, mudflats, sandflats, wrack lines[4], and shorelines of coastal ponds, lagoons or salt marshes (Gibbs 1986, Coutu et al. 1990, Hoopes et al. 1992, Loegering 1992, Goldin 1993). 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) 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 et al. 1990). Feeding activities of chicks may be particularly important to their survival. 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% of this weight gain by day 12 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 (see Table 1). 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).

THREATS FROM NONMOTORIZED BEACH ACTIVITIES

Sandy beaches that provide nesting habitat for piping plovers are also attractive recreational habitats for people and their pets. Nonmotorized recreational activities can be a source of both direct mortality and harassment of piping plovers. Pedestrians on beaches may crush

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

eggs (Burger 1987b, Hill 1988, Shaffer and Laporte 1992, Cape Cod National Seashore 1993, Collazo et al. 1994). Unleashed dogs may chase plovers (McConnaughey et al. 1990), destroy nests (Hoopes et al. 1992), and kill chicks (Cairns and McLaren 1980).

Pedestrians may flush incubating plovers from nests (see Table 2, Summary of Data on Distances at Which Plovers React to Disturbance), exposing eggs to avian predators or causing excessive cooling or heating of eggs. 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, Hoopes et al. 1992, Loegering 1992, Goldin 1993). Fireworks are highly disturbing to piping plovers (Howard et al. 1993). Plovers are particularly intolerant of kites, compared with pedestrians, dogs, and vehicles; biologists believe this may be because plovers perceive kites as potential avian predators (Hoopes et al. 1992).

THREATS FROM MOTOR VEHICLES

Unrestricted use of motorized vehicles on beaches is a serious threat to piping plovers and their habitats. Vehicles can crush eggs (Wilcox 1959; Tull 1984; Burger 1987b; Patterson et al. 1991; United States of America v. Breezy Point Cooperative, Inc., U.S. District Court, Eastern District of New York, Civil Action No. CV-90-2542, 1991; Shaffer and Laporte 1992), adults, and chicks. In Massachusetts and New York, biologists documented 14 incidents in which 18 chicks and 2 adults were killed by vehicles between 1989 and 1993 (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. Many biologists that monitor and manage piping plovers believe that many more chicks are killed by vehicles than are found and reported (Melvin et al. 1994). Beaches used by 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 vehicle restrictions during chick-rearing periods have been combined with protection of nests from predators (Goldin 1993; S. Melvin, pers. comm., 1993).

Typical behaviors of piping plover chicks increase their vulnerability to vehicles. Chicks frequently move between the upper berm or foredune and feeding habitats in 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 in, 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). 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 (see Table 1).

Vehicles may also significantly degrade piping plover habitat or disrupt normal behavior patterns. They may harm or harass plovers by crushing wrack into the sand and making it unavailable as cover or a foraging substrate, by creating ruts that may trap or impede movements of chicks, and by preventing plovers from using habitat that is otherwise suitable (MacIvor 1990, Strauss 1990, Hoopes et al. 1992, Goldin 1993).

III. GUIDELINES FOR PROTECTING PIPING PLOVERS FROM RECREATIONAL DISTURBANCE

The Service recommends the following protection measures to prevent direct mortality or harassment of piping plovers, their eggs, and chicks.

MANAGEMENT OF NONMOTORIZED RECREATIONAL USES

On beaches where pedestrians, joggers, sun-bathers, picnickers, fishermen, boaters, horseback riders, or other recreational users are present in numbers that could harm or disturb incubating plovers, their eggs, or chicks, areas of at least 50 meter-radius around nests above the high tide line should be delineated with warning signs and symbolic fencing[5]. Only persons engaged in rare species monitoring, management, or research activities should enter posted areas. These areas should remain fenced as long as viable eggs or unfledged chicks are present. Fencing is intended to prevent accidental crushing of nests and repeated flushing of

[5] "Symbolic fencing" refers to one or two strands of light-weight string, tied between posts to delineate areas where pedestrians and vehicles should not enter.

incubating adults, and to provide an area where chicks can rest and seek shelter when large numbers of people are on the beach.

Available data indicate that a 50 meter buffer distance around nests will be adequate to prevent harassment of the majority of incubating piping plovers. However, fencing around nests should be expanded in cases where the standard 50 meter-radius is inadequate to protect incubating adults or unfledged chicks from harm or disturbance. Data from various sites distributed across the plover's Atlantic Coast range indicates that larger buffers may be needed in some locations (see Table 2). This may include situations where plovers are especially intolerant of human presence, or where a 50 meter-radius area provides insufficient escape cover or alternative foraging opportunities for plover chicks.[6]

In cases where the nest is located less than 50 meters above the high tide line, fencing should be situated at the high tide line, and a qualified biologist should monitor responses of the birds to passersby, documenting his/her observations in clearly recorded field notes. Providing that birds are not exhibiting signs of disturbance, this smaller buffer may be maintained in such cases.

On portions of beaches that receive heavy human use, areas where territorial plovers are observed should be symbolically fenced to prevent disruption of territorial displays and courtship. Since nests can be difficult to locate, especially during egg-laying, this will also prevent accidental crushing of undetected nests. If nests are discovered outside fenced areas, fencing should be extended to create a sufficient buffer to prevent disturbance to incubating adults, eggs, or unfledged chicks.

[6] For example, on the basis of data from an intensive three year study that showed that plovers on Assateague Island in Maryland flush from nests at greater distances than those elsewhere (Loegering 1992), the Assateague Island National Seashore established 200 meter buffers zones around most nest sites and primary foraging areas (Assateague Island National Seashore 1993). Following a precipitous drop in numbers of nesting plover pairs in Delaware in the late 1980's, that State adopted a Piping Plover Management Plan that provided 100 yard buffers around nests on State park lands and included intertidal areas (Delaware Department of Natural Resources and Environmental Control 1990).

Pets should be leashed and under control of their owners at all times from April 1 to August 31 on beaches where piping plovers are present or have traditionally nested. Pets should be prohibited on these beaches from April 1 through August 31 if, based on observations and experience, pet owners fail to keep pets leashed and under control.

Kite flying should be prohibited within 200 meters of nesting or territorial adult or unfledged juvenile piping plovers between April 1 and August 31.

Fireworks should be prohibited on beaches where plovers nest from April 1 until all chicks are fledged.

MOTOR VEHICLE MANAGEMENT

The Service recommends the following minimum protection measures to prevent direct mortality or harassment of piping plovers, their eggs, and chicks on beaches where vehicles are permitted. Since restrictions to protect unfledged chicks often impede vehicle access along a barrier spit, a number of management options affecting the timing and size of vehicle closures are presented here. Some of these options are contingent on implementation of intensive plover monitoring and management plans by qualified biologists. It is recommended that landowners seek concurrence with such monitoring plans from either the Service or the State wildlife agency.

Protection of Nests

All suitable piping plover nesting habitat should be identified by a qualified biologist and delineated with posts and warning signs or symbolic fencing on or before April 1 each year. All vehicular access into or through posted nesting habitat should be prohibited. However, prior to hatching, vehicles may pass by such areas along designated vehicle corridors established along the outside edge of plover nesting habitat. Vehicles may also park outside delineated nesting habitat, if beach width and configuration and tidal conditions allow. Vehicle corridors or parking areas should be moved, constricted, or temporarily closed if territorial, courting, or nesting plovers are disturbed by passing or parked vehicles, or if disturbance is anticipated because of unusual tides or expected increases in vehicle use during weekends, holidays, or special events.

If data from several years of plover monitoring suggests that significantly more habitat is available than the local plover population can occupy, some suitable habitat may be left unposted if the following conditions are met:

1. The Service OR a State wildlife agency that is party to an agreement under Section 6 of the ESA provides written concurrence with a plan that:

   A. Estimates the number of pairs likely to nest on the site based on the past monitoring and regional population trends.

   AND

   B. Delineates the habitat that will be posted or fenced prior to April 1 to assure a high probability that territorial plovers will select protected areas in which to court and nest. Sites where nesting or courting plovers were observed during the last three seasons as well as other habitat deemed most likely to be pioneered by plovers should be included in the posted and/or fenced area.

   AND

   C. Provides for monitoring of piping plovers on the beach by a qualified biologist(s). Generally, the frequency of monitoring should be not less than twice per week prior to May 1 and not less than three times per week thereafter. Monitoring should occur daily whenever moderate to large numbers of vehicles are on the beach. Monitors should document locations of territorial or courting plovers, nest locations, and observations of any reactions of incubating birds to pedestrian or vehicular disturbance.

AND

2. All unposted sites are posted immediately upon detection of territorial plovers.

Protection of Chicks

Sections of beaches where unfledged piping plover chicks are present should be temporarily closed to all vehicles not deemed essential. (See the provisions for essential vehicles below.) Areas where vehicles are prohibited should include all dune, beach, and intertidal habitat within the chicks' foraging range, to be determined by either of the following methods:

1. The vehicle free area should extend 1000 meters on each side of a line drawn through the nest site and perpendicular to the long axis of the beach. The resulting 2000 meter-wide area of protected habitat for plover chicks should extend from the ocean-side low water line to the bay-side low water line or to the farthest extent of dune habitat if no bay-side intertidal habitat exists. However, vehicles may be allowed to pass through portions of the protected area that are considered inaccessible to plover chicks because of steep topography, dense vegetation, or other naturally-occurring obstacles.

OR

2. The Service OR a State wildlife agency that is party to an agreement under Section 6 of the ESA provides written concurrence with a plan that:

A. Provides for monitoring of all broods during the chick-rearing phase of the breeding season and specifies the frequency of monitoring.

AND

B. Specifies the minimum size of vehicle-free areas to be established in the vicinity of unfledged broods based on the mobility of broods observed on the site in past years and on the frequency of monitoring. Unless substantial data from past years show that broods on a site stay very close to their nest locations, vehicle-free areas should extend at least 200 meters on each side of the nest site during the first week following hatching. The size and location of the protected area should be adjusted in response to the observed mobility of the brood, but in no case should it be reduced to less than 100 meters on each

side of the brood. In some cases, highly mobile broods may require protected areas up to 1000 meters, even where they are intensively monitored. Protected areas should extend from the ocean-side low water line to the bay-side low water line or to the farthest extent of dune habitat if no bay-side intertidal habitat exists. However, vehicles may be allowed to pass through portions of the protected area that are considered inaccessible to plover chicks because of steep topography, dense vegetation, or other naturally-occurring obstacles. In a few cases, where several years of data documents that piping plovers on a particular site feed in only certain habitat types, the Service or the State wildlife management agency may provide written concurrence that vehicles pose no danger to plovers in other specified habitats on that site.

Timing of Vehicle Restrictions in Chick Habitat

Restrictions on use of vehicles in areas where unfledged plover chicks are present should begin on or before the date that hatching begins and continue until chicks have fledged. For purposes of vehicle management, plover chicks are considered fledged at 35 days of age or when observed in sustained flight for at least 15 meters, whichever occurs first.

When piping plover nests are found before the last egg is laid, restrictions on vehicles should begin on the 26th day after the last egg is laid. This assumes an average incubation period of 27 days, and provides a 1 day margin of error.

When plover nests are found after the last egg has been laid, making it impossible to predict hatch date, restrictions on vehicles should begin on a date determined by one of the following scenarios:

1) With intensive monitoring: If the nest is monitored at least twice per day, at dawn and dusk (before 0600 hrs and after 1900 hrs) by a qualified biologist, vehicle use may continue until hatching begins. Nests should be monitored at dawn and dusk to minimize the time that hatching may go undetected if it occurs after dark. Whenever possible, nests should be monitored from a distance with spotting scope or binoculars to minimize disturbance to incubating plovers.

OR

2) Without intensive monitoring: Restrictions should begin on May 15 (the earliest probable hatch date). If the nest is discovered after May 15, then restrictions should start immediately.

If hatching occurs earlier than expected, or chicks are discovered from an unreported nest, restrictions on vehicles should begin immediately.

If ruts are present that are deep enough to restrict movements of plover chicks, then restrictions on vehicles should begin at least 5 days prior to the anticipated hatching date of plover nests. If a plover nest is found with a complete clutch, precluding estimation of hatching date, and deep ruts have been created that could reasonably be expected to impede chick movements, then restrictions on vehicles should begin immediately.

Essential Vehicles

Because it is impossible to completely eliminate the possibility that a vehicle will accidently crush an unfledged plover chicks, use of vehicles in the vicinity of broods should be avoided whenever possible. However, the Service recognizes that life-threatening situations on the beach may require emergency vehicle response. Furthermore, some "essential vehicles" may be required to provide for safety of pedestrian recreationists, law enforcement, maintenance of public property; or access to private dwellings not otherwise accessible. On large beaches, maintaining the frequency of plover monitoring required to minimize the size and duration of vehicle closures may necessitate the use of vehicles by plover monitors.

Essential vehicles should only travel on sections of beaches where unfledged plover chicks are present if such travel is absolutely necessary and no other reasonable travel routes are available. All steps should be taken to minimize number of trips by essential vehicles through chick habitat areas. Homeowners should consider other means of access, eg. by foot, water, or shuttle services, during periods when chicks are present.

The following procedures should be followed to minimize the probability that chicks will be crushed by essential (non-emergency) vehicles:

1. Essential vehicles should travel through chick habitat areas only during daylight hours, and should be guided by a qualified monitor who has first determined the location of all unfledged plover chicks.

2. Speed of vehicles should not exceed five miles per hour.

3. Use of open 4-wheel motorized all-terrain vehicles (ATVs) or non-motorized all-terrain bicycles is recommended whenever possible for monitoring and law enforcement because of the improved visibility afforded operators.

4. A log should be maintained by the beach manager of the date, time, vehicle number and operator, and purpose of each trip through areas where unfledged chicks are present. Personnel monitoring plovers should maintain and regularly update a log of the numbers and locations of unfledged plover chicks on each beach. Drivers of essential vehicles should review the log each day to determine the most recent number and location of unfledged chicks.

Essential vehicles should avoid driving on the wrack line, and travel should be infrequent enough to avoid creating deep ruts that could impede chick movements. If essential vehicles are creating ruts that could impede chick movements, use of essential vehicles should be further reduced and, if necessary, restricted to emergency vehicles only.

SITE-SPECIFIC MANAGEMENT GUIDANCE

The guidelines provided in this document are based on an extensive review of the scientific literature and are intended to cover the vast majority of situations likely to be encountered on piping plover nesting sites along the U.S. Atlantic Coast. However, the Service recognizes that site-specific conditions may lead to anomalous situations in which departures from this guidance may be safely implemented. The Service recommends that landowners who believe such situations exist on their lands contact either the Service or the State wildlife agency and, if appropriate, arrange for an on-site review. Written documentation of agreements regarding departures from this guidance is recommended.

In some unusual circumstances, Service or State biologists may recognize situations where this guidance provides insufficient protection for piping plovers or their nests. In such a case, the Service or the State wildlife agency may provide written notice to the landowner describing additional measures recommended to prevent take of piping plovers on that site.

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APPENDIX C

Federally Listed and State-Listed Endangered and Threatened Species in New Jersey

FEDERALLY LISTED ENDANGERED AND THREATENED SPECIES IN NEW JERSEY

An **ENDANGERED** species is any species that is in danger of extinction throughout all or a significant portion of its range.

A **THREATENED** species is any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

	COMMON NAME	SCIENTIFIC NAME	STATUS
FISHES	**Shortnose sturgeon***	*Acipenser brevirostrum*	E
REPTILES	**Bog turtle**	*Clemmys muhlenbergii*	T
	Atlantic Ridley turtle*	*Lepidochelys kempii*	E
	Green turtle*	*Chelonia mydas*	T
	Hawksbill turtle*	*Eretmochelys imbricata*	E
	Leatherback turtle*	*Dermochelys coriacea*	E
	Loggerhead turtle*	*Caretta caretta*	T
BIRDS	**American peregrine falcon**	*Falco peregrinus anatum*	E
	Bald eagle	*Haliaeetus leucocephalus*	T
	Piping plover	*Charadrius melodus*	T
	Roseate tern	*Sterna dougallii dougallii*	E
MAMMALS	**Eastern cougar**	*Felis concolor couguar*	E+
	Indiana bat	*Myotis sodalis*	E
	Gray wolf	*Canis lupus*	E+
	Delmarva fox squirrel	*Sciurus niger cinereus*	E+
	Blue whale*	*Balaenoptera musculus*	E
	Finback whale*	*Balaenoptera physalus*	E
	Humpback whale*	*Megaptera novaeangliae*	E
	Right whale*	*Balaena glacialis*	E
	Sei whale*	*Balaenoptera borealis*	E
	Sperm whale*	*Physeter macrocephalus*	E

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	COMMON NAME	SCIENTIFIC NAME	STATUS
INVERTEBRATES	**Dwarf wedgemussel**	*Alasmidonta heterodon*	E
	Northeastern beach tiger beetle	*Cicindela dorsalis dorsalis*	T
	Mitchell saytr butterfly	*Neonympha m. mitchellii*	E+
	American burying beetle	*Nicrophorus americanus*	E+
PLANTS	**Small whorled pogonia**	*Isotria medeoloides*	E
	Swamp pink	*Helonias bullata*	T
	Eastern prairie fringed orchid	*Platanthera leucophaea*	T+
	Knieskern's beaked-rush	*Rhynchospora knieskernii*	T
	American chaffseed	*Schwalbea americana*	E
	Sensitive joint-vetch	*Aeschynomene virginica*	T
	Sea-beach pigweed	*Amaranthus pumilus*	T+

STATUS:			
E	endangered species	PE	proposed endangered
T	threatened species	PT	proposed threatened
+	presumed extirpated		

* Except for sea turtle nesting habitat, principal responsibility for these species is vested with the National Marine Fisheries Service.

Note: for a complete listing of Endangered and Threatened Wildlife and Plants, refer to 50 CFR 17.11 and 17.12.

For further information, please contact:

U.S. Fish and Wildlife Service
New Jersey Field Office
927 N. Main Street, Building D
Pleasantville, New Jersey 08232
Phone: (609) 646-9310
Fax: (609) 646-0352

FEDERAL CANDIDATE SPECIES IN NEW JERSEY

CANDIDATE SPECIES are species that appear to warrant consideration for addition to the federal List of Endangered and Threatened Wildlife and Plants. Although these species receive no substantive or procedural protection under the Endangered Species Act, the U.S. Fish and Wildlife Service encourages federal agencies and other planners to give consideration to these species in the environmental planning process.

SPECIES	SCIENTIFIC NAME
Bog asphodel	*Narthecium americanum*

Note: For complete listings of taxa under review as candidate species, refer to Federal Register Vol. 62, No. 182, September 19, 1997 (Endangered and Threatened Wildlife and Plants; Review of Plant and Animal Taxa that are Candidates for Listing as Endangered or Threatened Species).

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ENDANGERED AND THREATENED WILDLIFE OF NEW JERSEY

Endangered Species are those whose prospects for survival in New Jersey are in immediate danger because of a loss or change in habitat, over-exploitation, predation, competition, disease, disturbance or contamination. Assistance is needed to prevent future extinction in New Jersey.

Threatened Species are those who may become endangered if conditions surrounding them begin to or continue to deteriorate.

BIRDS

Endangered

Pied-billed Grebe,* *Podilymbus podiceps*
Bald Eagle, *Haliaeetus leucocephalus***
Northern Harrier,* *Circus cyaneus*
Cooper's Hawk, *Accipiter cooperii*
Red-shouldered Hawk, *Buteo lineatus* (Breeding)
Peregrine Falcon, *Falco peregrinus***
Piping Plover, *Charadrius melodus***
Upland Sandpiper, *Bartramia longicauda*
Roseate Tern, *Sterna dougallii*
Least Tern, *Sterna antillarum*
Black Skimmer, *Rynchops niger*
Short-eared Owl,* *Asio flammeus*
Sedge Wren, *Cistothorus platensis*
Loggerhead Shrike, *Lanius ludovicianus*
Vesper Sparrow, *Pooecetes gramineus*
Henslow's Sparrow, *Ammodramus henslowii*

Threatened

American Bittern*, *Botaurus lentiginosos*
Great Blue Heron*, *Ardea herodias*
Little Blue Heron, *Egretta caerulea**
Yellow-crowned Night Heron, *Nyctanassa violaceus*
Osprey, *Pandion haliaetus*
Northern Goshawk, *Accipiter gentilis*
Red-shouldered Hawk, *Buteo lineatus* (Non-breeding)
Black Rail, *Laterallus jamaicensis*
Long-eared Owl, *Asio otus*
Barred Owl, *Strix varia*
Red-headed Woodpecker, *Melanerpes erythrocephalus*
Cliff Swallow,* *Hirundo pyrrhonota*
Savannah Sparrow, *Passerculus sandwichensis*
Ipswich Sparrow, *Passerculus sandwichensis princeps*
Grasshopper Sparrow, *Ammodramus savannarum*
Bobolink, *Dolichonyx oryzivorus*

*Only breeding population considered endangered or threatened
**Federally endangered or threatened

REPTILES

Endangered

Bog Turtle, *Clemmys muhlenbergi*
Atlantic Hawksbill, *Eretmochelys imbricata***
Atlantic Loggerhead, *Caretta caretta***
Atlantic Ridley, *Lepidochelys kempi***
Atlantic Leatherback, *Dermochelys coriacea***
Corn Snake, *Elaphe g. guttata*
Timber Rattlesnake, *Crotalus h. horridus*

Threatened

Wood Turtle, *Clemmys insculpta*
Atlantic Green Turtle, *Chelonia mydas***
Northern Pine Snake, *Pituophis m. melanoleucus*

**Federally endangered or threatened

ENDANGERED AND NONGAME SPECIES PROGRAM

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION AND ENERGY
DIVISION OF FISH, GAME AND WILDLIFE

AMPHIBIANS

Endangered

Tremblay's Salamander, *Ambystoma tremblayi*
Blue-spotted Salamander, *Ambystoma laterale*
Eastern Tiger Salamander, *Ambystoma t. tigrinum*
Pine Barrens Treefrog, *Hyla andersonii*
Southern Gray Treefrog, *Hyla chrysoscelis*

Threatened

Long-tailed Salamander, *Eurycea longicauda*
Eastern Mud Salamander, *Pseudotriton montanus*

MAMMALS

Endangered

Bobcat, *Lynx rufus*
Eastern Woodrat, *Neotoma floridana*
Sperm Whale *Physeter, macrocephalus***
Fin Whale, *Balaenoptera physalus***
Sei Whale, *Balaenoptera borealis***
Blue Whale, *Balaenoptera musculus***
Humpback Whale, *Megaptera novaeangliae***
Black Right Whale, *Balaena glacialis***

INVERTEBRATES

Endangered

Mitchell's Satyr (butterfly), *Neonympha m. mitchellii***
Northeastern Beach Tiger Beetle, *Cicindela d. dorsalis*
American Burying Beetle, *Nicrophorus americanus***
Dwarf Wedge Mussel, *Alasmidonta heterodon***

**Federally endangered

FISH

Endangered

Shortnose Sturgeon, *Acipenser brevirostrum***

List revisions: March 29, 1979
January 17, 1984
May 6, 1985
July 20, 1987
June 3, 1991

ENDANGERED AND NONGAME SPECIES PROGRAM
GO WILD FOR WILDLIFE
CHECK-OFF N.J. Income Tax Conservation Fund
N.J. Division Fish-Game-Wildlife

The lists of New Jersey's endangered and nongame wildlife species are maintained by the DEP&E's Division of Fish, Game and Wildlife's, Endangered and Nongame Species Program. These lists are used to determine protection and management actions necessary to insure the survival of the State's endangered and nongame wildlife. This work is made possible only through voluntary contributions received through the Wildlife Check-off on the New Jersey State Tax Form. The Wildlife Check-off is the only major funding source for the protection and management of the State's endangered and nongame wildlife resource. For more information about the Endangered and Nongame Species Program or to report a sighting of endangered or threatened wildlife contact: Endangered and Nongame Species Program, Northern District Office, Box 383 R.D. 1, Hampton, N.J. 08827 or call (908) 735-8975.

APPENDIX D

Suggested Plantings, Transplants, or Revegetation
for Lower Cape May Meadows

Suggested Plantings, Transplants, or Revegetation for Lower Cape May Meadows

Suggested plantings are based on food or cover value to wildlife, in particular waterfowl, shorebirds, and neotropical birds that use Lower Cape May Meadows.

Estuarine emergent wetlands*

Saltmarsh cordgrass (*Spartina alterniflora*) e (90% of low marsh)
Saltmeadow cordgrass (*Spartina patens*) e (50%+ of high marsh)
Saltgrass (*Distichlis spicata*) e (20% of high marsh)
Sea pink (*Sabatia stellaris*) e (<10% of high marsh)
Saltwort (*Salicornia* spp.) e (10-20% of high marsh)

Estuarine / Palustrine Interface

(Wetland / upland complex between palustrine and estuarine wetlands)

Marsh goldenrod (*Solidago sempervirens*) e
Marsh elder (*Iva frutescens*) e
Bayberry (*Myrica pensylvanica*) e
Wax myrtle (*Myrica cerifera*) e
Smartweed (*Polygonum* spp.) e
Widgeongrass (*Ruppia maritima*)
Saltmarsh (Walters) millet (*Echinochloa walteri*)
Saltmarsh bulrush (*Scirpus robustus*)

Palustrine open water

(Ponds - 1-3 feet water depth)

Pondweed (*Potamogeton* spp.)
Wild celery (*Vallisneria americana*)
Bushy pondweed (*Najas flexilis*)
Duckweed (*Lemna* spp.)
Arrowhead (*Sagittaria* spp.)
Arrow arum (*Peltandra virginica*)

Palustrine open water / emergent interface

(Pond edge)

Narrow-leaved cattail (*Typha angustifolia*) e
Cattail (*Typha latifolia*) e
Bulrush (*Scirpus* spp.) e
Buttonbush (*Cephalanthus occidentalis*)
Smartweeds (*Polygonum* spp.)
Wild rice (*Zizania aquatica*)
Bur-reed (*Sparganium* spp.)
Soft-stem bulrush (*Scirpus validus*)
Arrow arum (*Peltandra virginica*)
Pickerelweed (*Pontederia cordata*)
Big arrowhead (*Sagittaria latifolia*)
Spatterdock (*Nuphar luteum*)

Palustrine emergent wetlands

Smartweeds (*Polygonum* spp.)
Wild millet (*Echinochloa* spp.) e
Rice cutgrass (*Leersia oryzoides*)
Spike rush (*Eleocharis* spp.) e
Widgeongrass (*Ruppia maritima*)
Bulrush (*Scirpus* spp.)
Woolgrass (*Scirpus cyperinus*)
Lowland broomsedge (*Andropogon glomeratus*)
Sedge (*Carex lurida, lupulina, or lonchocarpa*)

Adjacent Uplands

(Of the following, only bayberry and wax are recommended for planting, other species would voluntarily colonize)

Bayberry (*Myrica pensylvanica*) e
Wax myrtle (*Myrica cerifera*) e
Sumac (*Rhus* spp.) e
Poison Ivy (*Rhus radicans*) e
Rose (*Rosa* spp.) e
Greenbrier (*Smilax* spp.) e
Elderberry (*Sambucus canadensis*)
Wild raisin (*Viburnum nudum*)

Rare or special concern plants

(These rare plants, which exist in Lower Cape May Meadows, would be protected and provided areas in which to expand their population. If these plants are available, additional plantings or propagation of wild stock could be considered; however, local genetics should be maintained and not mixed with plants from unknown sources. Further coordination with the New Jersey State Heritage Program would be required.)

Butterfly pea (*Clitoria mariana*) e
Awl-leaved rush (*Juncus coriaceus*) e
Swamp Pine (*Pinus serotina*) e
Whorled marsh-pennywort (*Hydrocotyle verticillata*) e
Blue boneset (*Eupatorium coelestinum*) e
Wild crab apple (*Pyrus angustifolia*) e
Long's rush (*Juncus longii*) e
Rattlesnake master (*Eryngium aquaticum*) e
Early Ladies'-tresses (*Spiranthes vernalis*) e
Bearded skeleton grass (*Gymnopogon ambiguus*) e
Fog fruit (*Phyla lanceolata*) e

* Planting will probably not be required as most of these saltmarsh species will voluntarily colonize created estuarine wetlands from Cape Island Creek (provided hydrology is appropriate).

e Currently exist within the Lower Cape May Meadows.

SOURCE:

Martin, A.C., H.S. Zim, and A.L. Nelson. 1951. American wildlife and plants: A guide to wildlife food habits. Dover Publications, Incorporated, New York, New York. 500 pp.

Payne, N.F. 1992. Techniques for wildlife habitat management of wetlands. McGraw Hill, Incorporated, New York, New York. 549 pp.

Tiner, R.W., Jr. 1985. Wetlands of New Jersey. U.S. Department of the Interior, Fish and Wildlife Service, Hadley, Massachusetts. 117 pp.

State of New Jersey
Department of Environmental Protection

Christine Todd Whitman
Governor

Robert C. Shinn, Jr.
Commissioner

CAPE MAY POINT STATE PARK
P.O. BOX 107
CAPE MAY POINT, NJ 08212-0107
TEL. # 609-884-2159
FAX. # 609-884-0352

May 7, 1998

Robert L. Callegari
Chief, Planning Division
US Army Corps of Engineers, Phila. District
Wanamaker Building, 100 Penn Square East
Philadelphia PA 19107-3390

RE: DRAFT LOWER CAPE MEADOWS - CAPE MAY POINT FEASIBILITY STUDY REPORT

Dear Mr. Callegari:

The draft feasibility study report, represents many months, even years, of intensive work and expense aimed at resolving the damage done to the Cape May shore south of the Cape May Inlet by the installation of jetties at the inlet in 1911.

As Superintendent of Cape May Point State Park, I am very excited about the prospect of seeing the park receive the improvements outlined in the report.

The majority of this park is designated a State Natural Area, which brings it under the umbrella of the Natural Area System pursuant to N.J.S.A. 13:1B-15.4 et seq. and 13:1B-15.12a et seq. These acts call for a group of experts (Natural Areas Council) to oversee the management of a Natural Area in concert with the area Superintendent, and the administration of the Office of Natural Lands Management. Several comments on the Feasibility Study report will be submitted from that office, and are endorsed by me. I have no additional technical comments to add, but though it may not be appropriate at this time, I would like to mention the importance of planning the construction phase to accommodate the park visitors to the greatest extent possible. The busiest time for the public visitation is between June and October. Therefore, I request that work be restricted, as much as possible, to the period between November and April or May. Close communication would be necessary to ensure a minimum of disruption.

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1. Construction will be fully coordinated with NJDEP to ensure minimum disruption to both state park visitors and wildlife.

Thank you for providing a copy of the report to me and allowing me the opportunity to comment.

Sincerely,

Dean S. Cramer
Superintendent