US Army Corps
of Engineers
Philadelphia District

Delaware Bay Coastline
Delaware & New Jersey

Oakwood Beach, NJ
Feasibility Study

FINAL
FEASIBILITY REPORT
AND
INTEGRATED ENVIRONMENTAL ASSESSMENT

April 1999

DELAWARE BAY COASTLINE, DELAWARE & NEW JERSEY FEASIBILITY STUDY

The Oakwood Beach study is the final study of seven feasibility studies conducted by the Corps of Engineers in the interest of shore protection and ecosystem restoration along the Delaware Bay coastline in the States of Delaware and New Jersey. Three of the studies were conducted jointly with the Delaware Department of Natural Resources and Environmental Control (DNREC) in the State of Delaware. These studies were Broadkill Beach completed in October 1996; Roosevelt Inlet-Lewes Beach completed in June 1997; and Port Mahon completed in September 1997. The remaining four studies were conducted jointly with the New Jersey Department of Environmental Protection (NJDEP). These studies were Maurice River scheduled for completion in January 1997 but terminated in April 1996; Villas and Vicinity completed in September 1998; Reeds Beach to Pierces Point completed in August 1998; and Oakwood Beach scheduled for completion in May 1999.

DELAWARE BAY COASTLINE, DELAWARE & NEW JERSEY

OAKWOOD BEACH, NEW JERSEY
FINAL FEASIBILITY REPORT
AND
INTEGRATED ENVIRONMENTAL ASSESSMENT

SYLLABUS

The lead agency for the proposed action is the U.S. Army Corps of Engineers, Philadelphia District.

This report presents the results of a feasibility phase study to determine an implementable solution and the extent of Federal participation in a shore protection project for the community of Oakwood Beach, Elsinboro Township, Salem County, New Jersey. This feasibility study was conducted based on the recommendations of the Delaware Bay Coastline - Delaware and New Jersey Reconnaissance Study completed in 1992, which identified a possible solution to the storm damage problems in the study area. The reconnaissance study also determined that such a solution was in the Federal interest and identified the non-Federal sponsor. The Oakwood Beach study is the final of seven feasibility studies conducted by the Corps of Engineers (COE) in the interest of shore protection and ecosystem restoration along the Delaware Bay coastline.

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 in December 1993. This feasibility study was initiated in May 1996.

Oakwood Beach is a bayfront community located in Elsinboro Township, Salem County, New Jersey in the upper region of the Delaware Bay. The study area limits extend from the Salem River downshore to Elsinboro Point, a distance of approximately 3 miles. Significant beach erosion has left the study area vulnerable to storm damages. Continued erosion has resulted in a reduction in the height and width of the beach.

This feasibility study evaluated alternative plans of improvement formulated on storm damage reduction benefits and reduced Federal maintenance dredging benefits. The selected plan at Oakwood Beach consists of a 50 foot wide berm at an elevation of +6.0 feet NAVD for a total project length of 9500 feet. The selected plan includes suitable beachfill with periodic nourishment to ensure the integrity of the design. The plan requires 332,000 cubic yards of initial fill and advanced nourishment to be placed on Oakwood Beach and subsequent periodic nourishment of 32,000 cubic yards every 8 years for 50 years. Sand from the Reedy Island range of the Delaware River main channel will be used for beachfill at Oakwood Beach.

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

This feasibility report is based on a March 1998 price level and Federal discount rate of 7.125%. The economic analysis indicates that the selected plan will provide annual benefits of $648,000, which when compared to the annual cost of $336,000, yields a benefit to cost ratio of 1.9 with $312,000 in net benefits.

The total initial project cost of construction is currently estimated to be $3,314,000 (at a March 1998 price level). The Federal share of this first cost is $2,154,000, and the non-Federal share is $1,160,000. This cost sharing of the initial construction is in accordance with Section 103 of WRDA 1986. The Administration has proposed a new cost sharing policy for the periodic nourishment of shore protection projects. Under the Administration's proposed new cost sharing policy, periodic nourishment will be cost shared 35% Federal and 65% non-Federal. The total cost of periodic nourishment per cycle (every 8 years) is estimated at $567,000 and will be cost shared 35%-65% over the life of the project. The ultimate project cost which includes the initial construction and fifty years of periodic nourishment (including major renourishment and project monitoring) is currently estimated to be $8,321,000 (at a March 1998 price level).

The non-Federal sponsor, NJDEP, supports cost sharing of the project features consistent with existing law and implementation of periodic nourishment consistent with cost sharing enacted by Congress in law.

FOR FURTHER INFORMATION ON THIS FINAL FEASIBILITY REPORT AND INTEGRATED ENVIRONMENTAL ASSESSMENT, PLEASE CONTACT:

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DELAWARE BAY COASTLINE, DELAWARE & NEW JERSEY

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DESCRIPTION OF SELECTED PLAN

Project Title: Delaware Bay Coastline - Delaware and New Jersey Study; Oakwood Beach, New Jersey; Final Feasibility Report and Integrated Environmental Assessment

Description: The proposed project provides a protective beach to reduce the potential storm damages at Oakwood Beach, NJ. Use of the Reedy Island range of the Delaware River main channel as the borrow source for beachfill at Oakwood Beach also reduces Federal maintenance dredging costs.

Beachfill

Volume of Initial Fill	332,000 c.y.
Volume of Renourishment Fill	32,000 c.y.
Interval of Renourishment	8 yrs
Length of Fill (including tapers)	9500 l.f.
Width of Berm	50 ft.
Elevation of Berm	+ 6.0 ft.
Slope of Foreshore	1V:10H

Project Cost	**March 98 P.L.**	**Updated to Oct. 98 P.L.**
Initial Cost	$ 3,314,000	$ 3,360,000
Periodic Nourishment (includes major renourishment and project monitoring)	$ 5,007,000	$ 5,076,000
Annualized Periodic Nourishment	$ 79,000	$ 81,000
Ultimate Project Cost	$ 8,321,000	$ 8,436,000
Total Annualized	$ 336,000	$ 333,000
	(Discounted 7.125%)	(Discounted 6.875%)

NOTE: All elevations referenced to North American Vertical Datum, 1988 (NAVD88)

Average Annual Benefits	March 98 P.L.	Updated to Oct. 98 P.L.
Storm Damage Reduction	$ 518,000	$ 530,000
Reduced Federal Maintenance Dredging Costs	$ 130,000	$ 130,000
Total	$ 648,000	$ 660,000

Benefit/Cost Ratio	March 98 P.L.	Updated to Oct. 98 P.L.
	1.9	2.0

Cost Apportionment (First Cost)	March 98 P.L.	Updated to Oct. 98 P.L.
Federal (65%)	$2,154,000	$2,184,000
Non-Federal (35%)	$1,160,000	$1,176,000

SUMMARY

The Environmental Assessment has concluded that the project can be conducted in a manner which should not violate New Jersey's or Delaware's Surface Water Quality Standards. Pursuant to Section 401 of the Clean Water Act, a 401 Water Quality Certificate has been obtained from the New Jersey Department of Environmental Protection (NJDEP) and a letter was received from the Delaware Department of Natural Resources and Environmental Control (DNREC) indicating that the Department intends to issue a Water Quality Certificate upon review of the final project plans (refer to Appendix A, Section 3 of the main report). Based on the information developed during preparation of the Environmental Assessment, and the application of appropriate measures to minimize project impacts, it was determined in accordance with Section 307(c) of the Coastal Zone Management Act of 1972 that the plan complies with and can be conducted in a manner that is consistent with the approved Coastal Zone Management Programs of New Jersey and Delaware. A consistency determination was requested from NJDEP and DNREC. NJDEP concurred in the consistency determination in a letter dated 12 March 1999 and DNREC in a letter dated 12 February 1999 (refer to Appendix A, Section 3 of the main report).

MAJOR CONCLUSIONS AND FINDINGS

Berm restoration represents the least environmentally damaging structural method of reducing shoreline erosion at a reasonable cost. It is socially acceptable. Berm restoration is dynamic and adjusts to changing conditions until equilibrium can be achieved. Despite being structurally flexible, the created berm can effectively dissipate high storm energies, although at its own expense. Costly rigid structures like bulkheads and revetments utilize massive amounts of material foreign to the natural environment to absorb the force of the waves. Berm restoration uses material typical of adjacent areas, sand, to buffer the shoreline structures against erosional damage. Consequently, berm restoration is more aesthetically pleasing as it represents the smallest departure from natural conditions in a visual and physical sense.

Some of the suggested non-structural erosion damage reduction alternatives are currently practiced, such as flood insurance and development regulation. Consequently, implementation is somewhat a moot point. Others such as land acquisitions are prohibitively expensive, and are socially unacceptable.

AREAS OF CONCERN

A project of this nature will have temporary adverse impacts on water quality and on aquatic organisms. Dredging will increase suspended solids and turbidity at the point of dredging and the berm restoration site. The area 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 berm restoration site. Dredging will result in the temporary complete loss of the benthic community in the borrow area. These disruptions are expected to be of short duration and of minor significance if rapid recolonization by the benthic community occurs. Dredging will consequently temporarily displace a food source for some finfish.

The proposed borrow site, the Delaware River main navigation channel (Reedy Island range), has historically been dredged to maintain the depth for navigation. Recent surveys conducted upstream of the borrow site have shown that the benthic organisms in the navigation channel are similar to those in the surrounding areas outside the channel.

Concerns regarding the potential impacts of dredging on Federally listed threatened and endangered species (sea turtles and shortnose sturgeon) were raised with respect to this project. Based on coordination with the National Marine Fisheries Service (NMFS), the Philadelphia District will continue the measures used in the past to reduce the likelihood of negatively impacting marine species. These measures include the use of NMFS approved turtle monitors and dragarm deflectors on hopper dredges, and timing any hopper dredging when these species are known to be absent from the borrow area. These and any other measures will be fully coordinated with NMFS prior to dredging.

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 is with shore protection problems along Oakwood Beach. The State is interested in a long-term Federal shore protection project due to funding constraints which prohibit the State and local governments from carrying out a long term shore protection program on their own.

ENVIRONMENTAL STATUTES AND REQUIREMENTS

Preparation of this Feasibility Report and Integrated Environmental Assessment has included coordination with appropriate Federal and State resource agencies. As previously stated, all appropriate approvals have been obtained from the States of New Jersey and Delaware. A Section 404 (b)(1) evaluation has been prepared and is included in this Feasibility Report and Integrated Environmental Assessment. This evaluation concludes that the proposed action would not result in any significant environmental impacts relative to areas of concern under Section 404 of the Federal Clean Water Act. In accordance with the Fish and Wildlife Coordination Act (FWCA), a planning aid report was obtained in September 1997, and is provided in Appendix A, Section 2. A final Section 2(b) FWCA report was obtained in January 1999, and is provided in Appendix A, Section 3.

The following table provides a list of Federal environmental quality statutes applicable to this study, and their compliance status relative to the current stage of the project review.

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	Full
Endangered Species Act of 1973, as amended	Full
Estuary Protection Act	Full
Federal Water Project Recreation Act, as amended	N/A
Fish and Wildlife Coordination Act	Full
Land and Water Conservation Fund Act, as amended	N/A
Magnuson-Stevenson Act	Full
Marine Mammal Protection Act	Full
Marine Protection, Research and Sanctuaries Act	Full
National Historic Preservation Act of 1966	Full
National Environmental Policy Act, as amended	Full
Rivers and Harbors Act	Full
Watershed Protection and Flood Prevention Act	N/A

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

Federal Statutes	Compliance w/Proposed Plan
Wild and Scenic River Act	N/A
Coastal Barrier Resources Act	N/A

Executive Orders, Memorandum, etc.	Compliance w/Proposed Plan
EO 11988, Floodplain Management	Full
EO 11990, Protection of Wetlands	Full
EO 12114, Environmental Effects of Major Federal Actions	Full
EO 12989, Environmental Justice in Minority Populations and Low-Income Populations	Full

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

Noncompliance - None of the requirements of the statute, EO, or other policy and related regulations have been met.

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

Ongoing - Coordination is continuing.

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DELAWARE BAY COASTLINE STUDY, DELAWARE AND NEW JERSEY
OAKWOOD BEACH, NEW JERSEY

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INTRODUCTION

1. The Corps of Engineers (COE) was tasked with a study to examine the shoreline erosion, storm damage potential, and other problems along the Delaware Bay coastline. A reconnaissance report, entitled "Delaware Bay Coastline-New Jersey and Delaware", was completed in August 1992. This report reviewed problems and opportunities throughout the Delaware Bay and made recommendations for further studies in areas that demonstrated Federal interest in shore protection and other engineering improvements. The reconnaissance study covered approximately 130 miles of shoreline along the Delaware Bay between the Salem River and Cape May in New Jersey, and between the Chesapeake and Delaware Canal and Cape Henlopen in Delaware. The reconnaissance study also investigated the loss and degradation of fish and wildlife habitat throughout the Delaware Bay. Given the unique and significant ecological value of the Delaware Bay, opportunities for the restoration of the ecosystem were also identified.

2. As a result of the reconnaissance study, Federal interest in shore protection was identified at Oakwood Beach, New Jersey. This recommendation was based upon problem identification efforts conducted for the entire bay; results from detailed analyses conducted in the area; and the interest of the non-Federal sponsor for future study cost sharing. This Feasibility Report addresses the problems and potential solutions with regard to shore protection at Oakwood Beach and is the final study of seven feasibility studies conducted by the COE along the Delaware Bay.

STUDY AUTHORITY

3. Authorization to undertake this study was established by a resolution adopted by the Committee on Public Works and Transportation, United States House of Representatives, on October 1, 1986. The resolution states:

"RESOLVED BY THE COMMITTEE ON PUBLIC WORKS AND TRANSPORTATION OF THE UNITED STATES HOUSE OF REPRESENTATIVES, that the Board of Engineers for Rivers and Harbors is hereby requested to make a comprehensive review of the existing reports on communities within the tidal portion of the Delaware Bay and its tributaries with a view to developing and updating a physical and engineering data base as the basis for actions and programs to provide shoreline protection or to provide up-to-date information for state and local management of this coastal area and to determine whether any modifications of the conclusions and recommendations contained in the previous reports of the Chief of Engineers that pertain to the Delaware Bay Coasts of Delaware and New Jersey are advisable at the present time. Such modifications to previous conclusions and recommendations shall be cognizant of, and

incorporate where feasible, the findings of the final report of the Chief of Engineers on the Shoreline Erosion Control Demonstration Program, Section 54, of Public Law 93-251."

STUDY AREA

4. The study area is located at Oakwood Beach, Elsinboro Township, Salem County, New Jersey in the upper region of the Delaware Bay. Refer to Figure 1. The study area limits extend from the Salem River downshore to Elsinboro Point, a distance of approximately three miles. Refer to Figure 2. It should be noted that the mean low water line at Oakwood Beach is considered the boundary between the states of New Jersey and Delaware. The study area below mean low water is located in New Castle County, Delaware.

STUDY PURPOSE AND SCOPE

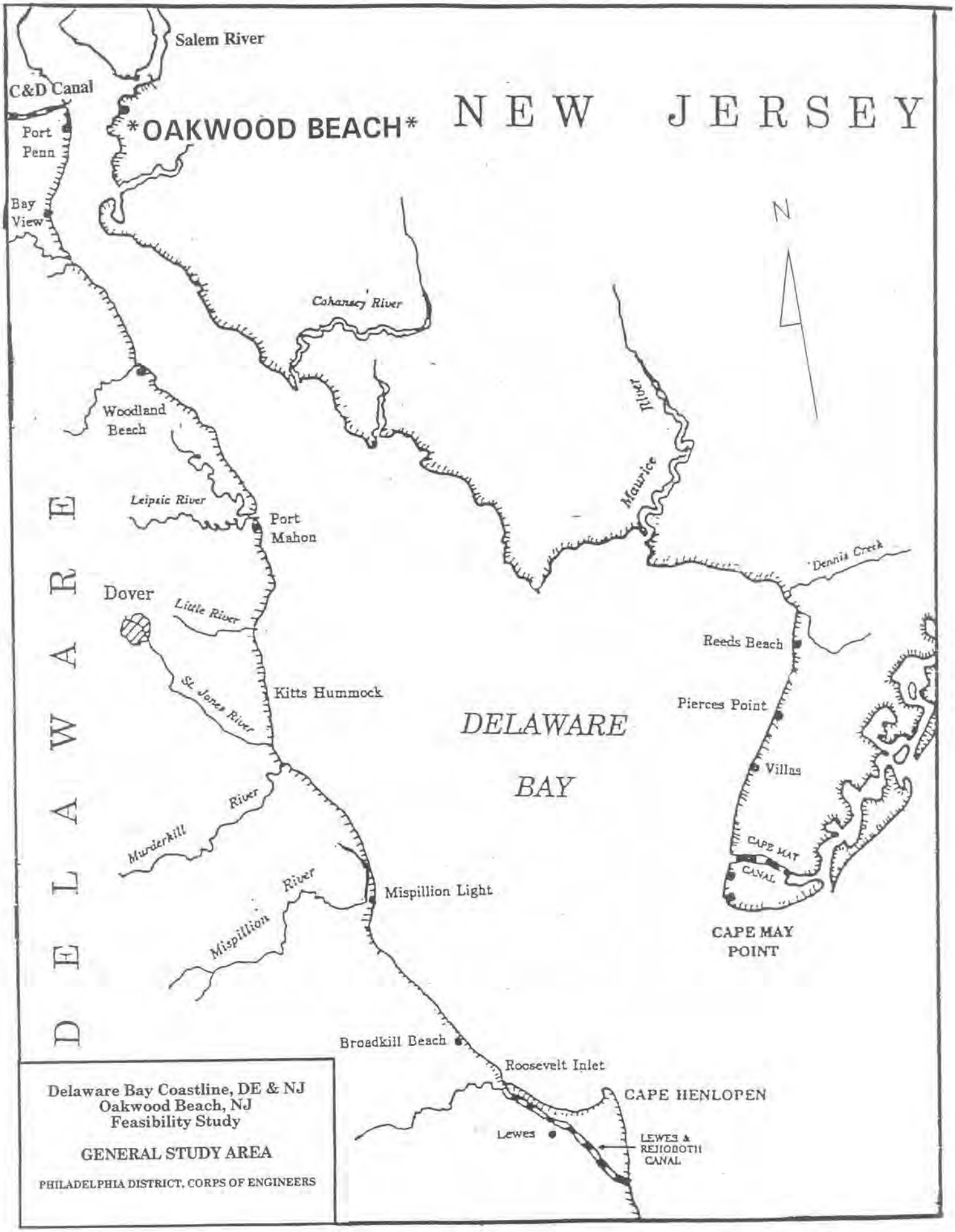
5. The purpose of this study is to determine the magnitude and effect of shoreline erosion problems at Oakwood Beach. The study will determine the feasibility of providing shoreline protection in this area as well as provide up-to-date information for state and local management of the study area.

6. The feasibility study used information from existing sources, supplemented by recent site inspections, aerial photography, field surveys, subsurface explorations, environmental inventories and cultural resources investigations. Interviews with local officials and residents were conducted to determine the extent of potential damages associated with tidal inundation, wave attack, and erosion. Hydraulic analyses for erosion rate determinations were conducted and baywide wave climate models were developed. Design, quantity, and cost estimates were based on generalized cross-sections, aerial photographs, surveys, and unit costs developed specifically for the study area. Preliminary cost estimates were used to compare alternative shore protection plans in choosing a selected plan of improvement. The plan of improvement was then analyzed further to determine its design features, quantities, and estimated project costs.

REPORT AND STUDY PROCESS

7. Planning by the Corps of Engineers for any Federal water resource project is accomplished in two phases: a reconnaissance phase and a feasibility phase. The reconnaissance phase is conducted at full Federal expense, while the cost of the feasibility phase is shared equally between the Federal government and a non-Federal sponsor(s).

8. The reconnaissance phase, completed in August 1992, investigated shoreline erosion, potential storm damage, and other problems along the entire Delaware Bay. Due to the large study area, the reconnaissance phase conducted detailed studies at four specific priority problem areas (Broadkill Beach, DE; Mispillion Inlet, DE; Roosevelt Inlet, DE; and Oakwood Beach, NJ). These study areas served to identify Federal interest for involvement in shore protection and determined that further study was warranted. The reconnaissance phase also conducted a baywide assessment of problem areas, identifying a number of areas being adversely impacted by erosion and inundation. Opportunities for ecosystem restoration were also identified given



Delaware Bay Coastline, DE & NJ
Oakwood Beach, NJ
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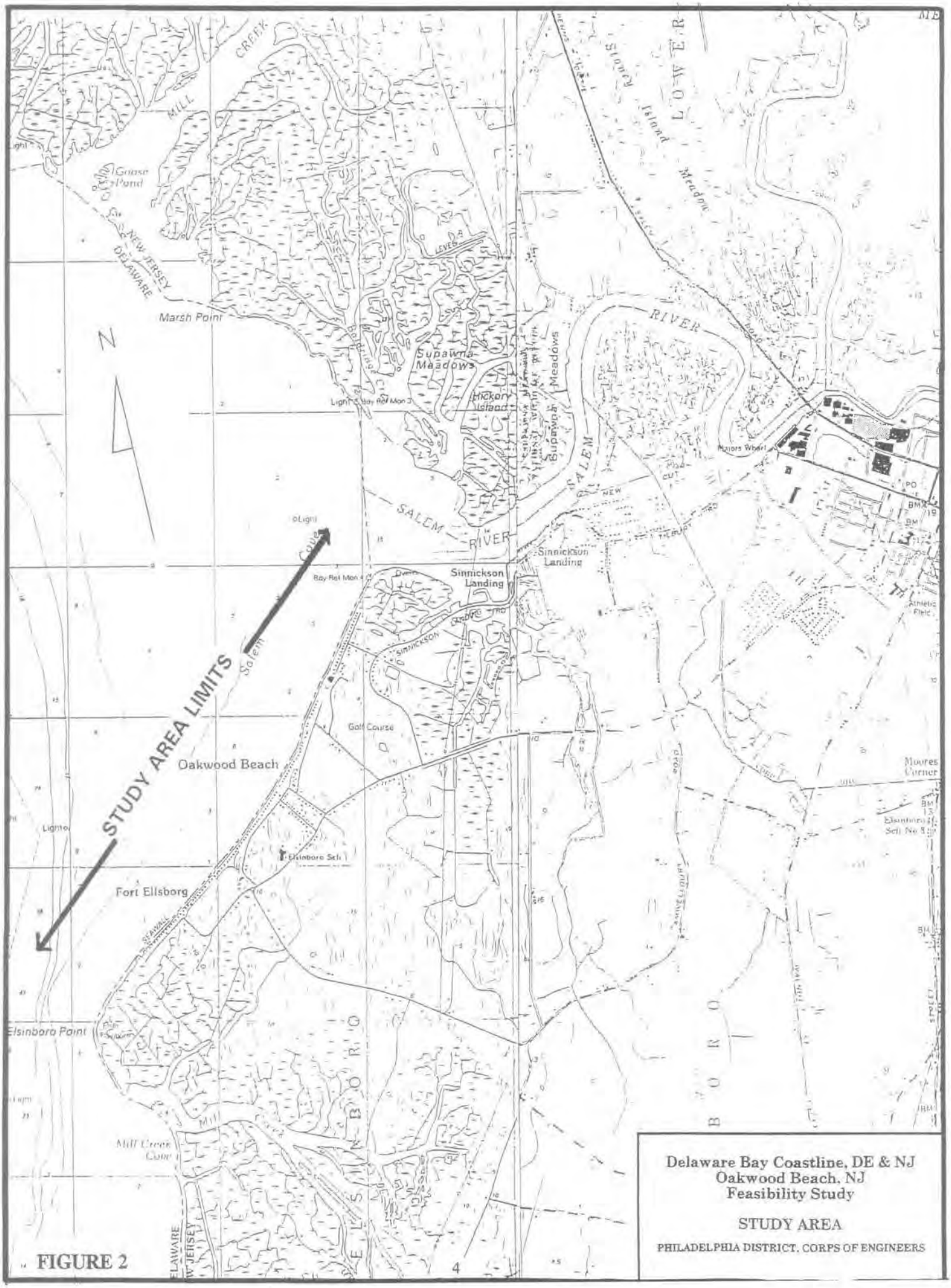
GENERAL STUDY AREA

PHILADELPHIA DISTRICT, CORPS OF ENGINEERS

FIGURE 1


STUDY AREA LIMITS
Oakwood Beach
Fort Ellsborg
Elsinboro Point
Marsh Point
Goose Pond
MILL CREEK
NEW JERSEY
DELAWARE
Supawna Meadows
Hickory Island
Supawna Meadows
SALEM RIVER
Sinnickson Landing
Sinnickson Landing
Golf Course
Majors Wharf
Moores Corner
Athletic Field
Mill Creek Cove
Salem Cove
N
Delaware Bay Coastline, DE & NJ
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STUDY AREA
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS

FIGURE 2

the ecological significance and uniqueness of the Delaware Bay. Based upon problem identification efforts conducted for the entire bay; results from detailed analyses conducted in the four priority problem areas; adherence to Federal law restricting Federal involvement along privately owned shorelines; and the interest of the non-Federal sponsors for future study cost sharing, seven interim feasibility phase studies were recommended to be conducted for problem areas along the Delaware Bay in the states of Delaware and New Jersey. Oakwood Beach, NJ was one of the seven areas recommended for further study.

9. This feasibility study, the second phase in the planning process, was initiated in May 1996 jointly by the Corps of Engineers and the New Jersey Department of Environmental Protection (NJDEP). The objectives of the feasibility phase are to evaluate the specific engineering, environmental, and economic effects of the proposed solutions; to identify the optimal solution from both a Federal and non-Federal perspective; and to recommend a project for construction, if justified and supported by the non-Federal sponsor.

PERTINENT REPORTS AND STUDIES

10. Pertinent reports and studies which are applicable to the study area are listed in chronological order in Table 1.

RELATED FEDERAL PROJECTS

11. **SALEM RIVER, NEW JERSEY NAVIGATION PROJECT.** The previous project, adopted as HD 68-110 in 1925 and modified by Section 859 of WRDA 1986, provides for an entrance channel from the Delaware River to the fixed highway bridge in Salem with dimensions and limits as shown in Figure 3, including a cut-off and turning area adjacent to the Port of Salem. The unconstructed work under the previous project, dredging the channel in Little Salem River, was deauthorized on 01 January 1990 by PL 99-662. The project length is about 5 miles.

12. In March 1995 the Secretary of the Army approved a modification to the previous project deepening the channel to 16 feet below mean lower low water between the Route 49 highway bridge and the Delaware River, a distance of about 5 miles. The channel was widened to 150-250 feet and a trapezoidal shaped turning basin with a width of 495 feet and average length of 1000 feet was provided. The project also provides for 15.6 acres of wetland restoration to replace the loss of wetlands and shallow water habitat. The dredging portion of the project was completed in November 1996. The wetland restoration portion of the project (mitigation) was completed in June 1997.

TABLE 1
PERTINENT REPORTS AND STUDIES

Publication & Date	Agency	Recommendations
H.D. 348, 88th Cong., 2nd Session, 1964 Delaware River and Bay, Pennsylvania, New Jersey, and Delaware	Corps of Engineers	Hurricane and tidal flood protection improvements for Delaware River and Bay, PA, NJ, and DE were not recommended.
Beach Erosion Control and Hurricane Protection, Delaware Bay Shore, New Jersey Survey Study, 1979	Corps of Engineers	No authorization for new Federal work. Recommended developing erosion control measures under the Water Resources Development Act of 1974 to be implemented by local groups
Flood Insurance Study, Township of Elsinboro, New Jersey, February 1982	FEMA	Floodplain analysis.
Delaware River Comprehensive Navigation Study, Interim Feasibility Report and Environmental Assessment, Salem River, New Jersey, dated July 1990, Revised March 1991	Corps of Engineers	Recommended that the Salem River channel be deepened from 12 ft to 18 ft and widened from 100-150 ft to 180 ft. Construction of a turning basin was also recommended
Salem River Design Memorandum dated February 1993 and Addendum dated 15 September 1994	Corps of Engineers	Presented results of PED studies for navigation improvements to the Salem River. Recommended deepening the channel to 16 feet, widening to 150-250 feet, and construction of a turning basin.
Delaware Bay Coastline, NJ & DE Reconnaissance Study, August 1991	Corps of Engineers	Recommended further investigation of shoreline protection and habitat restoration for seven interim study areas including Oakwood Beach, NJ.
Delaware River Comprehensive Navigation Study, Main Channel Deepening, Final Interim Feasibility Report and EIS for the Delaware River, February 1992	Corps of Engineers	Recommended improvements to the Federal navigation project for the Delaware River, Philadelphia to the Sea.
Design Memorandum for Delaware River Main Channel Deepening Project, May 1996	Corps of Engineers	Presented results of Preconstruction Engineering and Design studies for navigation improvements to the Delaware River Main Channel
Comprehensive Conservation and Management Plan, Delaware Estuary Program, September, 1996	Delaware Estuary Program	Final Management Plan for the Delaware Estuary

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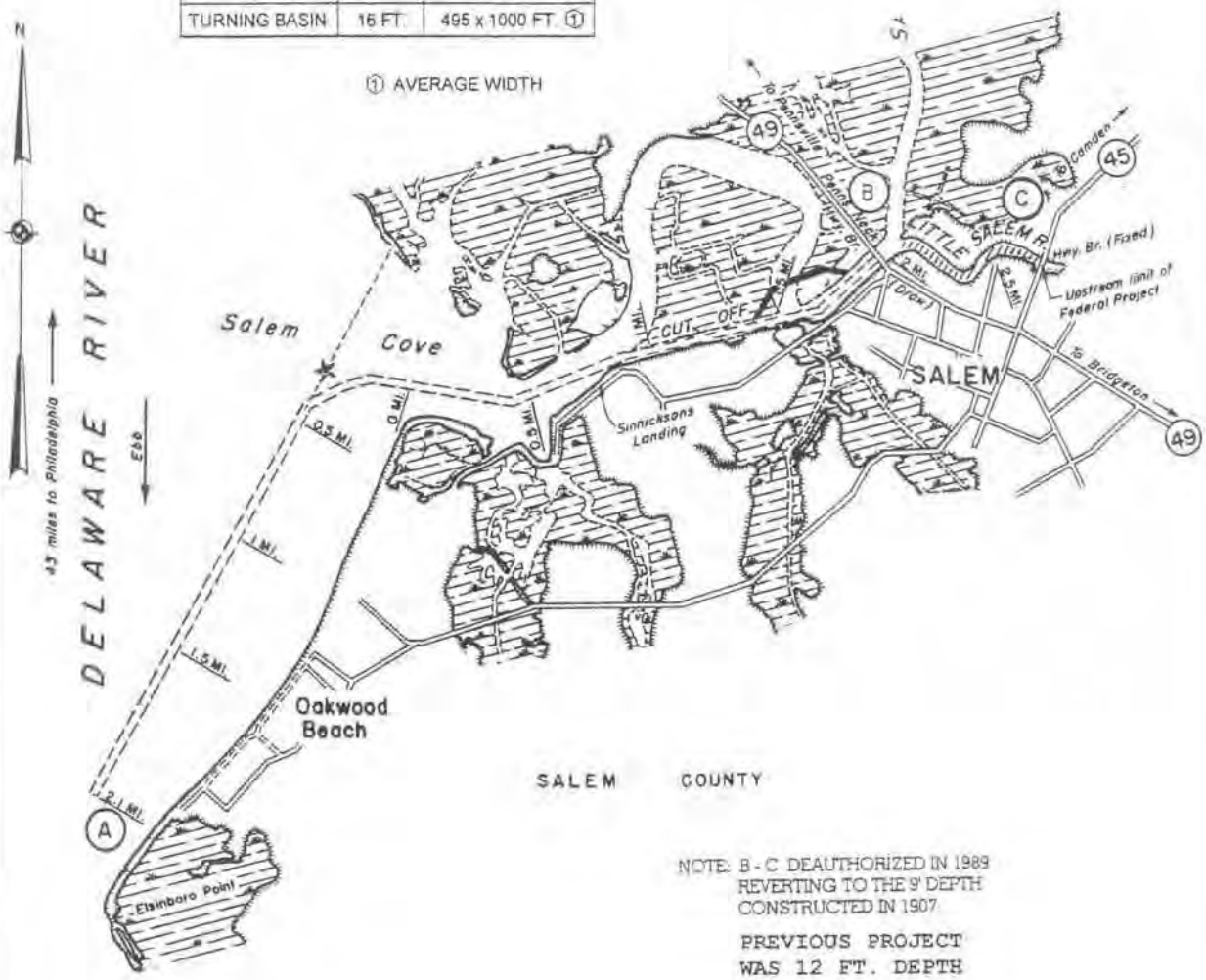
CHANNEL DIMENSIONS		
LOCATION	DEPTH	WIDTH
A - B	16 FT.	150 - 250 FT.
B - C	9 FT.	100 FT.
TURNING BASIN	16 FT.	495 x 1000 FT. ①

① AVERAGE WIDTH



NOTE: B - C DEAUTHORIZED IN 1989 REVERTING TO THE 9' DEPTH CONSTRUCTED IN 1907.

PREVIOUS PROJECT WAS 12 FT. DEPTH

SALEM RIVER

NEW JERSEY

REVISED 30 JUNE 1968

SCALE OF FEET

1000 0 1 2 3 4 5 6 7 8000

U.S. ARMY ENGINEER DISTRICT, PHILA.

FIGURE 3

13. **DELAWARE RIVER, PHILADELPHIA TO THE SEA, PA, NJ, & DE, NAVIGATION PROJECT.** The existing project, adopted as HD 61-733 in 1910, and modified by HD 71-304 in 1930, Rivers and Harbors Committee DOC 73-5 in 1935, SD 75-159 in 1938, HD 76-580 in 1945, HD 77-340 in 1945, HD 83-358 in 1954 and HD 85-185 in 1958. It provides for a channel from deep water in Delaware Bay to a point in the bay near Ship John Light, 40 feet deep and 1,000 feet wide; thence to Philadelphia Naval Base, 40 feet deep and 800 feet wide, with 1,200-foot width at Bulkhead Bar and 1,000-foot width at other bends; thence to Allegheny Avenue, Philadelphia, PA, 40 feet deep and 500 feet wide through Horseshoe Bend and 40 feet deep and 400 feet wide through Philadelphia Harbor along the west side of channel and 37 feet deep and 600 feet wide along the east side of channel; and for improvement of anchorages at Reedy Point, Deepwater Point, Marcus Hook, and Mantua Creek, each 40 feet deep and 2,300 feet wide with respective lengths of 8,000, 5,200, 13,650, and 11,500 feet; at Gloucester 30 feet deep and about 3,500 feet long and 400 feet wide, and at Port Richmond 37 feet deep and about 6,400 feet long and 750 feet wide. See Figure 4.

14. The project also provides for construction of dikes and training works for regulation and control of tidal flow; for maintenance of an area on the north side of the channel opposite the Philadelphia Naval Base between Shipway 3 and the Schuylkill River to 40 feet deep and a width of 150 feet on Mifflin Range; and for maintenance of any areas dredged by local interests to 35 feet deep between the channel and a line 100 feet channelward of pierhead line between Point House Wharf and the Philadelphia Naval Base, when in the opinion of the Chief of Engineers such areas are so located as to be of benefit to general navigation. The section included in the project is about 96.5 miles long. Eleven additional areas have been designated as special anchorages or anchorage areas but have not been authorized for improvement.

15. In May 1982, pursuant to the authority contained in Section 111 of the Rivers and Harbors Act of 1968, a project for mitigation of erosion damages caused by the Philadelphia to the Sea project at Pennsville, New Jersey, was approved by the Chief of Engineers. The improvement involved the placement of 1300 feet of rubble toe protection for the existing steel bulkhead.

16. WRDA '92 authorized the Delaware River Main Channel Deepening Project, PA, NJ, and DE. The authorized project provides for modifying the Philadelphia to the Sea project from 40 feet at mean lower low water to 45 feet following the existing channel alignment from Delaware Bay to Philadelphia Harbor and the Beckett Street Terminal in Camden, New Jersey. The plan of improvement will also include appropriate channel bend widenings and partial deepening of the Marcus Hook anchorage to 45 feet.

17. **INLAND WATERWAY-DELAWARE RIVER TO CHESAPEAKE BAY-DELAWARE AND MARYLAND-CHESAPEAKE AND DELAWARE (C&D) CANAL PROJECT.** The existing project was adopted as HD 63-196 in 1919 and modified by Section 3 of the R&H Act of 1927, by R&H Comm. Doc. 71-41 and SD 71-151 in 1930, by HD 72-201, HD 73-18, and HD 73-24 in 1935, and by SD 83-123 in 1954 and modified by H.R. 5314 (WRDA 90). It consisted initially of the purchase of the C&D Canal by the United States with

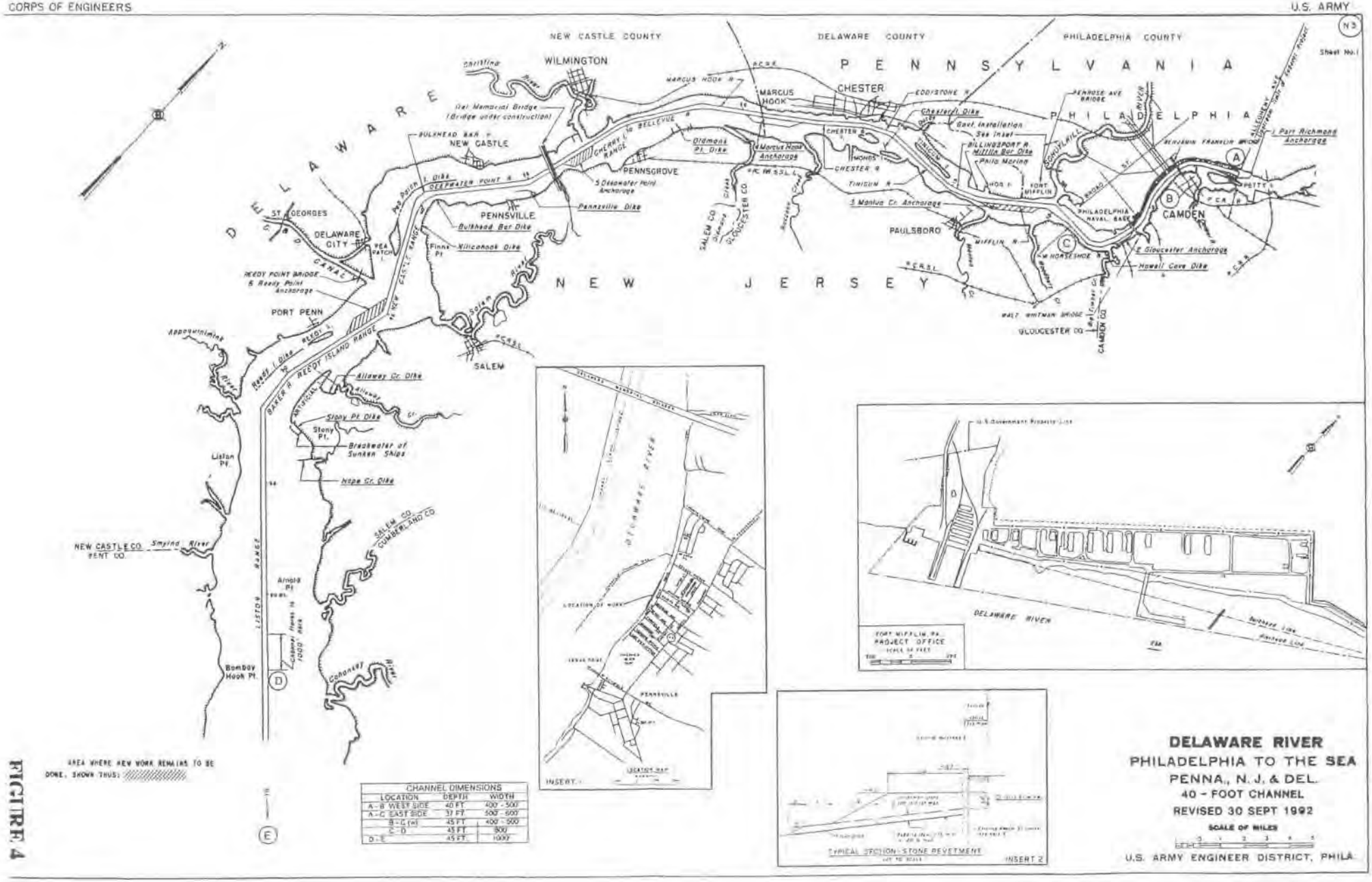

NEW CASTLE COUNTY
DELAWARE COUNTY
PHILADELPHIA COUNTY
PENNSYLVANIA
NEW JERSEY
DELAWARE
WILMINGTON
Christina River
Del. Memorial Bridge (Bridge under construction)
BULKHEAD BAR
NEW CASTLE
CHERRY I. RANGE
BELLEVUE
Oldmans Pt. Dike
PENNSGROVE
Pennsville Dike
Bulkhead Bar Dike
Finns Pt.
Villanova Dike
DEEPWATER POINT
ST. GEORGES
DELAWARE CITY
DELAWARE CANAL
REEDY POINT BRIDGE
Reedy Point Anchorage
PORT PENN
Appoquinimink River
Reedy I. Dike
REEDY ISLAND RANGE
BAKER R.
Alloway Cr. Dike
Stony Pt. Dike
Stony Pt.
Breakwater of Sunken Ships
Hope Cr. Dike
Liston Pt.
NEW CASTLE CO.
KENT CO.
Smyrna River
LISTON RANGE
Arnold Pt.
Bombay Hook Pt.
Cohansey River
SALEM CO.
CUMBERLAND CO.
SALEM
Salem River
MARCUS HOOK
CHESTER
Marcus Hook Anchorage
Eddystone R.
Chester I. Dike
Govt. Installation
Sea Inset
BILLINGSPORT R.
Mifflin Bar Dike
Philo Marina
FORT MIFFLIN
Tinicum R.
Manlua Cr. Anchorage
PAULSBORO
Mifflin R.
Horseshoe R.
Penrose Ave Bridge
SOUTHWARK
Benjamin Franklin Bridge
Port Richmond Anchorage
PHILADELPHIA
PHILADELPHIA NAVAL BASE
CAMDEN
Petty I.
E. Gloucester Anchorage
Howell Cove Dike
Walt Whitman Bridge
GLOUCESTER CO.
CAMDEN CO.
SALEM CO.
GLOUCESTER CO.
DELAWARE RIVER
LOCATION OF WORK
PENNSVILLE
INSERT 1
FORT MIFFLIN, PA.
PROJECT OFFICE
DELAWARE RIVER
TYPICAL SECTION - STONE REVETMENT
INSERT 2
AREA WHERE NEW WORK REMAINS TO BE DONE, SHOWN THUS:
CHANNEL DIMENSIONS
LOCATION DEPTH WIDTH
A-B WEST SIDE 40 FT 400 - 500
A-C EAST SIDE 37 FT 500 - 600
B-C (W) 45 FT 400 - 500
C-D 45 FT 800
D-E 45 FT 1000
DELAWARE RIVER
PHILADELPHIA TO THE SEA
PENNA., N.J. & DEL.
40 - FOOT CHANNEL
REVISED 30 SEPT 1992
SCALE OF MILES
U.S. ARMY ENGINEER DISTRICT, PHILA.

FIGURE 4

subsequent modifications for enlargements and bridge crossings. The project provides a channel 35 feet deep and 450 feet wide from Delaware River through Elk River and Chesapeake Bay to water of natural 35-foot depth in Chesapeake Bay including a cutoff at Penn Central Railroad crossing, and having a minimum radius of curvature of 7,000 feet at bends; a high-level, fixed railroad bridge with vertical clearance of 135 feet and horizontal clearance of 600 feet at the railroad crossing over the cutoff; high level fixed highway bridges over the canal, with vertical clearance 135 feet and horizontal clearance 500 feet, at Reedy Point, St. Georges, Summit, and Chesapeake City; a bascule drawbridge across Delaware City Branch Channel; extension of entrance jetties at Reedy Point; an anchorage in Elk River, 35 feet deep and 1,200 feet wide, with an average length of 3,700 feet; enlargement of anchorage and mooring basin in Back Creek to afford an area about 400 feet wide, 1,000 feet long, and 12 feet deep; dredging Delaware City Branch Channel to 8 feet deep and 50 feet wide, and deepening existing basin to same depth; revetment of banks of canal as required between Delaware and Elk Rivers, and on banks of Delaware City Branch Channel east of Fifth Street Bridge; and construction of bulkheads. Total of section included in project, excluding Delaware City Branch Channel, which is about 2 miles long, is about 46 miles. Refer to Figures 5 and 6.

18. The WRDA of 1990 authorized construction of a new highway bridge on U.S. Route 13 in the vicinity of St. George's, Delaware, to meet the current and projected traffic needs, at a Federal cost of $115,000,000. The State has completed the bridge construction and is being reimbursed by the Federal Government for costs incurred. Studies are ongoing to evaluate options for disposition of the original St. George's Bridge.

19. The WRDA of 1996 authorized modification of the C&D Canal to provide deepening of the channel and safety improvements at Reedy Point and Sandy Point, as well as construction of an emergency anchorage at Howell Point. The depth of improvement is to be determined during Preconstruction Engineering and Design.

RELATED INSTITUTIONS

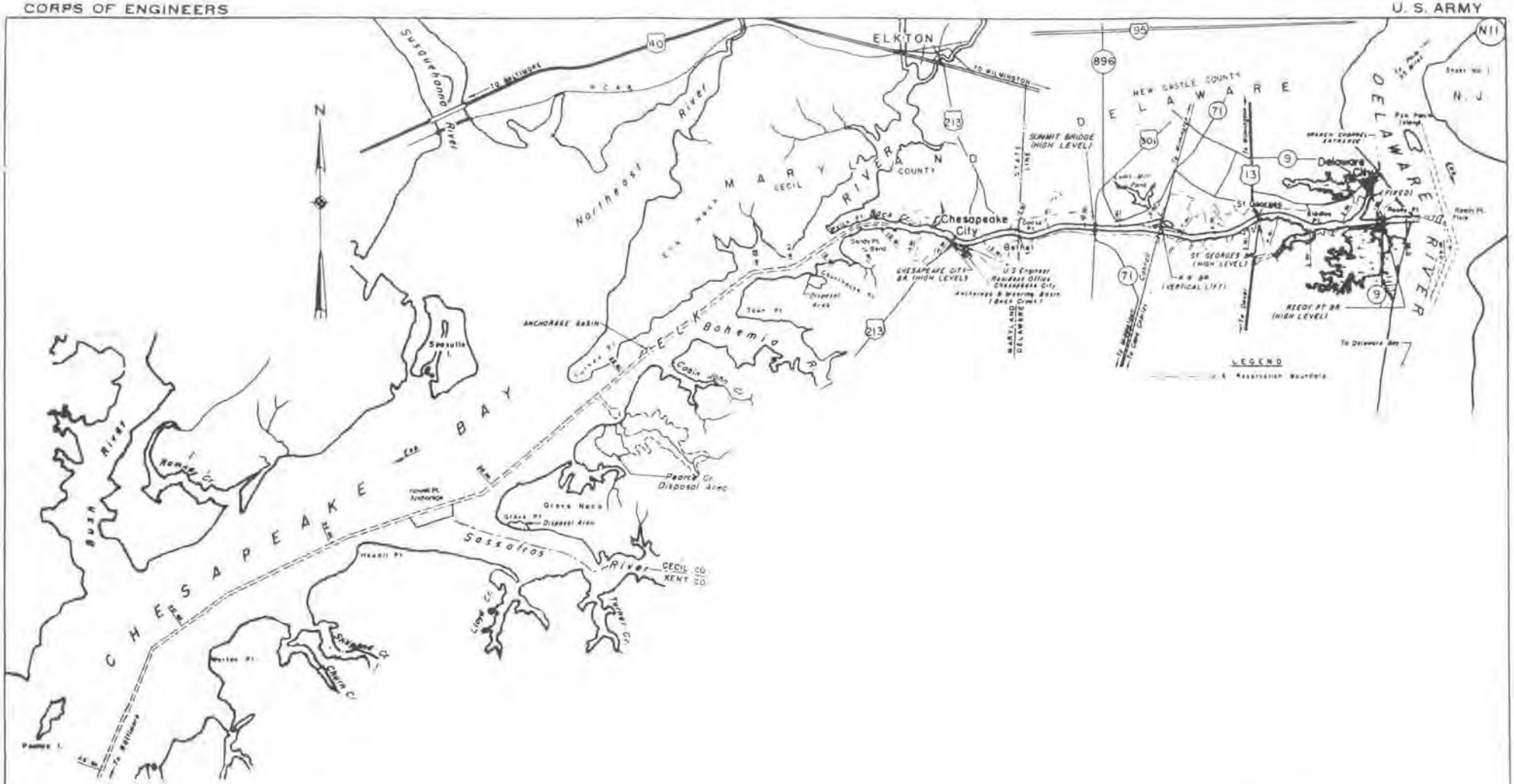
20. An inventory has been made of public institutions in the study area which affect or may be affected by the implementation of plans developed as part of this study. The inventory includes Federal, State and local agencies. The primary agencies concerned with shore protection in the study area include the following:

FEDERAL AGENCIES.

21. **U.S. Environmental Protection Agency (EPA)-Region II.** This agency is generally responsible for enforcement of Federal laws regarding air and water quality, solid waste, and hazardous materials. Relative to Federal navigational activities, the EPA and the Corps have established guidelines for the evaluation of water quality impacts associated with the disposal of dredged material as required by Section 404(b) (1) of the Clean Water Act (CWA). Similarly, the EPA and the Corps have developed evaluative criteria for specification of ocean dumping sites in accordance with the Marine Protection, Research, and Sanctuaries Act. EPA also maintains a veto authority over decisions made by the Corps regarding specification of disposal

CORPS OF ENGINEERS

U. S. ARMY



CORPS OF ENGINEERS

U. S. ARMY

N11

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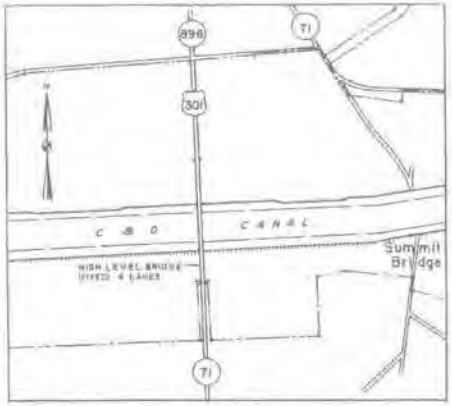
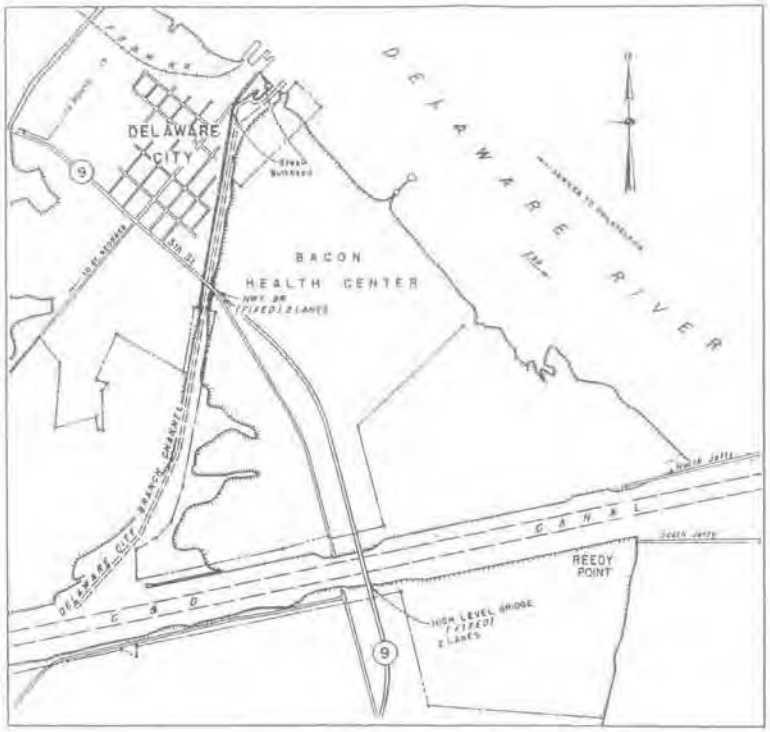


SCALE OF FEET

SUMMIT BRIDGE
DELAWARE

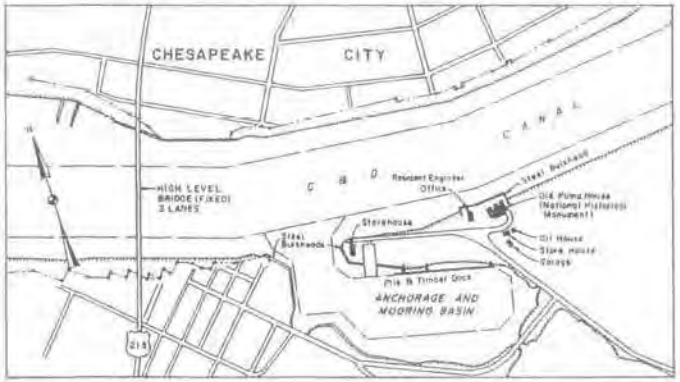
SCALE OF FEET

ST GEORGES BRIDGE
DELAWARE



SCALE OF FEET

REEDY POINT BRIDGE and 5th STREET BRIDGE
DELAWARE



SCALE OF FEET

CHESAPEAKE CITY BRIDGE and RESIDENT ENGINEER OFFICE
MARYLAND

LEGEND

U.S. Reservation Boundary

INLAND WATERWAY

DELAWARE RIVER TO CHESAPEAKE BAY
DELAWARE & MARYLAND

CHESAPEAKE & DELAWARE CANAL

RESIDENT ENGINEER OFFICE & INSTALLATIONS

REVISED 30 SEPT 1984

SCALES AS SHOWN

U.S. ARMY ENGINEER DISTRICT, PHILA.

FIGURE 6

sites under Section 404(c) of the CWA. In the Clean Air Act (Section 309), EPA has been given the authority to review and comment on actions subject to the National Environmental Policy Act (NEPA) and to refer those actions to the Council on Environmental Quality (CEQ) if the agency finds the action to be unacceptable from an overall environmental stand-point.

22. **U.S. Fish and Wildlife Service (USFWS).** This agency is responsible for evaluation of project impacts to Fish and Wildlife resources and recommendations concerning the conservation of those resources and mitigation of impacts. Those recommendations must be considered in project planning (Fish and Wildlife Coordination Act). Enforcement and coordination under the Endangered Species Act is primarily the responsibility of the FWS. The FWS also is the responsible agency for compliance with the coordination and consultation requirements under the Coastal Barrier Resources Act.

23. **National Marine Fisheries Service (NMFS), Department of Commerce.** This agency is similarly responsible for evaluation of project impacts on marine life and enforcement coordination under the Endangered Species Act for endangered species in the marine environment.

24. **National Park Service, Office of Archeological Services (OAS), U.S. Department of the Interior.** This agency is charged primarily with overseeing the historic preservation program established as a result of the Archeological and Historic Preservation Act of 1974. A primary function is the review of historic preservation reports prepared by various Federal agencies.

25. Federal agencies are required to afford the Advisory Council on Historic Preservation (ACHP) an opportunity to comment on any Federally-funded or licensed activities that may have an effect on any District, building, site, structure, or object that is listed in or is eligible for inclusion in the National Register of Historic Places.

26. **U.S. Coast Guard, Department of Transportation.** This agency's authority includes maritime law enforcement, placement and maintenance of aids to navigation, supervision over the anchorage and movement of vessels, the handling of explosives and other dangerous vessel cargoes, and safeguarding life and property on the high seas. It also enforces laws relating to oil pollution, immigration, quarantine and numerous statutes under the jurisdiction of other Federal agencies that require marine personnel and facilities.

27. **Natural Resources Conservation Service, U.S. Department of Agriculture.** This agency has the responsibility for developing and carrying out a national soil and water conservation program in cooperation with landowners and operators and other land users and developers, with community planning agencies and regional resource groups, and with other Federal, State, and local government agencies. The Service also assists in agricultural pollution control, environmental improvement, and rural community development.

28. The Soil and Water Conservation Program is carried on through technical help to locally organized and operated conservation districts; local sponsors of watershed protection projects and resource conservation and development projects; and consultative assistance to other

individuals and groups. About 3,000 conservation districts cover more than 2 billion acres in the 50 States, Guam, Puerto Rico, and the Virgin Islands.

29. **U.S Army Corps of Engineers, Department of the Army.** This agency performs the full range of real property activities (requirements, programming, acquisition, operation, maintenance, and disposal); manages and executes engineering, construction, and real estate programs for the Army and the United States Air Force; and performs research and development in support of these programs. The Corps manages and executes Civil Work Programs. These programs include research and development, planning, design, construction, operation and maintenance, and real estate activities related to rivers, harbors, and waterways; administration of laws for protection and preservation of navigable waters and related resources such as wetlands. The Corps also assists in recovery from natural disasters.

STATE AGENCIES.

30. **New Jersey Department of Environmental Protection (NJDEP), Engineering and Construction, Coastal Engineering.** This division is responsible for planning and designing shore protection projects; conducting waterway maintenance dredging activities; and overseeing the development of the State's Shore Protection Plan. The agency also acts as the local cooperative agency with the Philadelphia District, Army Corps of Engineers on all matters of shore protection. Aids to Navigation installs all of the navigation monitoring aids on state-controlled waterways and lakes.

31. **NJDEP, Engineering and Construction, Floodplain Management.** This division is responsible for providing matching grants to local governments for flood control projects; and planning long-term, state-supported flood control grants program. The agency also prepares flood plain delineation maps for state adoption and provides assistance to municipalities in the National Flood Insurance Program.

32. **NJDEP, Green Acres.** This division is responsible for providing planning assistance and low-interest loans and grants to municipalities and counties for open space acquisition and recreational development projects. The agency also furnishes matching grants to nonprofit organizations for open space acquisition projects, and serves as the NJDEP's land acquisition agent in purchasing land for state parks, forests and wildlife management areas. The agency also prepares and updates the Statewide Comprehensive Outdoor Recreation Plan, and manages all federal funds granted to New Jersey for open space preservation and recreational development.

33. **NJDEP, Division of Fish, Game and Wildlife, Central Services.** This division has the following responsibilities:

- Administration is responsible for the division's licensing, revenue receipt and accounting, budgeting, purchasing and billing functions.

- Endangered & Nongame provides scientific information and makes recommendations necessary to develop management programs for the state's endangered and threatened nongame species.

- Environmental Review coordinates the input and recommendations of the division's technical experts regarding the impacts of various types of development on wildlife.

- Education & Wildlife Information coordinates the dissemination of information describing division programs to the public and promoting the wise use of the state's natural resources.

- Laboratory Services monitors wildlife diseases and makes recommendations for their control. This group also monitors chemical substances in water which may negatively affect fish or their consumption by humans.

34. **NJDEP, Division of Fish, Game and Wildlife, Marine Fisheries.** This division provides scientific information and makes recommendations necessary to develop regulations governing the harvest of marine fish and shellfish and the protection of habitat.

35. **NJDEP, Division of Fish, Game and Wildlife, Operations.** This division has the following responsibilities:

- Development & Maintenance is responsible for administration of the 209,000-acre Wildlife Management Area system including wildlife habitat development, maintenance and construction of division facilities and lease administration.

- Freshwater Fisheries provides scientific information and makes recommendations necessary to develop regulations governing the harvest of fresh-water fish and the protection of habitat.

- Law Enforcement is responsible for the enforcement of all statutes and regulations dealing with the wildlife resources of the state and their habitat.

- Wildlife Management is responsible for conducting a variety of research and management efforts designed to maintain healthy and productive wildlife populations while providing for wildlife-oriented recreational opportunities. Wildlife Management also addresses wildlife damage problems and operates the state pheasant farm.

36. **NJDEP, Division of Parks and Forestry, Natural Lands Management.** This division identifies and develops strategies to protect unique, rare, endangered and scenic habitats. The unit leads, prepares and implements management plans for state and designated natural areas; plans and develops the State Trail System; and implements the Wild and Scenic Rivers Act and the Open Lands Management Act. This unit also works with the Natural Lands Trust, an autonomous organization established to accept land donations for preservation.

37. **NJDEP, Division of Parks and Forestry, New Jersey Historic Preservation Office.** This division offers technical assistance to individuals, organizations and government agencies in the identification, evaluation and protection of historic resources. It also administers the following state and Federal programs: New Jersey and National Registers of Historic Places; Matching Grant Program for Historic Site Surveys, Preservation Planning and Predevelopment Projects; Matching Grant Program for Acquisition and Development Projects, Statewide

Comprehensive Planning and Preservation Education; Tax Act Program for Certified Rehabilitations Under the Tax Reform Act of 1986; and Main Street New Jersey.

38. **NJDEP, Division of Parks and Forestry, Resource Development.** This division manages the capital improvements and land acquisition programs and special development programs.

39. **NJDEP, Division of Parks and Forestry, State Forestry Service.** This division through programs of technical and/or financial assistance to communities, private property owners and state-owned lands, nurtures and sustains healthy biologically diverse forests that provide habitats for wildlife and plants including those that are threatened or endangered and yield quality water, air, and recreational and education opportunities; wood products and supply for local economies; the protection of historical and aesthetic values; and the planting and care of community trees and protection of life and property threatened by wildfire.

40. **NJDEP, Division of Parks and Forestry, State Park Service.** This division administers the operations, maintenance, law enforcement and natural resources protection programs of 36 parks, 11 forests, four recreation areas, 42 natural areas, one golf course, 50 historic sites, and four marinas, providing a variety of quality recreational opportunities for the public. These units comprise over 325,000 acres incorporating facilities for camping, cabins, natural and historic interpretive programs, picnicking, bathing, hiking, boating, hunting, fishing and many other related outdoor activities and programs.

41. **Delaware Department of Natural Resources & Environmental Control (DNREC).** Established in the Spring of 1970, DNREC is charged with oversight of Delaware's natural resources and addressing its ecological and environmental concerns. The Department is comprised of six divisions:

42. **DNREC, Office of the Secretary.** This division provides overall direction, management and policy, as well as central administrative functions including human resources, financial management, information and systems management, business and permitting assistance and public information and education.

43. **DNREC, Division of Fish and Wildlife.** This division is responsible for the conservation and wise use of the state's fish and wildlife populations.

44. **DNREC, Division of Parks and Recreation.** This division operates and maintains 13 state parks and related preserves and greenways throughout Delaware totaling more than 15,000 acres. The state's land protection programs, as well as the state's Greenways program, are administered by the Division. The Division is also responsible for providing recreational opportunities and educational and interpretive programs for the public needs.

45. **DNREC, Division of Soil and Water Conservation.** This division is responsible for preserving and protecting the state's soil, water, and coastal resources by managing the state's shoreline, coastal zone and navigable waterways, by regulating coastal and urban land use and construction activities and by promoting wise agricultural land management practices.

46. **DNREC, Division of Water Resources.** This division assures that Delaware's rivers, ponds, streams, bays, wetlands and groundwater are properly managed and protected.

47. **DNREC, Division of Air and Waste Management.** This division oversees the handling, transfer and storage of solid and hazardous materials through regulations, monitoring, inspection, emergency response and enforcement. The Division also operates the state's air monitoring, permitting and compliance programs.

48. **COUNTY AND LOCAL AGENCIES.**

Salem County, New Jersey
Township of Elsinboro, New Jersey

RELATED INSTITUTIONAL PROGRAMS

49. **NATIONAL ESTUARY PROGRAM - DELAWARE ESTUARY PROGRAM.** The National Estuary Program (NEP) was established by Congress under the Water Quality Act of 1987, Section 320. 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 by a Comprehensive Conservation and Management Plan (CCMP), developed in a management and study effort called a Management Conference.

50. 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.

51. The Delaware Estuary Program (DELEP) is a Federally-funded program which has been undertaken by the States of Delaware, New Jersey, and Pennsylvania and the EPA. Its study area includes: (1) the Delaware River and Bay from Morrisville, Pennsylvania and Trenton, New Jersey, to Lewes, Delaware and Cape May, New Jersey; (2) all tributaries to these waters; and (3) the surrounding land areas. The DELEP was included into the NEP in 1988. A Management Conference was convened in July 1989, and five goals were established:

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

- Reduce and control point and non-point 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 program affecting the Estuary.

52. The final CCMP for the Delaware Estuary was signed in September 1996 by the EPA Administrator and the governors of New Jersey, Delaware, and Pennsylvania. The program is now in an ongoing implementation phase. The CCMP documents 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 plan recommends solutions to guide future management of the Estuary's resources that will be implemented through existing and possibly new institutions and agencies. The Oakwood Beach study area is within the boundaries of the Delaware Estuary Program.

53. **NORTH AMERICAN WATERFOWL MANAGEMENT PLAN.** The North American Waterfowl Management Plan (NAWMP) was established on 14 May 1986 by the United States Fish & Wildlife Service and the Canadian Wildlife Service. The purpose of the plan is to reverse the decline of wetlands and waterfowl by establishing goals for conserving wetland habitats and for restoring waterfowl populations. Broad guidelines are provided for habitat protection and management through the year 2000. Each country, state, province, and territory will need to establish specific plans for habitat preservation and management in their respective jurisdictions. The implementation of the NAWMP takes place through "Joint Ventures", coalitions of State and Federal agencies, conservation groups, and landowners.

54. About ten to twenty million shorebirds from over 48 species migrate annually from South America to Canada along the Atlantic Flyway, relying upon strategically placed habitats for food and rest. The Delaware Estuary is the largest staging site in the eastern United States for shorebirds migrating along the Atlantic Flyway. It is also the second largest staging site in North America. The conservation of the Delaware Estuary through the NAWMP is critical to the survival of the various species of migrating shorebirds as well as the Estuary's unique resources.

55. **WESTERN HEMISPHERE SHOREBIRD RESERVE NETWORK.** The Western Hemisphere Shorebird Reserve Network (WHSRN) was created in 1985 by the International Association of Fish and Wildlife Agencies. The Network is an inclusive, multi-organizational effort. The objectives of the WHSRN are: (1) to promote the conservation of Western Hemisphere Shorebirds; and (2) sustenance of natural ecological processes in wetlands and other critical habitats upon which they depend. The member sites or "Sister Reserves" are Hemispheric, International, Regional, and Endangered Species sites. Throughout the Western Hemisphere, fifteen sites have been dedicated as of 1991.

56. The lower 25 miles of the Delaware Bay shore of New Jersey and Delaware have been established as a "Sister Reserve" through a joint resolution by former Governor Thomas H. Kean of New Jersey and former Governor Michael M. Castle of Delaware. The objective of the joint resolution is to recognize and protect the critical migrating and feeding habitat for over one

million shorebirds which utilize the Delaware Bay shore of both states during spring and fall migrations.

57. **COASTAL AMERICA PARTNERSHIP.** The Coastal America Program was established in 1991. The goal of the program is to preserve, restore, and protect national coastal resources. The program is managed through the combined efforts of the U.S. Department of the Interior, the U.S. Environmental Protection Agency, the U.S. Army Corps of Engineers, and the National Oceanic and Atmospheric Administration.

58. These agencies provide the foundation for reaching the goal of the program by: (1) quickly responding to coastal management needs at the state and local level; and (2) assisting local governments and states to obtain public participation in coastal management through educational programs.

59. Coastal America provides support for both short-term and long-term coastal management projects using a three-level strategy which consists of: (1) preventive measures applied to all coastal areas; (2) site-specific restoration; and (3) long-term plans for containing or removing pollutants in highly contaminated areas.

60. **MARINE FISH HABITAT RESTORATION AND CREATION PROGRAM.** A cooperative agreement between the Corps and the National Marine Fisheries Service (NMFS) to establish a national NMFS-Corps program that will contribute toward balancing fish habitat conservation with orderly development and management of the Nation's water resources was signed on January 31, 1991. It states the Corps' policy to restore and create fish habitat at existing projects, some of which include wetlands, when habitat creation can be accomplished in an acceptable manner without added cost. If added costs are involved, the Corps will consider those opportunities using funds and authorities which may be available to them and with appropriate cost-sharing by non-Federal interests. Restoration and creation features may include marine, estuarine, and anadromous fish habitats.

EXISTING CONDITIONS

SOCIAL AND ECONOMIC SETTING

61. **POPULATION AND LAND USE.** Oakwood Beach is a small residential community consisting of approximately 3 miles of beach along the Delaware Bay, in Elsinboro Township, Salem County, New Jersey. It lies adjacent and roughly parallel to the entrance channel for the Salem River navigation project and is east of the Reedy Point entrance to the C&D Canal as it connects to the Delaware River shipping channel. The Port of Salem is located upstream of the study area. Vessels travel along both the Salem River and Delaware River navigation channels in the vicinity of the study area. The mean low water line at Oakwood Beach is considered the boundary between the States of New Jersey and Delaware.

62. The primary concern among residents of Oakwood Beach is the long term erosion along Locust Avenue, River Lane and Shadroe Lane. The study area consists of approximately 133 structures, all residential with the exception of one commercial building, the Country Club of Salem. The shoreline at Oakwood Beach is primarily used by local residents. Public access to the site is limited.

63. Salem County, covering an area of 346 square miles, is the least populated of the eight southern most counties in New Jersey. Salem County had a total population of 65,294 people in 1990, an increase of only 1.0% since 1980. Elsinboro Township had an estimated population of 1,246 in 1990 with about 60% of that population residing in Oakwood Beach. It is projected that by the year 2005 Salem County will be the only county in the state to have a population of less than 100,000.

64. Although Oakwood Beach is not expected to experience significant development, both Salem County and New Jersey will continue to increase its population over the next twenty years, but at a decreasing rate of growth. Table 2 displays population projections for Salem County and New Jersey through the year 2010.

TABLE 2
POPULATION PROJECTIONS

	1960	1970	1980	1990	2000	2010
Salem County	58,711	60,346	64,676	65,294	68,300	69,700
New Jersey	6,066,782	7,171,112	7,365,011	7,730,188	8,500,200	8,996,500

65. **ECONOMIC DEVELOPMENT.** There has been very little new development in Oakwood Beach with the exception of one structure near the southern boundary of the study area. Construction is not expected to continue along the shoreline due to the lack of vacant lots, as well the high cost incurred by homeowners along the shoreline for maintenance of local shore

protection structures. Two structures at the southern most end of the study area have been abandoned due to the high maintenance costs of necessary shore protection structures.

66. In 1990 the median value of a single family home in Salem County was $79,800, almost 20% less than that of the State's median value. Refer to Table 3 for average housing prices for Salem County and the State of New Jersey. Less than half of the homes in Salem County are owner occupied with 12.6% renter occupied and 41.2% vacant. Refer to Table 4. Median rent for single family homes in Salem County is approximately $278, more than 65% of New Jersey's median rent. Unlike Salem County, however, residents of Oakwood Beach permanently occupy about 75% of the homes year round and the majority of homes are owner occupied rather than renter occupied.

TABLE 3
AVERAGE HOUSING PRICES
BASED ON UNITS SOLD IN FY 1989 AND FY 1990

	FY 1989, Average Housing Price	Units Sold	FY 1990, Average Housing Price	Units Sold
Salem County	$72,459	605	$81,873	511
New Jersey	$166,696	80,704	$166,399	69,682

TABLE 4
HOUSING UNIT OCCUPANCY

	Total Households	Total Housing Units	% Owner Occupied	% Renter Occupied	% Vacant
New Jersey	247,497	289,919	60.0	25.4	14.6
Salem County	43,681	74,253	46.2	12.6	41.2

Source: Upclose U.S. Data Book 1993

67. Table 5 contains 1989 income information for Salem County as well as Elsinboro Township. The estimated median per capita income in 1989 for Salem County was $13,961, almost $3,000 less than that of Elsinboro Township. Table 6 shows projections of the total civilian labor force for the State of New Jersey and Salem County.

TABLE 5
1989 MONEY INCOME AND PERCENT PERSONS BELOW POVERTY

	Household Income	Family Income	Median Non Family Income	Median Per Capita Income
Salem County	33,155	38,294	15,392	13,961
Elsinboro Township	38,512	44,583	21,375	17,370

Source: 1990 Census of Population & Housing, Summary Tape File 3.
Prepared by: New Jersey State Data Center, New Jersey Department of Labor, August 1992

TABLE 6
PROJECTIONS OF TOTAL CIVILIAN LABOR FORCE

	1980	1990	1995	2000	2005	2010
New Jersey	3,523,255	4,104,676	4,148,600	4,373,700	4,586,300	4,736,000
Salem County	27,830	31,339	31,800	33,200	34,800	36,000

GEOTECHNICAL SETTING

68. **GENERAL.** The project area lies entirely within the Atlantic Coastal Plain Physiographic Province. The geology of this province is characterized by a wedge of unconsolidated sediments which thicken and dip toward the Atlantic Ocean. These unconsolidated sediments, ranging in age from Cretaceous to Holocene, rest unconformably upon the crystalline basement of Precambrian schists and gneiss and consist of pervious and impervious materials, which form a series of aquifers and aquicludes. The Coastal Plain deposits thicken seaward from nothing at the fall line to more than 6,500 feet at the southern tip of Cape May.

69. **SITE GEOLOGY AND GROUNDWATER.** The Oakwood Beach study area is underlain by roughly 1,400 feet of unconsolidated Quaternary, Tertiary and Cretaceous sediments. These sediments overlie bedrock which consists of metamorphic and igneous rocks of the upper Precambrian age. The unconsolidated formations dip to the southeast and generally thicken oceanward. The older formations are at or near the surface in the vicinity of the Delaware River and are progressively deeper toward the Atlantic Ocean.

70. The geologic units within the vicinity of Oakwood Beach belong to the Wenonah Formation and Mount Laurel Sand of Cretaceous age, the Vincentown Formation of Tertiary age and the Cape May Formation of Pleistocene age. The Wenonah Formation and Mount Laurel

Sand and the Vincentown Formation outcrop in and around the Salem River in bands trending southwest to northeast while the Cape May deposits blanket areas of the older formations. In some locations in or adjacent to the Salem River, recent alluvial deposits mantle these geologic units.

71. The Wenonah Formation and overlying Mount Laurel Sand function as a single hydrologic unit. They comprise a highly used aquifer and are an important source of water for future development. The Wenonah Formation overlies the Cretaceous Marshalltown Formation, a leaky aquiclude composed of sandy clay. The Woodbury Clay, also of Cretaceous age, underlies the Marshalltown Formation and constitutes a widespread major aquiclude.

72. The Mount Laurel Sand is overlain by the Navesink Formation of Cretaceous age, which is in turn overlain by the scarcely distinguishable Hornerstown Sand of Tertiary age. These deposits are composed of sand with varying amounts of silt and clay, and function together as a leaky confining unit for the underlying Mount Laurel aquifer. The Vincentown Sand overlies the Hornerstown Sand and is an important local source of water supply.

73. The Cape May Formation is predominantly composed of sands and gravels. In areas where the Cape May deposits are not thick enough to function as an aquifer, their chief hydrologic function is to absorb precipitation and transmit it to the underlying formations. If these formations are pervious, a hydraulic connection exists between the shallow water table in the Cape May Formation and the underlying materials.

74. **GROUNDWATER QUALITY.** Groundwater in the vicinity of Salem Cove generally has natural total dissolved solids concentrations of less than 500 mg/l; this corresponds with New Jersey Department of Environmental Protection (NJDEP) Groundwater Class GW2. Designated uses and quality criteria for this class are:

> Suitable for potable, industrial, or agricultural water supply, after conventional water treatment (for hardness, pH, Fe, Mn, and chlorination) where necessary, or for the continual replenishment of surface waters to maintain the quantity and quality of the surface waters of the State and other reasonable uses (NJDEP 1978).

75. Groundwater beneath the study area in the Cape May Formation, Mount Laurel Sand and Wenonah Formation, and Raritan Formation is influenced by the major recharge areas of these respective aquifers. Recharge from or toward the Delaware River is topographically dependent. The Cape May Formation receives induced recharge from the Delaware River between Wilmington and Trenton and is also recharged by rainwater infiltration. The Formation's hydraulic gradient in the study area, however, is generally toward the Delaware River. Tidal action and supply well pumpage can locally control or reverse groundwater gradients. The relatively impermeable Holocene alluvium acts as only a partial barrier to saltwater intrusion from the Delaware River.

76. The groundwater recharge area of the Mount Laurel Sand and Wenonah Formation is approximately parallel to and midway between the Delaware River and the Atlantic Ocean. The major source of recharge is rainwater infiltration and leakage from the overlying Cape May

Formation. The hydraulic gradient is generally toward the southwest; however, local reversals occur due to the effect of pumping wells for water supply and tidal action. Leakage from the Cape May Formation has introduced salt water into this aquifer. In addition, iron concentrations are extremely high in the formation.

77. Because of the overlying aquiclude, groundwater in the Raritan Formation aquifer is recharged mainly in outcrops in urbanized areas immediately west of the Delaware River, including the city of Philadelphia, and by the Delaware River reach extending from Wilmington to Trenton. The aquifer historically has provided good quality water. However, in recent years groundwater quality has been degraded in portions of the aquifer upgradient of the study area. Changes have occurred in concentrations of dissolved solids, chlorides, alkalinity, iron, and manganese. Concentrations of iron and manganese greatly exceed the New Jersey groundwater standards. The changes in groundwater quality can be attributed in part to conditions characteristic of an urban recharge area and can be expected to eventually affect groundwater quality in the study area.

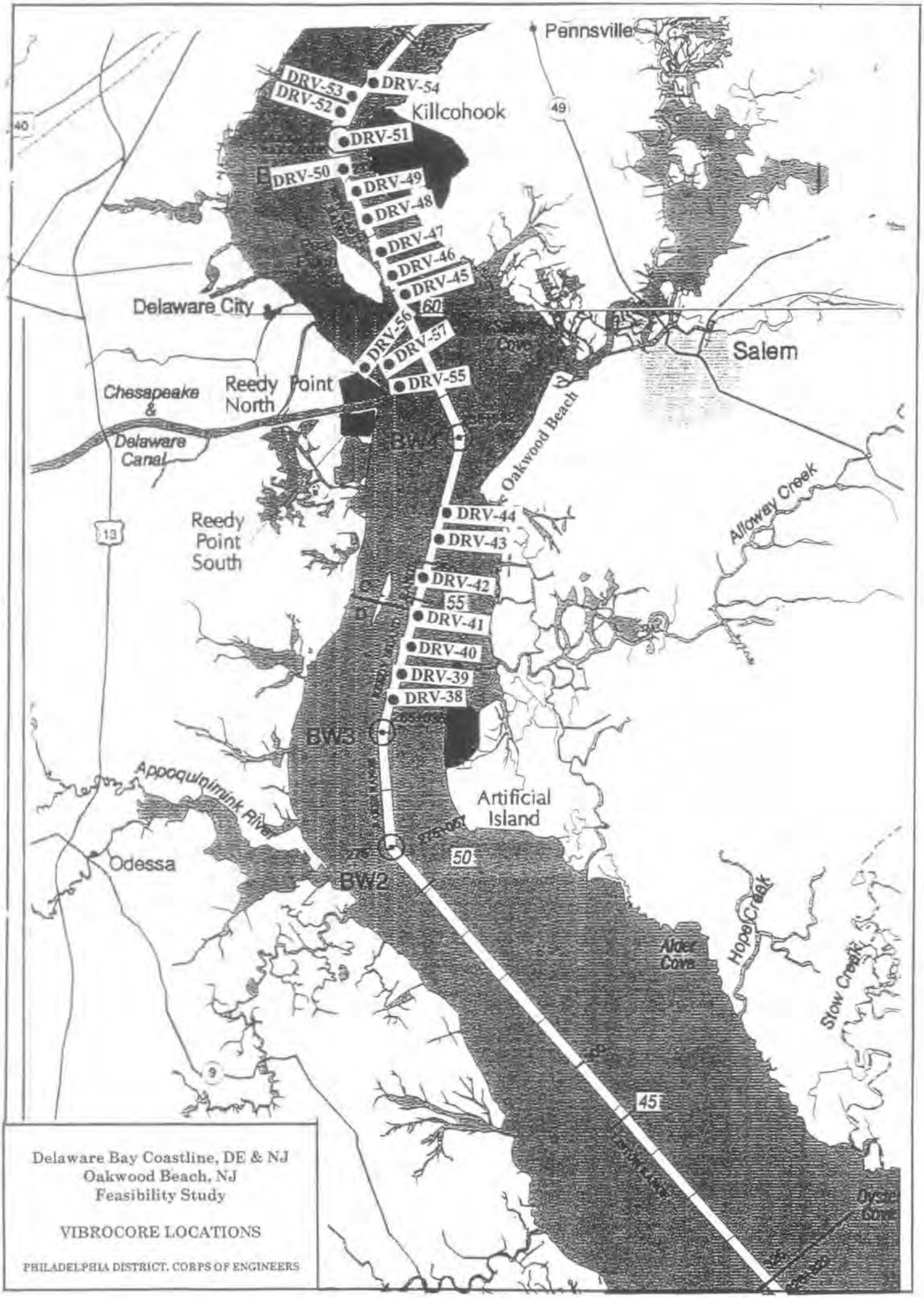
78. **POTENTIAL BORROW AREAS.** A series of ten vibrocores were taken in the Delaware River main channel north of the study area. An additional seven vibrocores were taken in the Delaware River main channel south of the study area and three vibrocores were taken in the vicinity of the channel flair for the proposed Chesapeake and Delaware Canal deepening project. Refer to Figure 7. The subsurface exploration program identified three distinct locations as potential borrow areas for the project.

79. The first location, and the proposed borrow area for the project, is located in the Delaware River main channel south of the study area. Refer to Figure 8. The northern extent of the area lies directly adjacent to the northern limit of Reedy Island in the Reedy Island range of the Delaware River. The proposed borrow area extends from this point approximately two miles down river. There is an estimated quantity of 5.3 million cubic yards of beach quality sand located in this borrow area. Vibrocores DRV-38 through DRV-42 were used to characterize this borrow area.

80. The second potential borrow area is located in the Delaware River main channel north of the study area adjacent to Pea Patch Island. This borrow area is approximately one mile in length and contains an estimated 3.1 million cubic yards of beach quality sand. A complicating factor weighing against the use of this borrow area is the fact that there is documented cable crossings near the middle of the area. Vibrocores DRV-45 through DRV-47 were used to characterize this borrow area.

81. The third potential borrow area located by the subsurface exploration program lies adjacent to Killcohook in the Bulkhead Bar Range and the downstream extent of the Deepwater Point Range. This borrow area is not quite one mile in length and contains an estimated 2 million cubic yards of beach quality sand. Vibrocores DRV-52 through DRV-54 were used to characterize this borrow area.

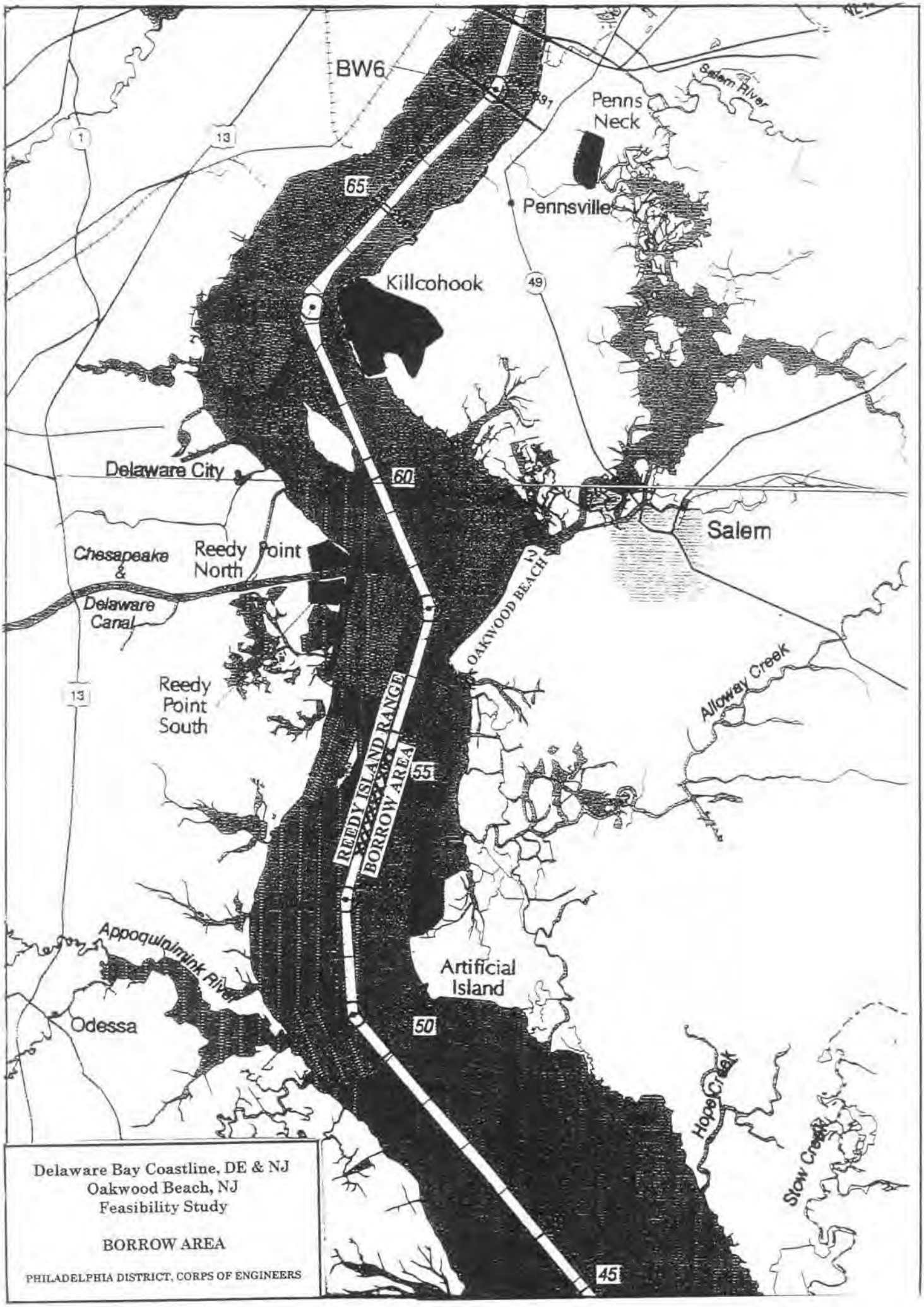
82. A fourth potential source for borrow material is the channel of the Chesapeake and Delaware Canal. No intrusive investigations were conducted during the feasibility study.



Delaware Bay Coastline, DE & NJ
Oakwood Beach, NJ
Feasibility Study

VIBROCORE LOCATIONS

PHILADELPHIA DISTRICT, CORPS OF ENGINEERS



Delaware Bay Coastline, DE & NJ
Oakwood Beach, NJ
Feasibility Study

BORROW AREA

PHILADELPHIA DISTRICT, CORPS OF ENGINEERS

However, historical information was evaluated and it is estimated that from station 0+000 to station 10+000 the canal's channel contains at a minimum one million cubic yards of beach quality sand.

83. A fifth potential source for borrow material, Reedy Point South Disposal Area, was evaluated during the feasibility study although no intrusive investigations were conducted. Based upon historical information, it is estimated that this area contains approximately 850,000 cubic yards of beach quality sand.

84. Other dredged material disposal areas that were evaluated included Reedy Point North, Killcohook, Artificial Island and Penns Neck. These areas are estimated to contain 160,000 cubic yards, 14,000 cubic yards, 70,000 cubic yards and 13,000 cubic yards of sand respectively.

ENVIRONMENTAL SETTING

85. **GENERAL.** The study area is located along the Delaware Bay in Salem County, New Jersey. The study area consists of 2 miles of developed shoreline, which is part of Elsinboro Township. The boundary between the states of Delaware and New Jersey follows the mean low water line adjacent to the Oakwood Beach shoreline. The study area below mean low water is located in New Castle County, Delaware.

86. The Delaware Bay and its tidal tributaries constitute a unique and extremely important estuary contributing to the environmental resources of the mid-Atlantic region. The Delaware Estuary has vast areas of coastal wetland habitat that is vital resting area for migrating shore birds along the Atlantic flyway. The study area is also within a focus area as defined by the Atlantic Coast Venture of the North American Waterfowl Management Plan. Focus areas contain critical waterfowl wintering, migratory or breeding habitat, particularly for black duck (*Anas rubripes*). Erosion and inundation of these ecological resources results in adverse impacts to the crucial fish and wildlife habitat found within the Delaware Estuary.

87. **VEGETATION.** The shoreline in the study area is characterized by being residentially developed. Most of the plants are ornamental. The yards are mowed grasses. The land use/cover types for the project area would be described as urban, range herbaceous, range shrub, range mix, water riverine, and wetland non-forest.

88. **WETLANDS.** There are no wetlands directly on the project area, but they can be found at the extreme ends of Oakwood Beach. Due to the oligohaline water characteristics (0.5 to 5.0 ppt) the coastal wetlands of this area are characterized by the presence of salt-tolerant species. The two dominant plants in these wetlands are the common reed (*Phragmites australis*) and cord grass (*Spartina alterniflora*). The common reed is evidence of diked or otherwise altered marshlands. Other common plants in the marshes are wild rice (*Zizania aquatica*), cattail (*Typha* sp.), salt hay (*Spartina patens*), spikegrass (*Distichlis spicata*), groundsel bush (*Baccharis halimifolia*), and marsh elder (*Iva frutescens*). The wetlands surrounding the project area are designated as priority wetlands by the Department of the Interior under the Emergency Wetlands Resources Act of 1986 (100 Stat. 3582) because of the national ecological significance of these wetlands.

89. **WATER QUALITY.** The Delaware River Basin Commission (DRBC), a four-state Federal compact agency, is responsible for managing the water resources within the entire Delaware River Basin. Pursuant to Section 305(b) of the Clean Water Act, the DRBC prepares biennial assessments of water quality for the Delaware River. In order to more accurately characterize the entire river, the DRBC has divided the area into six water quality zones. The study area falls into zone five, which extends from the Pennsylvania-Delaware-New Jersey border at Marcus Hook to Liston Point, Delaware. The information provided in this section was obtained from the DRBC's 1988 and 1989 Delaware River water quality assessment reports. Table 7 provides the 1988-1989 water quality data collected by the DRBC for the two closest stations to the study site. The DRBC characterizes water quality in this portion of the Delaware estuary as fair to good. This portion of the estuary is a transition zone between urbanized upstream areas and rural Delaware Bay. Minimum dissolved oxygen (DO) levels for the summer seasons did not meet DRBC standards, but summer averages were consistently above DRBC standards. pH levels were generally within the range of DRBC standards. Nutrient levels appear to be high enough to support algal blooms, but chlorophyll A concentrations are low. Bacteria levels remained well below the DRBC and USEPA recommended criteria for primary contact recreation during the summer seasons of 1988 and 1989.

90. This zone is the transitional area between the freshwater habitats upstream and more saline areas downstream. The salinity ranges from 0.5 to 5.0 ppt. The largest salinity variation occurs around, and below the C&D Canal, this limits the organisms that can inhabit this region to a relatively few hearty species (Sutton, 1996).

TABLE 7. SUMMARY OF 1988 AND 1989 WATER QUALITY DATA COLLECTED BY THE DELAWARE RIVER BASIN COMMISSION FOR WATER QUALITY ZONE 5

Closest Sites to Oakwood Beach		Dissolved Oxygen (mg/l)	Fecal Coliform M-TEC (#/100 ml)	E. Coli (#/100 ml)	Enterococci (#/100 ml)	Total Phosphorus (mg/l)	Dissolved Ortho-Phosphate (mg/l)	Nitrate Nitrogen (mg/l)	Ammonia Nitrogen (mg/l)	pH	Alkalinity (mg/l)	BOD_5
Pea Patch Island RM 61	Avg	7.5	43	33	9	0.15	.05	1.85	0.37	7.7	44.8	<2.4
	Max	12.7	166	146	46	0.27	.08	2.38	1.38	8.7	67	3.0
	Min	4.3	7	4	1	0.08	.02	1.30	<0.05	6.5	31	<2.4
	# of samples	35	38	38	38	35	10	35	45	35	35	
Reedy Island RM 55	Avg	8.2	19	15	7	0.14	0.05	1.69	0.26	7.6	49.9	<2.4
	Max	12	220	200	38	0.32	0.08	2.50	0.94	8.4	70	2.7
	Min	6	4	2	1	0.02	<0.02	1.27	<0.05	6.5	31	<2.4
	# of samples	36	38	38	38	36	10	36	46	34	36	

91. **FINFISH.** The finfish population of the Delaware Estuary is extensive and diverse, because of the large salinity range fresh water and marine species utilize the habitat. Some of the species spend only part of their life cycle in the area, others just migrate through, and finally some spend their whole life in the this part of the estuary. Table 8 is a list of common fish and their scientific names that utilize the estuary between Wilmington and Liston Point, Delaware at some point in their life cycle. Fisheries of the Delaware Estuary have declined since the late 19th century. Factors contributing to this decline include loss of habitat, water quality degradation, toxic substances and fishing pressures. Species of current recreational and commercial importance that can be found near the study site include: weakfish, American shad, white perch, striped bass, windowpane flounder, summer flounder, spot, and Atlantic sturgeon. The State of New Jersey, Department of Environmental Protection, Bureau of Marine Fisheries state that the Oakwood Beach location is a nursery area for many fish species, including striped bass, bluefish (*Pomatomus saltatrix*), silverside, anchovy, spot, shortnose sturgeon (*A. brevirostrum*) and menhaden. Oakwood Beach is also an established juvenile striped bass survey site. The following list summarizes the species that have been found at the site from 1980 to 1995: alewife, American eel, American shad, Atlantic croaker (*Micropogocia undulatus*), Atlantic menhaden, Atlantic needlefish (*Strongylura marina*), Atlantic silverside, banded killifish, bay anchovy , black drum (*Pogania cromis*), blueback herring, bluefish, bluegill sunfish (*Lepomis macrochirus*), brown bullhead, carp, channel catfish, crevalle jack (*Caranx hippos*), gizzard shad (*Dorosoma cepedianum*), harvestfish (*Peprilus alepidotus*), hogchoker, inland silverside (*menidia beryllina*), inshore lizardfish (*Synodus foetens*), mummichog, northern kingfish (*Menticirrhus saxatilis*), northern pipefish (*Syngnathus fuscus*), rough silverside (*Membras martinica*), Spanish mackerel (*Scomberonorus maculatus*), spot, spottail shiner, striped anchovy *(Anchoa hepsetus)*, striped bass, summer flounder, weakfish, and white perch. The eastern mosquito fish *(Gambusia holbrooki)* is an ecologically important fish found in the nearby brackish water marshes.

92. **BENTHOS.** Benthic sampling was not conducted in the proposed borrow areas located in the Delaware River main navigation channel. These proposed borrow areas are disturbed areas that have been dredged on several occasions. In 1993 the Delaware Estuary Program sponsored a study that examined the benthos from the C&D Canal to Trenton (Environmental Consulting Services, Inc., 1993). This study was divided into different salinity zones defined by DRBC water quality regions. The study's downstream most zone is part of DRBC's zone 5, and ends at the C&D Canal. The end of the sampling area is approximately 4 miles upstream of the proposed Reedy Island range borrow area for the Oakwood Beach project. The study also divided the samples into three depth strata; intertidal, shallow/intermediate, and the navigational channel.

93. For all zones the shallow/intermediate and the navigational channel had similar mean densities and biomasses, and were both higher than the figures for the intertidal region. Refer to Table 9. The Shannons's Diversity and Pielous's Evenness are similar for all depth categories, in all zones.

TABLE 8: COMMON FISH SPECIES THAT UTILIZE THE ESTUARY BETWEEN WILMINGTON AND LISTON POINT, DELAWARE.				
Species	Common Residence	Migrate Anadromous or Catadromous	Spawn in Area	Nursery in Area
Atlantic sturgeon *Acipenser oxyrhnchus*		Anadromous (spring)	March - May	?
American eel *Anquilla rostrata*		Catadromous (adults in fall)		Feb. - April
Blueback herring *Alosa aestivalis*		Anadromous (Mar. - May)		late April - Nov.
Alewife *Alosa pseudoharengus*		Anadromous (Mar. - May)		April - Nov.
American shad *Alosa sapidissima*		Anadromous (Mar. - May)		
Atlantic menhaden *Brevoortia tyrannus*				summer - early fall
Bay anchovy *Anchoa mitchilli*	year round		May - Sept.	May - Nov.
Carp *Cyprinus carpio*	year round			May - fall
Silvery minnow *Hybognathus nuchalis*	year round			
Spottail shiner *Notropis hudsonius*				April - fall
White catfish *Ictalurus catus*	year round			May - fall
Brown bullhead *Ictalurus nebulosus*	year round			
Channel catfish *Ictalurus punctatus*	year round			
Banded killifish *Fundulus diaphanus*	year round			
Mummichog *Fundulus heteroclitus*	year round		April - Sept.	May - Dec.

TABLE 8 (CONTINUED): COMMON FISH SPECIES THAT UTILIZE THE ESTUARY BETWEEN WILMINGTON AND LISTON POINT, DELAWARE.				
Species	Common Residence	Migrate Anadromous or Catadromous	Spawn in Area	Nursery in Area
Atlantic silverside *Menidia menidia*	year round		April - Aug.	
White perch *Monroe americana*	winter			April. - Oct.
Striped Bass *Monroe Saxatilis*	year round		Early April -Early July	Early April - Fall
Weakfish *Cynoscion regalis*				mid May - Fall
Spot *Leiostomus xanthurus*	year round			June - Dec.
Summer flounder *Paralichtys dentatus*				fall - spring
Windowpane flounder *Scophthalumus aquosus*	year round		late April - Dec.	late summer - fall
Hogchoker *Trinactes maculatus*	year round		May - Aug.	May - fall

TABLE 9
MEAN DENSITY AND MEAN BIOMASS FOR ALL ZONES

All Zones	Intertidal	Shallow/ Intermediate	Navigational Channel
Total Mean Density (n/m^2)	1486.2	3744.8	2888.5
Total Mean Biomass (g/m^2)	1.1258	18.1005	15.5750
Shannons's Diversity	2.5400	2.6702	2.3746
Pielous's Evenness	0.6591	0.5712	0.5783

94. In Zone 5 the dominant taxa in order of decreasing abundance were polychaetes, bivalves, oligochaetes, isopods, and amphipods accounting for over 96% of the total mean biomass. The total mean density (n/m^2) for Zone 5 was 1352.9, while the total mean biomass (g/m^2) was 4.6374. The Shannons's Diversity and Pielous's Evenness are similar for all depth categories in Zone 5. Refer to Table 10.

TABLE 10
SHANNONS'S DIVERSITY AND PIELOUS'S EVENNESS FOR ZONE 5

Zone 5	Overall	Intertidal	Shallow/ Intermediate	Navigational Channel
Shannons's Diversity	2.3875	2.6528	2.6855	1.9936
Pielous's Evenness	0.5919	0.7169	0.5648	0.4877

95. There has been a loss of sandy substrate along the project site. The clay layer has been exposed. This clay layer is a less suitable habitat for many benthic species.

96. **SHELLFISH.** The New Jersey, Bureau of Marine Fisheries states that the Oakwood Beach area is important to juvenile and adult blue crabs (*Calinectes sapidus*), and that there is a sizeable commercial fishery for blue crabs at Oakwood Beach.

97. In the Delaware Estuary, copepods provide the major food for developing fishes, including the larvae stage of economically important species. The following copepods are known to tolerate oligohaline waters and are found in abundance around Oakwood Beach: *Halicyclops fosteri*, *Eurytemora affinis*, *Acaryia tonsa*, *A. hudsonica*, and *Pseudodiaptomus pelagicus*. Another important food item for juvenile fish are mysid shrimp. The mysid shrimp (*Neomysis americana*) is omnivorous, consuming algae, plankton, and plant detritus. Other ecologically important crustaceans that can be found in the surrounding waters are grass shrimp (*Palaemonetes* spp.), and fiddler crabs (*Uca minax*, *U. pugnax*, and *U. pugilator*).

98. The wedge rangia (*Rangia cuneata*) is an important bivalve filter feeder in soft bottom areas with oligohaline waters. The coffee-bean snail (*Melampus bidentatus*) serves as a detrital/algal grazer in the marsh.

99. **WILDLIFE.** Due to the developed nature of the project site, most of the wildlife that can be found in the area will either be transient in nature or very adaptable to human intervention. Table 11 shows the faunal species that might be found at or around the project site.

100. **THREATENED AND ENDANGERED SPECIES.** The U.S. Fish and Wildlife Service states, with exception for the occasional transient species bald eagle (Haliaeetus leucocephalus) and peregrine falcon (Falco peregrinus), no Federally listed or proposed threatened or endangered species under their jurisdiction are known to exist in the project area. According to Service records, the diamondback terrapin (Malaclemys terrapin terrapin), a species of special concern, occurs within the vicinity of the study area. Other Federally endangered and threatened species that frequent Delaware Bay include several aquatic species not known to breed within the bay.

101. The National Marine Fisheries Service has jurisdiction over the endangered shortnose sturgeon (Acipenser brevirostrum), Kemp's Ridley turtle (Lepidochelys kempii), hawksbill turtle (Eretmochelys imbricata), loggerhead turtle (Caretta caretta) and green turtle (Chelonia mydas). The shortnose sturgeon has been found throughout the estuary though spawning is thought to be limited to areas well upstream from the project area. The sea turtles are known to use the estuary as far upriver as the Delaware Memorial bridge during the summer.

102. Some marine mammals may be classified as threatened or endangered species, but all fall under the jurisdiction of the Marine Mammal Protection Act. The marine mammal species that are commonly encountered in the Delaware Estuary are bottlenose dolphin (Tursiops truncatus), harbor porpoise (Phocoena phocoena), humpback whale (Megatera novaeangliae), harbor seal (Phoca vitulina concolor), and gray seal (Halichooerus grypus). Species not commonly sighted but which may incidentally utilize the estuary are pygmy sperm whale (Kogia breviceps), long-finned pilot whale (Globicephala melaena), fin whale (Balaenoptera physalus), northern right whale (Eubalaena glacialis), harp seal (Cystophora cristata), and ringed seal (Poca hispida).

103. **VISUAL.** The shore protection structures along Oakwood Beach range in size, shape, height and material. There are concrete walls, timber or steel bulkheads, stone revetment, concrete rubble, random stone and concrete fill, groins, gabions, and miscellaneous materials including tire breakwaters and open beach. Some of the structures have beaches in front of them others do not. In some areas the underlying clay layer shows through. Due to the variety of shore protection structures, the shoreline is visually haphazard. At low tide a mud flat is visible and is known for shorebird viewing.

TABLE 11
WILDLIFE IN VICINITY OF OAKWOOD BEACH

Amphibians			
American toad	*Bufo americanus*	leopard frog	*Rana pipens*
Reptiles			
Common snapping turtle	*Chelydra serpentine*	eastern garter snake	*Thamnophi sirtalis*
Smooth green snake	*Opheodrys vernalis*	Kemp's Ridley turtle	*Lepidochelys kempii*
Hawksbill turtle	*Eretmochelys imbricata*	loggerhead turtle	*Caretta caretta*
Dimondback terrapin	*Malaclemys terrapin terrapin*	green turtle	*Chelonia mydas*
Birds			
Peregine falcon	*Falco perginus*	osprey	*Pandion halieatus*
bald eagle	*Haliaeetus leucocephalus*	northern harrier	*Circus cyaneus*
American bittern	*Botaurus lentiginosus*	least bittern	*Ixobrychus exilis*
great blue heron	*Ardea herodias*	little blue heron	*Egretta caerulea*
tri-colored heron	*Egretta tricolor*	green-back heron	*Butorides stratus*
black-crowned night heron	*Nycticorax nyticorax*	snowy egret	*Egretta thula*
Yellow-crowned night heron	*Nycticorax violaceus*	great egret	*Casmerodius albus*
Glossy egret	*Plegadis falcinellus*	black duck	*Anas rubripes*
Mallard	*Anas platyrhynchos*	green-winged teal	*Anas crecca*
king rail	*Rallus elegans*	black rail	*Laterallus jamaicensis*
Northern clapper rail	*Rallus longerostris crepitans*	marsh wren	*Cistothorus palustris*
Coastal plain swamp sparrow	*Melospiza georgiana*		
Mammals			
Raccoon	*Procyon lotor*	eastern grey squirrel	*Sciurus carolinensis*
Striped skunk	*Mephitis mephitis*	woodchuck	*Marmotoa monax*
white-footed mouse	*Peromyscus leucopus*	house mouse	*Mus musculus*
Norway rat	*Rattus norvegicus*	eastern cottontail	*Sylvilagus floridanus*
marsh rice rat	*Oryzomys palustris*	muskrat	*Ondatra zibethicus*

104. **AIR QUALITY AND NOISE LEVEL.** The project area is rural in nature. The air quality is good since there are no major sources of emissions in the area. Noise at the project site is very low and is not disturbing to animals or human users of the area.

105. **RECREATION.** The recreational resources of the area are bird watching, fishing, and crabbing. There is limited recreational use of the project area by nonresidents due to the location and lack of public access.

CULTURAL SETTING

106. In preparing the Final Feasibility Report and Integrated Environmental Assessment, the Corps has consulted with the New Jersey State Historic Preservation Office (NJSHPO), the Delaware State Historic Preservation Office (DESHPO) and other interested parties to identify and evaluate historic properties in order to fulfill our responsibilities under the National Historic Preservation Act of 1966, as amended, and its implementing regulations, 36 CFR Part 800. As part of this work, the Philadelphia District conducted an evaluation of existing site conditions and previous cultural resources investigations to determine the potential for significant cultural resources in the Oakwood Beach project area. The results of this review indicate that the likelihood for intact and undisturbed cultural resources along the project shoreline and in the proposed Delaware River main channel borrow area is extremely minimal.

107. The Oakwood Beach study area is located along the eastern shore of the Delaware River in an area that became an important regional center of maritime activity during the seventeenth, eighteenth and nineteenth centuries. Significant historic maritime and military sites are located within four miles of the project area. These include the approximate location of Fort Elfsborg (Elsinboro Point), Fort Dupont (Delaware City), Fort Delaware (Pea Patch Island) and Fort Mott (Finns Point), the entrance to the Chesapeake and Delaware Canal at Delaware City, the Ice Harbors at Port Penn and Reedy Island, and Salem Cove -- the site of intense nineteenth century shell fishing activity.

108. Historic maritime activity within the project area was almost exclusively transient as most commercial vessels were passing the area in route to northern ports such as Wilmington and Philadelphia, or south along coastal networks linking the Delaware River ports and New York with other ports from Maine to Central and South America. Over the years, many types of ships and vessels have wrecked while enroute up and down the river. Adverse river conditions, storms, treacherous northeast winds and swift tidal currents caused the loss of dozens of documented sailing vessels, steamships, barges, tugs and large modern ships in the Delaware River. A variety of potential submerged cultural resource types in the project vicinity could date from the first half of the seventeenth century through the Second World War.

109. There are no National Register of Historic Places properties located within the project boundaries. Numerous residential structures dating from roughly the 1920's to the present are located along the shoreline landward of the existing shore protection structures. The project area shoreline, which lies riverward of the existing shore protection structures, has never been systematically investigated for cultural resources. However, numerous cultural resources investigations have been conducted within the immediate project vicinity and were conducted in

association with the proposed deepening of the Delaware River Main Channel (Cox, 1986 and 1988; Dolan Research, Inc. and Hunter Research, Inc. 1995 and 1995a; GAI Consultants Inc., 1983; Gilbert/Commonwealth, 1979; Heite and Heite 1986). The proposed project borrow area, which is located in the existing Delaware River Channel between River Mile 252+000 and 262+000, was investigated for submerged cultural resources as part of the proposed Delaware River Main Channel Deepening project (Cox, 1995). Researchers did not identify any significant cultural resources in the proposed project borrow area.

SHORE PROTECTION INVENTORY

110. **GENERAL.** In August of 1996, a site inspection of the shore protection structures along the existing beachfront was conducted. All of the shore protection structures are privately owned and constructed. The structures range in size, shape, height, and material. Some structures extend more bayward than others. The structures were constructed at various times, some in the last few years, while others were constructed over 50 years ago. Many of these structures were not engineeringly designed to include filter material and toe protection. The following paragraphs provide a summation of the coastal structures present on Oakwood Beach. Refer to Figures 9 through 12 as well as the Engineering Technical Appendix (Appendix B) for representative photographs of the structures.

111. **CONCRETE WALLS.** There are numerous variations of concrete walls, ranging from sloped walls to stepped walls to vertical walls. There are also walls that are a combination of sloped and stepped. The condition of these walls range from good to poor. There are a few walls that were recently constructed within the last few years.

112. **BULKHEADS.**

Timber. There are a number of timber bulkheads located along Oakwood Beach. Some of these bulkheads are made up of only timber piles or only timber sheeting, while others have a combination of the two. The condition of the timber bulkheads ranges from good to severely deteriorated.

Steel. There are two steel sheet pile bulkheads along Oakwood Beach. These bulkheads are considered to be in good condition.

Shore Guard Vinyl Sheetpile. Ten contiguous Shore Guard vinyl sheet pile bulkheads were recently installed by local residents in the Fall of 1996. These bulkheads are in very good condition. Previously this area had been protected by a natural beach.

113. **REVETMENT.**

Stone. There are a few locations that have stone revetment placed on the beach. The stone revetment is in good condition and seems to be providing adequate protection.

Concrete Rubble. There are numerous locations that have concrete rubble placed on the beach and/or on the land. The rubble is made up of various shapes and sizes and consists mainly of

Photo #1: Sloped concrete wall fronted by timber bulkhead (southern 1/3 of beach).

Photo #2: Stone revetment (southern 1/3 of beach).

FIGURE 9

Photo #3: Timber bulkhead (middle 1/3 of beach).

Photo #4: Sloped concrete walls (middle 1/3 of beach).

FIGURE 10

Photo #5: Sloped concrete walls (middle 1/3 of beach).

Photo #6: Natural beach area in July 1996 (middle 1/3 of beach).

FIGURE 11

Photo #7: Timber bulkhead (middle 1/3 of beach).

Photo #8: Natural beach area in November 1996 protected by Shore Guard vinyl sheetpile bulkhead (middle 1/3 of beach).

FIGURE 12

broken-up concrete slabs. This concrete rubble revetment seems to be providing some degree of protection, however, the long term reliability of these structures is poor.

114. **RANDOM STONE AND CONCRETE FILL.** There are a number of areas that have stone and broken-up concrete, of different shapes and sizes, randomly placed on the beach. This fill provides minimal protection in the areas where it is located.

115. **GROINS.** There are a few wooden groins existing along Oakwood Beach. These groins are in poor condition and appear not to be functioning.

116. **GABIONS.** There is one location on Oakwood Beach that has stone and concrete rubble filled gabions. These gabions are located in front of an existing concrete rubble revetment, and a timber bulkhead. These gabions are in fair condition and, combined with the existing revetment and bulkhead, are providing some protection.

117. **MISCELLANEOUS.** There are a few locations that have interlocking steel sheet piling placed in front of an existing concrete wall. This steel sheeting protrudes above the existing beach by approximately 6 inches, and goes down 5 to 6 feet. This type of structure is being used to provide toe protection to the existing structure. The construction of this sheeting will prevent any further undermining damage to existing structures.

118. Most of the houses along Oakwood Beach have a combination of the previously mentioned shore protection structures. As an example, sloped concrete walls with timber bulkhead or revetment in front, or stepped concrete walls with random stone and concrete fill in front. The condition of these combined structures range from good to poor. In addition, some properties have no shore protection structures at all, but have a natural beach.

HYDRAULIC SETTING

119. **CLIMATE.** The study area is situated in the mid-Atlantic temperate zone. The climate of Delaware Bay is moderated somewhat by its proximity to the Atlantic Ocean. In the summer, weather is relatively constant with uniform warm temperatures, high humidity and low windspeeds, but there may also be frequent unstable showers and thunderstorms. Hurricane season extends from June to October. In the winter, storms may be accompanied by strong gusty winds and rain or snow. Large amounts of ice form in the Delaware River and Bay during severe winters. Ice pressures and impacts by floe ice can damage shore protection structures. Warm spells, sometimes with abundant rain, alternate with cool, dry weather in the spring. The mean annual precipitation totals at Wilmington, Delaware, about 10 miles north of Oakwood Beach, is 41.4 inches. The mean annual temperature at Wilmington is 54.2 degrees Fahrenheit. Precipitation is well distributed throughout the year, but somewhat heavier during July and August. Temporary droughts or periods of subnormal rainfall, however, are not uncommon for the area.

120. **WIND.** Prevailing wind direction reported from different weather stations within the study region vary from southwest to northwest. At Philadelphia, the prevailing wind direction for the summer months is from the southwest, while winds from the northwest prevail during the

winter. Wind data from the Dover (Delaware) Air Force Base show that the most frequently occurring winds blow from the northwest. Monthly data show the wind regime varies from season to season, with stronger winter winds prevailing from the northwest and summer winds prevailing from the southwest. The dominant winds (highest velocity) are from the northeast. Data from the U.S. Weather Bureau Breakwater Harbor station (Lewes, Delaware) show that southwest is the prevailing wind direction, but winds from other directions occur nearly as often. Gale force winds, those over 30 miles per hour, blow most often from the northwest and winds of more than 60 miles per hour have originated from seven of the eight principal compass directions.

121. **WAVES.** There are no known quantitative wave data, either observed or hindcast, for the immediate vicinity of the study area. The study area shoreline is exposed to maximum fetches of about 7 miles from the northwest, and about 8 miles from the south-southwest. Because of the orientation of the study area shoreline with respect to the configuration of the Delaware River, wind from other than these critical directions experience significantly shorter fetches. Winds blowing along the critical directions are capable of producing the largest waves at the Oakwood Beach shoreline. Maximum calculated wave heights at the shoreline, using shallow-water restricted-fetch procedures from the USACE ACES (Automated Coastal Engineering System) program, are on the order of 3 to 4 feet for windspeeds of 50 to 60 miles per hour along the directions of the critical fetches.

122. **TIDES.** Tides in the study area are semi-diurnal; i.e. two high waters and two low waters occur in a period of 24 hours and 50 minutes. In this area, successive normal high waters differ by less than a foot in elevation. The same is also true of successive low waters.

123. The National Ocean Service (NOS) presently operates five tide gages in the Delaware estuary. The gages are located in Breakwater Harbor (DE), Cape May Canal Entrance (NJ), Reedy Point (DE), Philadelphia (PA), and Trenton (NJ). The Oakwood Beach study area is located on the east shore of the Delaware River, directly across from the tide gage located at Reedy Point at the entrance to the C&D Canal. Table 12 lists the mean high water and mean low water elevations relative to NAVD88 and NGVD29 for these tide stations. It requires about 7 hours for the high-water phase to propagate from Breakwater Harbor to the head of tide at Trenton, NJ, and 8.5 hours for the low-water phase to travel the same distance.

TABLE 12
TIDAL DATUMS, PERMANENT NOS GAGING LOCATIONS
DELAWARE RIVER AND BAY

Location	Mean High Water ft NAVD88/(ft NGVD29)	Mean Low Water ft NAVD88/(ft NGVD29)
Breakwater Harbor	1.4/(2.2)	-2.8/(-2.0)
Cape May Canal	1.8/(3.1)	-3.1/(-1.8)
Reedy Point	2.4/(3.2)	-3.1/(-2.3)
Philadelphia	2.9/(4.0)	-3.2/(-2.2)
Trenton	4.2/(5.3)	-3.9/(-2.8)

124. In addition to the five recording tide stations, NOAA also publishes tidal parameters for secondary tide stations, including the mouth of the Salem River adjacent to Oakwood Beach. NOAA reports a mean tide range of 5.5 feet, and a spring range of 6.0 feet for this location.

125. **CURRENTS.** Tidal currents play an important role in transport processes within the estuary, as they are the principal mechanism by which ocean-derived salinity is transported and distributed in the system. Currents represent the horizontal motion of water in the estuary, as distinct from the vertical motion of the water surface due to the tide. Currents in the Delaware estuary largely result from water surface differentials caused by the tide. When the tide is high at the bay mouth, locations upstream, such as Oakwood Beach, are experiencing lower tidal water levels. As a result of this head difference, a tidal current is induced in the direction from higher to lower water levels. The current corresponding to high tide at the mouth flows upstream and is referred to as the flood tidal current. Likewise, the current induced by low tide at the mouth flows downstream, and is referred to as ebb. Because tidal currents are driven by the tides, the tidal currents also exhibit a semidiurnal periodicity; an average of 12.4 hours is required to go through a full tidal current cycle, from slack before flood, through flood maximum, slack before ebb, and ebb maximum, before returning to slack before flood.

126. The National Ocean Service (NOS) conducted a comprehensive survey of tides and currents in the Delaware Estuary between 1984 and 1985. This effort included measurements from the head of tide at Trenton downstream to the bay mouth and out onto adjacent portions of the continental shelf. The results of this measurement program were utilized in a subsequent NOS model investigation to calculate tidal currents over the entire estuary system on a model grid of approximately 0.5 nautical miles, under mean tidal conditions. Because this was a two-dimensional model, the calculated tidal current velocities represent the average velocity over the water column at any point.

127. The model results were synthesized into an NOS report titled "Delaware River and Bay - Tidal Circulation and Water Level Forecast Atlas" (1987.) This report graphically depicts the spatial distribution of currents over the entire estuary at one-hour intervals beginning with the time of high tide at Breakwater Harbor (Lewes, DE). The results show that the highest velocities typically occur near the longitudinal axis of the estuary, where the navigation channel is located, and at locations where significant localized constrictions of the estuary shoreline occur. For mean tide conditions, typical mid-channel peak velocities during the flood phase range from 1 to 1.5 knots, or from about 1.7 to 2.5 feet per second, with comparable values indicated for peak ebb conditions. Locations within the estuary with localized constrictions, such as at Artificial Island (about 3 miles south of Oakwood Beach) can experience mean maximum flood or ebb velocities which may exceed 2 knots, or 3.4 feet per second. The typical values cited here can be modified, either increased or decreased, by a number of factors. These factors include spring (or other astronomic effect) tides, wind speed, direction and duration, and freshwater discharges.

128. Additional current data specific to the Oakwood Beach study area were developed in 1996 for a 2-D hydraulic model study of tidal currents for the Salem River navigation project. This study showed that Delaware River currents immediately offshore of Oakwood Beach typically attain speeds of 1 to 1.5 feet per second at ebb or flood maximum under ordinary tidal conditions. The study also demonstrated that tidal currents in the Salem Cove channel, located

about 2,000 feet offshore of the Oakwood Beach shoreline, flowed essentially parallel to the shoreline, with northeasterly flow (toward the mouth of Salem River) when tide in the Delaware River was rising, and southwesterly flow when tide in the Delaware was falling. The model investigation also showed a progressive decrease in current speed, at any phase of the tidal cycle, from the Salem Cove channel to the Oakwood Beach shoreline.

129. **SEDIMENT TRANSPORT.** The study area is situated in a reach of the Delaware Estuary which is transitional between the broad, open-water conditions of Delaware Bay to the south, and the more confined geometry typical of Delaware River to the north. In this regard, the study area is subject to a range of forcing functions which may contribute to sediment transport at the shoreline. For example, tidal currents flow past the shoreline continuously, except for four brief periods each tidal day when the current direction reverses and slack tide occurs. Additionally, depending on wind direction and speed, the Oakwood Beach shoreline is exposed to over-water fetches of between 2.5 and 8 miles, from northeast counter-clockwise to south-southwest, which generate waves impacting the shoreline. There are also ship-generated waves which originate from vessels transiting the main navigation channel of the Delaware River, the centerline of which is about 3,000 feet from the Oakwood Beach shoreline at its closest.

130. The sediment regime at Oakwood Beach is characterized by a relatively small lens of fine to coarse sand along portions of the study area shoreline. Underlying this sand is a much more extensive (laterally and vertically) layer of dense clay which is resistant to erosion and thus not subject to sediment transport considerations.

131. The Oakwood Beach study area includes a total of about 9,000 lineal feet of developed shoreline. There is a non-uniform distribution of sand along this shoreline. The southern 4,000 lineal feet of this frontage has essentially no existing sandy beach above the plane of mean low water. This reach consists of upland property fronted by a continuous line of heterogeneous bulkheads and seawalls constructed of a variety of materials. Immediately north of this area is a zone about 2,000 feet long with a sand beach of variable cross-shore and vertical dimensions. At its widest, this beach is about 100 feet wide between the profile crest and the plane of MLW, and about 40 to 50 feet wide between the profile crest and the plane of MHW. The beach width tapers to "zero" at its southern and northern limits. This zone contains a volume of sand estimated to be on the order of 30,000 cubic yards, perched atop the underlying clay layer. North of the "beach" zone is a second reach, about 3,000 feet long, with little or no sand beach above the plane of MLW. Most of this zone is fronted by a discontinuous series of bulkheads, revetments, and seawalls, separated by several small pockets of sandy beach.

132. Sediment transport within the study area is driven by a combination of tidal currents and wind-generated waves. There is a long but poorly defined history of sediment deficit along Oakwood Beach, with reported problems of little or no beach for portions of the shoreline over the past five decades or more. Reports by current residents of the study area suggest that there is a net northward transport of sandy sediment, and a pattern of small seasonal changes, with onshore transport during the summer, and offshore transport in the winter. Residents also indicate that the southern end of the "beach" zone has been migrating northward at a rate on the order of 100 lineal feet per year for the past 5 to 10 years. This behavior is consistent with two principal fetch directions relative to the shoreline alignment. Wind from the northwest fetch

direction generates waves which approach the shoreline nearly normal to the shore. Further, there are several dredged material disposal islands and shoals about 2,000 to 2,500 feet offshore of the subject shoreline which intercept some of the wave energy from the northwest. Wind from the south-southwest fetch direction generates waves which approach the shoreline obliquely and would lead to northward transport along Oakwood Beach.

133. **STORMS AND STORM SURGE.** Elevated storm water levels can be caused by tropical (hurricanes) or by extra-tropical (northeasters) storms. Both can cause beach erosion and damage to coastal structures. Hurricanes are associated with extreme low pressure systems and can result in large increases in water level. A hurricane can cause significant flooding and damage when the elevated water levels are coincident with high tides and waves. Northeasters cause their damage principally through wave attack of the shoreline and adjacent structures. They can be as damaging or more damaging than hurricanes depending on their duration, which can extend over several tidal cycles.

134. Table 13 presents the Delaware River and Bay stage-frequency relationship at the location of Oakwood Beach, NJ. It is based on the empirical stage-frequency analysis conducted for the entire tidal Delaware River and Bay in 1981 by the Philadelphia District. The original stage data are referenced to NGVD. The table below presents the stage values in NGVD, and also converted to NAVD, using the 0.94 foot difference reported by COPRSCON for the latitude and longitude of the center of the Oakwood Beach shoreline. (Note: the plane of 0.0 NAVD lies above the plane of 0.0 NGVD by 0.94 feet at Oakwood Beach.) For further reference in this study, only NAVD elevations will be used. Table 13 is presented in both datums for purposes of referencing the stage frequency from the source study in its original datum (NGVD).

TABLE 13
STUDY AREA STAGE-FREQUENCY

Event (yrs)	Annual Probability of Exceedance	Water Surface Elevation (ft, NGVD)	Water Surface Elevation (ft, NAVD)
2	0.500	5.9	5.0
5	0.200	6.5	5.6
10	0.100	7.0	6.1
20	0.050	7.8	6.9
50	0.020	8.8	7.9
100	0.010	9.6	8.7
200	0.005	10.4	9.5
500	0.002	11.5	10.6

REAL ESTATE

135. The study area is fairly densely developed in the immediate area of the coastline. All parcels are privately-owned with no public access to the shoreline in the project area. The properties are residential, with the exception of the Country Club of Salem, and approximately

90% of the parcels have houses on them. Approximately 75% of the beachfront properties are occupied by their owners as primary residences.

136. Submerged lands below the Mean High Water Line (MHWL) of the Delaware River to the Mean Low Water Line (MLWL) are owned by the State of New Jersey and managed by the NJDEP Bureau of Tidelands Management. The MLWL demarcates the state boundary between New Jersey and Delaware with Delaware owning the submerged land from the MLWL on the New Jersey shoreline to the MHWL on the shoreline of Delaware.

WITHOUT PROJECT CONDITIONS

WITHOUT PROJECT HYDRAULIC ANALYSIS

137. **HISTORIC SHORELINE EROSION ANALYSIS.** The shoreline history of much of the Oakwood Beach study area has been characterized by narrow beach widths and a small background erosion trend for about the last century. Topographic maps, nautical charts, and aerial photographs were reviewed in an attempt to quantify the study area erosion rates. A review of this shoreline position information reveals that there have been periods of small accretion interspersed with periods of small erosion. The overall condition at Oakwood Beach has involved less than 100 feet of shoreline retreat from the date of the earliest mapped shoreline (1843) to the most recent (1996), for an average long-term erosion rate of less than one foot per year.

138. Although the background erosion rate for Oakwood Beach is small compared to other sites on Delaware Bay and the Atlantic Ocean coast, the relatively narrow, sandy barrier strip, combined with the location of the bulkheads and seawalls protecting residential structures, has led to the present condition in which little or no beach width exists on the bay side of many of the structures. Even the small values of long-term erosion are sufficient to increasingly expose the existing structures to threat of damage or loss during storm conditions.

139. **STORM-INDUCED EROSION ANALYSIS.** The principal damage mechanism for the study area relates to the potential for failure of the bulkheads and seawalls fronting most residential properties followed by the failure of the residential structures themselves. Most of the shore protection structures have been built either on top of or into the surface of the clay layer underlying the study area. There is little or no protective buffer offered by sandy beaches due to the paucity of sand in the study area nearshore.

140. The upper surface of the clay layer is approximately at the elevation of mean lower low water (MLLW). The beach in the southern part of the study area has been completely eroded away, leaving the clay layer at the beach level at the base of the protective structure. Behind the shore protection structures is granular material which supports the residential structures. This granular material is subject to storm-induced erosion. During storm events, exposure of the seawall and bulkhead toes allows upland soil to be displaced, causing washout (erosion) of soil supporting the residential structures behind the walls, and ultimately, damage to or loss of the protection works and residential structures. The upland soils eroded from behind the seawall/bulkheads during storms lie above and are geologically distinct from the clay layer encountered at 0 feet MLLW. Many of the existing protective structures are not founded in the clay layer and therefore are exposed to continual scour and wave damages. Given the critical age and condition of many of the shoreline protective structures, continued periodic exposure to storm waves, currents, and elevated water levels will lead to an accelerated rate of loss and damage to the adjacent upland property and residential structures. Refer to the Problem Identification section for further discussion.

141. Because most of the 133 contiguous segments of bulkheads, seawalls, and other protective measures were planned and constructed independently, and at different times by

individual landowners, it is not practical to attempt to rigorously define the individual damage frequency for each protective structure. Analytical tools such as SBEACH are not appropriate for simulation of without-project storm erosion damages as there is virtually no sandy beach remaining along most of Oakwood Beach. Instead, the District used a team that included a number of experienced civil, structural, and coastal engineers to classify the total population of protective structures into three broad classes of "erosion susceptibility" based on the combined judgment of the team.

142. A subjective analysis of seawall/bulkhead conditions and degree of exposure was conducted to rate the structures in terms of degree of protection under existing conditions. The weakest group of structures was assigned to Category 1 (0-5 year life expectancy beyond the base year), with Category 2 (5-20 year life expectancy beyond the base year) considered intermediate in terms of level of protection, and Category 3 (greater than 20 year life expectancy beyond the base year) considered the structures offering the greatest protection against storm- and erosion-related failure. Table 14 presents the inferred storm event frequency required to cause failure of each of the groups of shore protection structures. Figure 13 shows the shore protection structure failure categories by location.

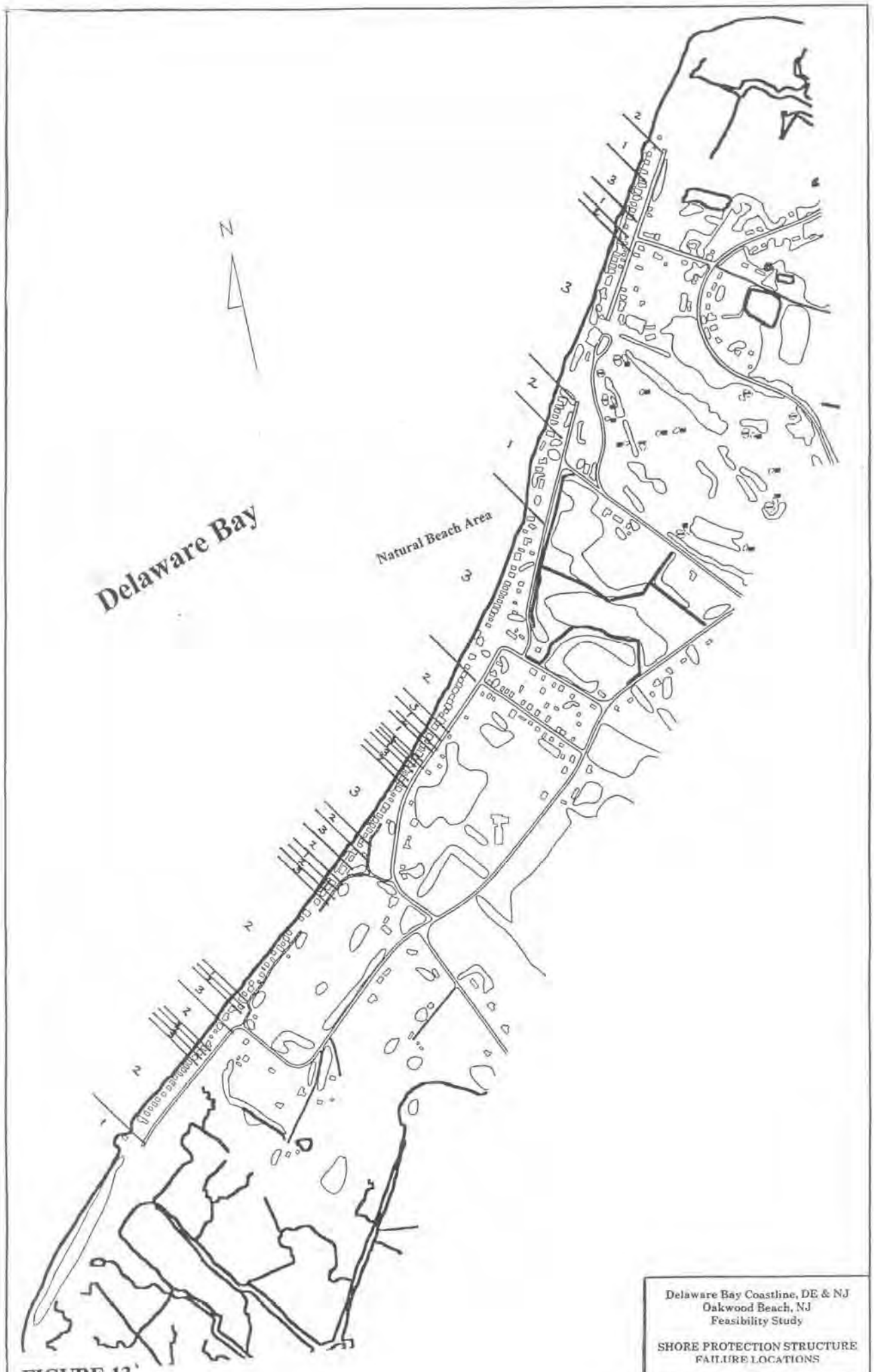
TABLE 14
WITHOUT PROJECT
SHORE PROTECTION STRUCTURE FAILURE CATERGORIES BY FREQUENCY

RETURN PERIOD (yrs)	SHORE PROTECTION STRUCTURE CATEGORIES EXPERIENCING FAILURE (Category 1 fails first, Category 3 last)
2	none fail
5	none fail
10	Category 1
20	Category 1
50	Categories 1 and 2
100	Categories 1, 2, & 3
200	Categories 1, 2, & 3
500	Categories 1, 2, & 3

143. **STORM-INDUCED INUNDATION ANALYSIS.** The potential for inundation damage at Oakwood Beach is determined by the stage-frequency relationship presented previously in the section on "Storms and Storm Surge" (Table 13) and is not repeated here.

WITHOUT PROJECT ECONOMIC ANALYSIS

144. **GENERAL.** The purpose of this section is to describe the information and methods used in the economic analysis of storm damage reduction and erosion protection benefits for the developed area along the Delaware Bay at Oakwood Beach, New Jersey.



Delaware Bay Coastline, DE & NJ
Oakwood Beach, NJ
Feasibility Study

SHORE PROTECTION STRUCTURE
FAILURE LOCATIONS

PHILADELPHIA DISTRICT, CORPS OF ENGINEERS

FIGURE 13

145. **REACH DELINEATION.** The study area was divided into 5 reaches as shown in Figure 14. Reach 1 extends from the southernmost structure to a point approximately 4000 feet northward where a natural beach begins. Reach 1 has essentially no existing sandy beach above the plane of mean low water. This reach consists of upland property fronted by a continuous line of heterogeneous bulkheads and seawalls constructed of a variety of materials. Immediately north of this area is Reach 2, a zone about 1800 feet long, with a sand beach of variable cross-shore and vertical dimensions. The beach width tapers to zero at its southern and northern limits. Approximately, twelve properties in the southern most part of Reach 2 also have some type of shore protection. Reach 3 which extends from the end of the beach zone northward approximately 1000 feet to the end of Slape Avenue, at which point the Country Club of Salem property begins. From this point northward approximately 600 feet is Reach 4, which consists of the Country Club of Salem property. From the end of Reach 4 northward to the northern limit of the study area is Reach 5, which is approximately 1600 feet in length. Reaches 3 through 5 have little or no sand beach above the plane of mean low water. Most of this area is fronted by a discontinuous series of bulkheads, revetments, and seawalls, separated by several small pockets of sandy beach.

146. **ECONOMIC CONDITIONS.** A December 1996 price level, 50 year project life, and a base year of 2002 were used in the economic analysis. Damages were converted to an annual equivalent time basis using a 7.375% discount rate as applicable to public works projects for FY 1997. The "with" and "without" project damages were evaluated at the same price level and discount rate. The benefits were subsequently updated to reflect a March 1998 price level and an FY 1998 discount rate of 7.125%.

147. **STORM DAMAGE METHODOLOGY AND ASSUMPTIONS.** Without project condition damages were calculated for eight frequency storm events (2, 5, 10, 20, 50, 100, 200 and 500 year events) for erosion and inundation damages to residential and commercial structures, as well as for erosion damages to shore protection structures and improved property.

148. **Residential and Commercial Structures.** A structure inventory survey was undertaken to gather data pertaining to the structural characteristics of all residential and commercial structures in the study area. The information was then placed in the Marshall & Swift Residential and Commercial Estimator program, where the structural value was determined through the manipulation of such data as: the number of stories, square footage, quality, basement, garages, etceteras. An example of the input is shown in Table 15. The Marshall & Swift Estimator Program calculates the depreciated structural replacement cost value. The average associated content value of each structure is estimated to be 40% of the structural replacement cost. This estimate is based on interviews with locals as well as through field observations. Interviews with local realtors also confirmed estimated structural replacement costs. Affluence was evaluated and found not to be significant and therefore not claimed.

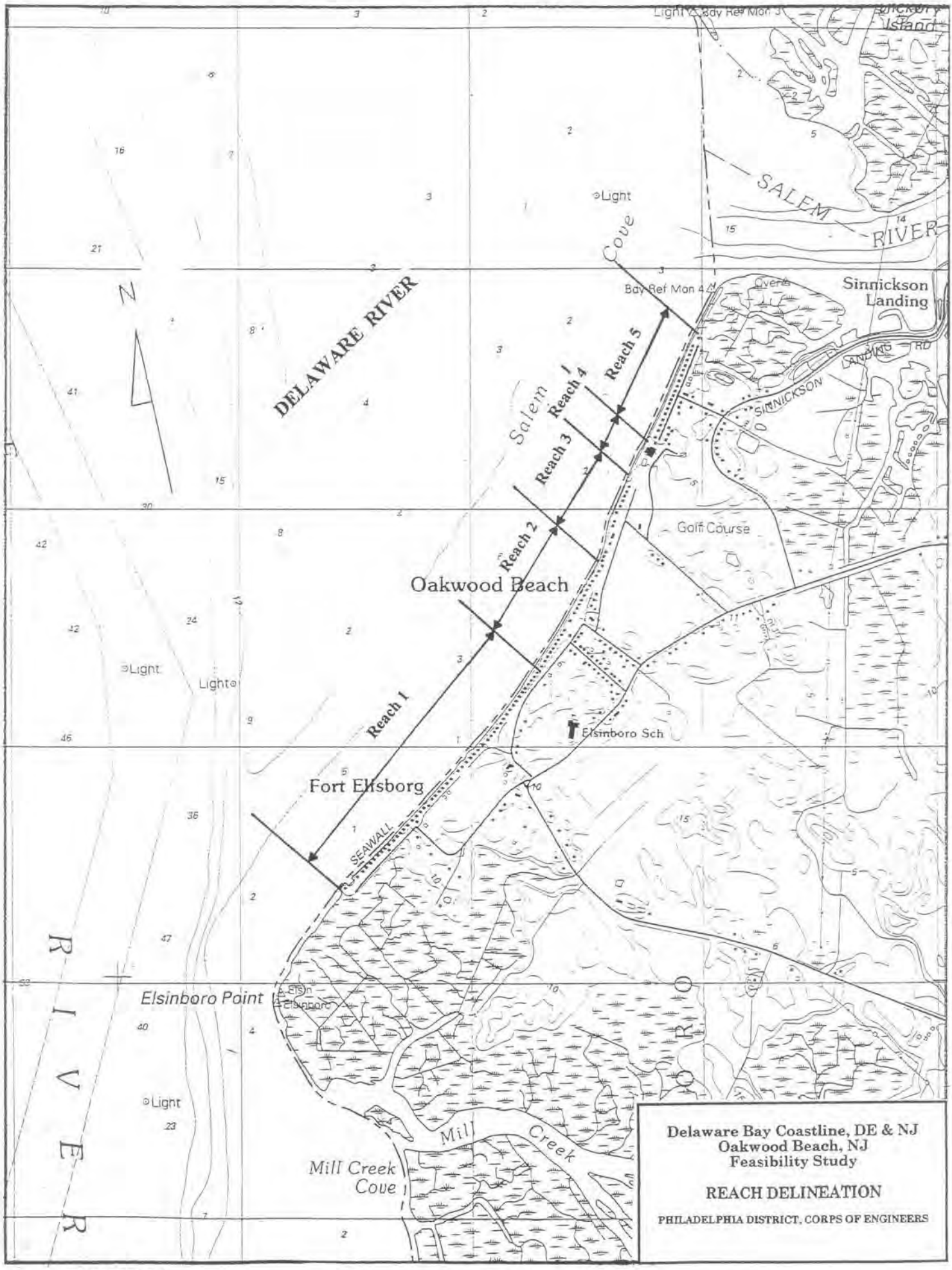

Delaware Bay Coastline, DE & NJ
Oakwood Beach, NJ
Feasibility Study
REACH DELINEATION
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
DELAWARE RIVER
SALEM RIVER
Salem Cove
Sinnickson Landing
Oakwood Beach
Fort Elsborg
Elsinboro Point
Mill Creek
Mill Creek Cove
Golf Course
Elsinboro Sch
SEAWALL
Reach 1
Reach 2
Reach 3
Reach 4
Reach 5
Light
N

FIGURE 14

TABLE 15
MARSHALL & SWIFT ESTIMATOR PROGRAM INPUT DATA

Address: 3001
City, State ZIP: Oakwood Beach, NJ 08079

Floor Area: 1,800 square feet
Quality: Avg
Condition: Avg

Style: Two Story
Heating and Cooling: Warmed and Cooled Air
Exterior Wall: Siding
Roofing: Composition Shingle
Floor Structure: Wood Subfloor
Floor Cover: Standard Allowance
Appliances: Standard Allowance

Replacement Cost	1,800	65.56	118,000

149. Damage calculations for residential and commercial structures were performed using COSTDAM. 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 storm frequency parameters for each reach and an ASCII "Structure" file which contains the database information of each structure as previously described. An excerpt from the structure file is shown in Table 16.

TABLE 16
EXCERPT OF STRUCTURE FILE

1	1002	20.0	40.0	5.5	0.9	58	23S01S02 1-1
2	2004	20.0	45.0	5.6	3.2	106	42S03S04 1-1
3	3016	20.0	50.0	5.2	2.9	101	40S03S04 1-1
4	4076	100.0	120.0	5.5	1.2	188	75S03S04 1-1

Columns 1-3 contain the Reach ID.
Columns 4-9 contain the Structure ID.
Columns 10-19 are blank.
Columns 20-27 contain the distance to the front of the structure.
Columns 28-35 contain the distance to middle of structure.
Columns 36-40 contain the ground elevation.
Columns 41-44 contain distance between the first floor and ground.
Columns 45-53 contain structure replacement cost value.
Columns 54-62 contain content replacement cost value.
Columns 63-65 contain structure depth damage curves.
Columns 66-68 contain content depth damage curves.
Columns 69-70 contain a code to make the structure "active".
Columns 71-72 contain the damage category.

150. COSTDAM initially evaluated a structure for damages caused by erosion followed by damages caused by inundation. Storm waves were not significant in this area and therefore were not evaluated. COSTDAM calculated inundation damages if the water elevation was higher than

the first floor elevation based on Federal Insurance Administration (FIA) depth-damage curves adjusted for increased salt water damagability. To avoid double counting, if damages occurred by more than one mechanism, COSTDAM took the maximum damage of any given mechanism (erosion or inundation) and eliminated the remaining damages from the structure's total damages. Average annual damages were then calculated and aggregated for the study area.

151. Storm-Induced Erosion Damages. COSTDAM evaluated the expected storm erosion damages to the residential and commercial structures caused by a range of storm events. It was assumed that once a shore protection structure failed, approximately 25 feet of land behind the protective works eroded as well. As was previously described in the Without Project Hydraulics section of this report, the shore protection structures were classified into three categories of failure for damage assessment purposes. Category 1 shore protection structures were of the lowest quality and Category 3 shore protection structures were estimated to be of the highest quality. Based on engineering judgement a storm event frequency was associated with the failure of each of the groups of shore protection structures. Refer to Table 14. The assumption of 25 feet of land lost from behind the wall upon failure of the wall is considered reasonable given that erosion of about 10 feet of upland has occurred even without structural failure of the protective works. The analysis assumed that if a structure on a slab foundation had minimum and maximum distances of 10 and 30 feet respectively from the reference line, complete failure of the structure occurred upon failure of the shore protection structure. Based on engineering judgement, it was assumed that if the structure was not on a pile foundation, it was destroyed at the point that the land below the structure was eroded halfway through the structure. If the structure was on piles, erosion needed to retreat entirely through the footprint before the total damage was claimed. Before total failure, for both foundation types, the percent damage claimed was equal to the proportion of erosion under the structure's footprint compared to the total footprint. It should be noted however that there are no structures on piles at Oakwood Beach. The total damages for the residential and commercial structures were calculated by COSTDAM and entered directly into an Excel file to annualize all damages accrued.

152. The assumption that erosion damage claimed is equal to the proportion of erosion under the structure's footprint compared to the total footprint prior to total destruction is an assumption that was made based on engineering judgement. This assumption is used in all shore protection studies in the Philadelphia District as well as other districts throughout the Corps which use the economic model COSTDAM. This assumption is inherent in the model.

153. Storm-Induced Inundation Damages. The percentages of total depreciated replacement costs used to calculate damages by the depth-damage function curves for inundation damages reflect various characteristics of a structure. The depth-damage curves display the percent damaged at various depths relative to the first floor. These depth-damage curves used to estimate the damage of structures were derived from previous studies of saltwater areas and FIA curves. The distinguishing characteristics were construction type (frame, concrete block, or masonry), and the number of stories in a structure as well as the presence of a basement. Refer to Table 17 for a sample depth-damage curve. The stage-frequency data used in the analysis is shown in Table 13.

TABLE 17
SAMPLE DEPTH-DAMAGE CURVE

Residential Structures S03 (2 story, no basement) # of rows (free format) 13 Depth Damage (expressed as a decimal) (free format)		Residential Contents (S04) # of rows (free format) 13 Depth Damage (expressed as a decimal) (free format)	
-2	0	-2	0
-1	.01	-1	0
0	.10	0	.22
1	.24	1	.31
2	.30	2	.40
3	.36	3	.54
4	.39	4	.61
5	.42	5	.67
6	.47	6	.76
7	.49	7	.81
8	.56	8	.88
9	.64	9	.88
10	.67	10	.96

154. **Shore Protection Structures and Improved Property.** Shore protection structure damage and loss of improved property, due to erosion, was also calculated for each reach. Without project damages were evaluated using the Corps of Engineers' Hydrologic Engineering Center's (HEC) Expected Annual Damage (EAD) Computation Program. This program is based on the principle that damages to an individual category or damage categories can be estimated by determining the dollar value of damages for different magnitudes of storm events. The damage mechanism in the study area is attributed to the effects of erosion.

155. Unlike most coastal communities Oakwood Beach does not have a single uniform type of shore protection maintained by the township, but rather individual shore protection structures which are maintained by each property owner. Because these structures are so unique, it was necessary to determine the condition of each of these shore protection structures and place them into one of three categories to make the data more manageable. These categories are based on the life expectancy of the shore protection structures beyond the base year. The categories are Category 1 (0-5 years; fair), Category 2 (5-20 years; average) and Category 3 (>20 years; good). The natural beach section in Reach 3 where the structures are fronted only by the natural beach was classified as Category 3. A damage frequency for each of these categories was determined based upon engineering judgement. Refer to the previously mentioned Table 14 which displays the shore protection structure failure categories by damage frequency. Failure does not begin until the 10 year event for Category 1 structures.

156. The assumption was made that the shore protection structures damaged at Oakwood Beach would be replaced in-kind. Values for the shore protection structures were estimated

using standard engineering criteria. Once damages were calculated for the shore protection structures for the storm events they were placed into EAD to calculate the Expected Annual Damages. An in-kind replacement cost for the mix of shore protection structures is estimated to be $460 per linear foot with an estimated lot size of 50 feet per house.

157. The EAD model was also used to calculate the annual damages to improved property from erosion. The land value was determined by comparing market value of a typical 50' x 100' non-shorefront lot, compared to the cost of filling in the eroded land for reutilization, and using the least expensive of the two values. The cost of filling/restoring the land is based on a typical 50' x 100' lot for the different depths, widths and cubic yards of erosion produced by the storms. The cost of filling/restoring the eroded developed land was determined to be the cheaper of the two, and the cost of fill was prorated for the width of each reach to estimate total damages for the reach. The unit cost of fill was not a fixed value. It decreased with greater quantities eroded, therefore reflecting economies of scale.

158. Loss of landscaping was calculated by estimating the value of landscaping for each reach. Structures were individually placed into two categories of landscaping fair and low. Once the individual structures were assigned a rating the reach received a general rating based on the overall ratio of structures within each category. "Fair" landscaping was estimated to have a replacement cost of $300 per linear foot of recession for a 50' x 100' lot, while "low" was estimated to be $200.

159. **WITHOUT PROJECT DAMAGE SUMMARY.** Table 18 displays the total value of structures and contents by damage frequency and damage category. Table 19 displays the average annual damages for structures and contents by damage category and reach. Average annual damage results for structures (including contents), improved property and shore protection structures were combined to provide total "without project" average annual damages of $884,000, as shown in Table 20. Table 21 shows the dollar damage and number of structures impacted by frequency for each reach. Table 22 shows the average annual damage per structure by reach and Table 23 shows the total dollar damage by frequency.

TABLE 18
WITHOUT PROJECT CONDITIONS
VALUE OF STRUCTURES AND CONTENTS BY DAMAGE FREQUENCY AND CATEGORY
VALUES ARE IN $000S

	5		10		20		50		100		200		500	
	Structure	Content	Structure	Content	Structure	Content	Structure	Content	Structure	Content	Structure	Content	Structure	Content
Erosion	0	0	1,776	710	6,035	2,413	6,033	2,413	8,797	3,519	8,797	3,519	8,797	3,519
Inundation	242	97	386	154	1,231	492	2,394	957	3,628	1,451	5,130	2,052	6,458	2,583
Total	**339**		**3,026**		**10,171**		**11,797**		**17,395**		**19,498**		**21,357**	

* There are 11 residential and 1 commercial buildings which do not receive damages at the 500 year event.

TABLE 19
WITHOUT PROJECT CONDITIONS
AVERAGE ANNUAL DAMAGES FOR STRUCTURES AND CONTENTS
BY DAMAGE CATEGORY AND REACH
DECEMBER 1996 P.L. & 7.375% DISCOUNT RATE
(VALUES ARE IN $000S)

	Erosion	Inundation	Total
Reach 1 (4000 ft)	248	27	275
Reach 2 (1800 ft)	118	49	167
Reach 3 (1000 ft)	136	12	148
Reach 4 (600 ft)	0	0	0
Reach 5 (1600 ft)	70	5	75
Total (9000 ft)	572	93	665

TABLE 20
WITHOUT PROJECT CONDITIONS
TOTAL AVERAGE ANNUAL DAMAGES
DECEMBER 1996 P.L. & 7.375% DISCOUNT RATE

	STRUCTURES AND CONTENTS	SHORE PROTECTION STRUCTURES	IMPROVED PROPERTY	TOTAL
Reach 1	$275,000	$60,000	$35,000	$370,000
Reach 2	$167,000	$26,000	$15,000	$208,000
Reach 3	$148,000	$25,000	$15,000	$188,000
Reach 4	$0	$0	$0	$0
Reach 5	$75,000	$27,000	$16,000	$118,000
Total	$665,000	$138,000	$81,000	$884,000

TABLE 21
WITHOUT PROJECT CONDITIONS
DOLLAR DAMAGE & NUMBER OF STRUCTURES BY FREQUENCY
DAMAGES ARE IN $000s

Reach 1

	Dollar Damage				Number of Structures			
Zone	Wave	Erosion	Inundation	Total	Zone	Wave	Erosion	Inundation	Total
2	0	0	0	0	2	0	0	0	0
5	0	0	4	4	5	0	0	1	1
10	0	607	7	607.7	10	0	6	1	7
20	0	607	8	615	20	0	6	4	10
50	0	4,661	37	4,698	50	0	37	5	42
100	0	6,083	27	6,110	100	0	54	4	58
200	0	6,083	61	6,144	200	0	54	7	61
500	0	6,083	179	6,262	500	0	54	9	63

Reach 2

	Dollar Damage				Number of Structures			
Zone	Wave	Erosion	Inundation	Total	Zone	Wave	Erosion	Inundation	Total
2	0	0	0	0	2	0	0	0	0
5	0	0	.7	.7	5	0	0	2	2
10	0	0	1	1	10	0	0	3	3
20	0	0	19	19	20	0	0	11	11
50	0	2,339	67	2,466	50	0	13	10	23
100	0	4,996	0	4,996	100	0	31	0	31
200	0	4,996	0	4,996	200	0	31	0	31
500	0	4,996	0	4,996	500	0	31	0	31

Reach 3

	Dollar Damage				Number of Structures			
Zone	Wave	Erosion	Inundation	Total	Zone	Wave	Erosion	Inundation	Total
2	0	0	0	0	2	0	0	0	0
5	0	0	0	0	5	0	0	0	0
10	0	736	0	736	10	0	3	0	3
20	0	736	0	736	20	0	3	2	5
50	0	1,458	17	1,475	50	0	8	1	9
100	0	1,593	49	1,642	100	0	9	2	11
200	0	1,593	78	1,671	200	0	9	2	11
500	0	1,593	129	1,722	500	0	9	3	12

Reach 4

	Dollar Damage				Number of Structures			
Zone	Wave	Erosion	Inundation	Total	Zone	Wave	Erosion	Inundation	Total
2	0	0	0	0	2	0	0	0	0
5	0	0	0	0	5	0	0	0	0
10	0	0	0	0	10	0	0	0	0
20	0	0	0	0	20	0	0	0	0
50	0	0	0	0	50	0	0	0	0
100	0	0	0	0	100	0	0	0	0
200	0	0	0	0	200	0	0	0	0
500	0	0	0	0	500	0	0	0	0

Reach 5

	Dollar Damage				Number of Structures			
Zone	Wave	Erosion	Inundation	Total	Zone	Wave	Erosion	Inundation	Total
2	0	0	0	0	2	0	0	0	0
5	0	0	0	0	5	0	0	0	0
10	0	426	0	426	10	0	3	0	3
20	0	426	0	426	20	0	3	0	3
50	0	486	0	486	50	0	4	1	5
100	0	854	1	855	100	0	8	4	12
200	0	854	19	873	200	0	8	7	15
500	0	854	153	1,007	500	0	8	12	20

TABLE 22
WITHOUT PROJECT CONDITIONS
AVERAGE ANNUAL DAMAGE PER STRUCTURE
DECEMBER 1996 PRICE LEVEL & 7.375% DISCOUNT RATE

Reach	# of Structures	Total Structure & Content Value	*Average Structure Value	Total Average Annual Damages	Average Annual Damage Per Structure	% of Damage to Structure Value
1	68	$11,264,400	$118,324	$275,000	$4,044	3.42%
2	31	$5,000,800	$115,226	$167,000	$5,387	4.68%
3	12	$3,131,800	$186,417	$148,000	$12,333	6.62%
4	1	$681,000	$681,000	$0	$0	0%
5	21	$4,102,000	$139,524	$75,000	$3,571	2.56%
Total	133	$24,180,000	$129,865	$665,000	$5,038	3.88%

*Average Structure Value column is only for structure values and does not include contents
**Reach 4 contains the only commercial structure in the study area and it is not included in the total Average Structure Value

TABLE 23
TOTAL DOLLAR DAMAGE BY FREQUENCY

Storm Event	Cumulative Dollar Damage By Storm Event	% of Structure & Contents Damaged by Storm Event
2	$0	0%
5	$0	0%
10	$1,770,000	8%
20	$1,796,000	8%
50	$9,125,000	39%
100	$13,603,000	58%
200	$13,684,000	58%
500	$13,987,000	60%

PROBLEM IDENTIFICATION

160. Water resource problems identified within the study area are described in the following paragraphs. The problems were identified during site visits with local officials and residents; literature review; public and interagency coordination; a local workshop; beach profile surveys; and recent and historic aerial photography.

161. Problems identified in the study area include 1) long term shoreline erosion as a result of natural forces; 2) storm damage vulnerability with potential for storm-induced erosion, inundation and wave attack exacerbated by long term erosion; and 3) shoreline erosion as a result of Federal navigation projects in the vicinity.

LONG TERM SHORELINE EROSION

162. Oakwood Beach has eroded both horizontally and vertically through the years. Postcards dating back to the 1800s depict a significant beach which ran the entire length of the community. In the 1930s, local residents constructed a concrete seawall along the southern one-third of the community. The beach elevation has dropped significantly from the time the seawall was constructed to the present. The seawall has not been maintained systematically or regularly through the years and is deteriorated. Erosion has caused undermining of the wall and occasional loss of backfill from behind the seawall which poses a threat to the foundations of the houses behind the wall. Throughout the years, local residents have made individual efforts to place additional shore protection in front of the seawall to prevent its undermining. Without attempts to halt the erosion, the seawall will increasingly be subject to failure, ultimately resulting in the loss of homes behind the wall during a storm of sufficient severity.

163. Most of the remainder of the shoreline at Oakwood Beach is fronted by a heterogeneous collection of gravity walls and wooden bulkheads, some dating back more than fifty years. Several feet of vertical beach erosion has occurred in front of the walls and bulkheads. The erosion protection structures at Oakwood Beach basically represent a collection of individual efforts by the homeowners in both the construction and maintenance of the structure. Concrete is used in the majority of structures even though the form of the concrete structures varies considerably. Other structures use other material such as steel and vinyl sheet piling, timber, cinderblocks, concrete rubble, various sizes of stone and even rubber tires. These materials are used in many combinations and proportions. Long term vertical erosion threatens to undermine these structures. Material then washes out from underneath and behind the structures, threatening failure to the houses behind the structures. In most instances, the foundations of the houses rest on the backfill behind the shore protection structures. The entire shoreline at Oakwood Beach, with the exception of a small segment in the middle, has some type of shore protection provided by each individual homeowner. The shore protection structures do not provide a consistent level of protection nor were they designed to meet any "standard". Figures 15 through 19 show the various types of shore protection structures along the beach. These protective structures are increasingly subject to failure due to scouring at the toe and washout of

material from behind the structure. Ultimately the homes behind the protective structures will be lost during a storm of sufficient severity.

STORM-INDUCED EROSION

164. The study area has experienced erosion damage within the past ten years due to localized minor seawall/bulkhead failures. Most of these damages have occurred as a result of waves and elevated water levels during storms, at locations where progressive beach erosion has exposed the bulkhead or seawall toe. Exposure of the structure toes during storms allows upland soil to be displaced, and several homes have incurred structural damage due to washout of supporting soil from behind a protective structure. This was evident in March 1996 during a field trip following a winter storm event. Several homes had decks and beachfront structures or steps damaged to some degree. One home with a porch founded on a seawall had a room-sized cavity under the porch where granular material had been washed out from behind the seawall. Refer to Figure 20. To help remedy this type of problem, a number of Oakwood Beach homeowners have driven sheetpile cutoff walls on the bay side of the older seawalls/bulkheads, followed by poured concrete to seal the base of the wall from further washout. Although this approach has been successful to date in preventing further erosion damages at those locations, it is only a partial solution, as it does not remedy the problem associated with the deteriorated wall above the toe.

165. Following the winter of 1996 storms, 10 property owners in the unprotected beach area drove vinyl sheet piling varying in length from 12 to 16 feet into the ground to protect their property. The sheet piling is exposed about 3-4 feet above the ground. Refer to Figure 12, photo #8. It is estimated that the 10 homeowners spent approximately $10,000 each. These estimates did not include labor provided by the local residents. A local contractor also repaired several walls following these storms. A long-time local resident living in this area of the beach noted that in the mid-1970s he could walk off the top of his roof onto a 6-7 foot high dune. Another nearby resident noted a loss of about 60 feet from his property through the years.

166. Following the March 1996 storm, the local newspaper noted that "sections of the shoreline looked victimized by an earthquake or bombing with the remains of broken seawalls." The article also noted how concrete steps leading down to where the beach should have been were hanging in mid-air. The article indicated that property owners have spent thousands of dollars to maintain their seawalls. It was estimated that about half of the residents experienced undermining of their seawalls. The article also noted that one property owner had five seawalls one behind the other. Every time one failed, another was constructed.

167. Local officials have indicated that within the last 6 to 8 years, about 5 property owners per year have spent between $10,000 and $20,000 each on local shore protection structures. One property owner at the southern end of the beach recently placed an additional footer on his concrete wall at a cost of $10,000. Local residents at the southern end of the natural beach area noted that over the last 10 years they have vertically lost about 6 feet of sand. Local residents noted that the vertical erosion has occurred down to the clay layer in many areas and that many of their seawalls have been undermined 6 to 8 inches. They fear that the walls will tumble over.

Photo #9: Southern 1/3 of beach. Note the staged construction of the protective structures undertaken by individual homeowners. Note the vertical concrete wall fronting the properties, followed by a sloped concrete wall, followed by a timber bulkhead.

Photo #10: Southern 1/3 of beach. Note concrete steps adjacent to the wall. These steps were constructed during a later time period following a vertical drop in the beach elevation.

FIGURE 15

Photo #11: Southern 1/3 of beach. Stone revetment recently placed by a local resident in front of a deteriorated concrete wall. Note the condition of the concrete wall on the right (i.e. substantial protection next to deteriorated protection allows flanking to occur – no consistent protection).

Photo #12: Southern 1/3 of beach. Deteriorated concrete wall and timber bulkhead. Remains of a timber groin in the foreground.

FIGURE 16

Photo #13: Remains of a failed wall fronting a deteriorated concrete vertical wall.

Photo #14: Southern 1/3 of beach. Note the remains of a crude bulkhead in the foreground.

FIGURE 17

Photo #15: Northern 1/3 of beach. Note the steps adjacent to the concrete wall and the vertical erosion of the beach.

Photo #16:. Northern 1/3 of beach. Historical photo from 1973. Compare beach elevation relative to concrete steps with Photo #15.

FIGURE 18

Photo #17: Southern 1/3 of beach. Note the step and wall extensions to the vertical concrete wall undertaken by local residents as sand was lost through the years.

Photo #18: Northern 1/3 of beach. Note the vertical loss of beach from the bottom of the ladder which occurred relatively recently.

FIGURE 19

Photo #19: Middle 1/3 of beach. Unprotected beach area following March 1996 storm. Note the debris and deck damage and the undermining of the structures. Following this storm, local residents bulkheaded the area (refer to Figure 12, photo #8).

Photo #20: Note the loss of backfill from behind the concrete wall following the March 1996 storm.

FIGURE 20

168. Over the last 20-25 years local officials estimate that about 25 property owners at the southern end of the beach have spent approximately $20,000 each. One local resident at the southern end of the beach who has lived there for over 50 years has invested approximately $30,000 in local shore protection measures. Local officials noted that following a major storm approximately 20 years ago, interest-free Federal loans were granted to local residents to repair their local shore protection structures. The loans were paid back over time until repayment was no longer required. Following this storm Oakwood Beach was declared an official disaster area. One long-time resident noted that at one time there were approximately 30 piers located along the beach. There are now only about three piers with only one or two that are useable. Due to damage from storms and permitting issues the piers were not maintained.

169. Local township officials conducted a survey in October 1998 of property owners along the bayfront requesting information on costs of bulkhead/seawall repairs incurred through the years. Forty-four of the approximately 124 property owners were surveyed. From 1985 on, forty-two property owners have spent a total of approximately $450,000. This averages approximately $805 per year per property owner since 1985.

170. Local township officials also conducted a survey in November 1998 of five property owners along the bayfront requesting additional information on storm-related damages to their houses and properties as opposed to their shore protection structures. On average each property owner spent a total of about $32,000 during both the 1980s and 1990s. These costs included preventative measures taken such as sealing windows, sandbagging, and using sump pumps. Storm-related costs incurred included: replacement of screens, furniture, decks, porches, steps, landscaping, sidewalks, water pumps and heaters; repairs to house walls, siding, roofing, and foundations; replacement of plumbing and electrical equipment; and emergency clean-up costs. Some of the foundations of the houses were also strengthened and raised.

171. In 1973, the Corps of Engineers conducted a survey study along the Delaware Bay shore of New Jersey. Information contained in the 1973 report indicated the following: four adjoining property owners constructed a common wooden bulkhead at a cost of $20,000 in 1973; the Country Club of Salem installed 600 feet of rip-rap at a cost of $60,000; one property owner spent $500 in material and $1000 for labor to repair 50 feet of wall and the same property owner estimated an annual expenditure of $500 for each 50 foot lot; one property owner spent $3000 in 1973 for approximately 50 feet of new wall; one property owner estimated that he spent $10,000 for protection since living at Oakwood Beach; one resident gathered information from 58 residents who claimed to have spent $201,500 collectively (or $3500 each) for repair and replacement over a 5 year period prior to 1973 and the same resident estimated that the 120 Oakwood Beach property owners spent between $400,000 and $500,000 during the same time period; and eight completely new bulkheads were constructed in the area in 1973.

172. Due to the significant erosion of the beach both horizontally and vertically through the years, there is currently very limited protection against future storms at Oakwood Beach. A storm of sufficient severity would pose a threat to the foundations of the houses behind the shore protection structures should these structures be undermined and the backfill material be washed

away. It should also be noted that two homes have already been abandoned at the extreme southern end of the study area.

FLOODING AND STORM DAMAGES

173. Long term erosion of Oakwood Beach has made the area more susceptible to flooding and storm damage. Significant economic damages would occur in the event of a major storm. Major floods may occur during any season of the year, particularly in the late summer and early fall when high tides are generated in the Delaware Bay and River by hurricanes and tropical storms moving up the Atlantic Coast. There have been three major floods along the Delaware Bay associated with a hurricane in 1933, and two northeasters in 1950 and 1962. The high tide of the November 25, 1950 storm was recorded at 8.5 feet MSL on the Delaware River at the mouth of the Cohansey River in Cumberland County, New Jersey. Tide waters reached 7.3 feet MSL during the 1962 northeaster. The flood of March 1962 produced high tides of 7.9 feet (NGVD) at Lewes, Delaware, the highest elevation of water recorded at Lewes, DE. The flooding from these storms produced extensive damage along the entire Delaware Bay shoreline. Storm damages were estimated at $5.4 million at that time along the Delaware bayshore communities.

174. Houses along Oakwood Beach have been subjected to inundation damages in the past. Evidence provided by Oakwood Beach homeowners indicates that low-elevation portions of the study area experienced flooding on at least two recent occasions, in 1978 and 1985. A 1973 Corps of Engineers survey study of the Delaware Bay shore of New Jersey indicated that in the early 1970s the Locust Street area was exposed to repeated flooding when waves either breached or broke through the bulkheads. Basements along the beach were subject to flooding, resulting in damages to water pumps and heaters. Flooding problems during storms were also reported in the southern portion of the study area due to the lower elevations. In the 1973 report, the residents attributed flooding not only to storm activity but also to outsized waves generated by ship traffic in the Delaware Bay. It was reported that ship wakes often crested the bulkhead, especially during high tide. The houses and properties along Oakwood Beach are such that there is approximately a 3 to 7 foot drop from the houses and properties to the beach. For significant inundation to occur the water level would need to rise above this height range. As such, flood damages are infrequent in the study area. At Oakwood Beach, the primary damage mechanism is the continual erosion resulting from currents and wave action that undermines the shore protection structures and poses a risk to the homes and properties immediately behind the shore protective works. Should a storm of sufficient severity occur, the homes behind the protective works would be destroyed.

IMPACTS OF FEDERAL NAVIGATION PROJECTS ON EROSION AT OAKWOOD BEACH

175. **GENERAL.** Local residents also have a concern that since the deepening of the Salem River navigation project by 5 feet in the Fall of 1996, erosion at Oakwood Beach has increased at a much faster rate. Locals have noticed increased wave activity along Oakwood Beach. A

technical analysis was conducted to determine if Federal navigation projects, including the Delaware River, Philadelphia to the Sea, and the Salem River, have adversely affected the Oakwood Beach study area. On several occasions during the last approximately 20 years, some local interests have expressed the opinion that the Federal navigation projects are responsible in whole or in part for the shoreline erosion problems at Oakwood Beach. The analysis performed for this study indicates that there are no significant adverse impacts from the Federal navigation projects on the Oakwood Beach shoreline. The following sections of this analysis summarize the history of navigation features constructed in the vicinity of the Oakwood Beach study area, a review of the shoreline history of Oakwood Beach, and finally an assessment of navigation project impacts on the Oakwood Beach study area.

176. **HISTORIC OVERVIEW OF NAVIGATION IMPROVEMENTS.** The following paragraphs describe the historic overview of navigation improvements in the vicinity of Oakwood Beach.

177. **Delaware River, Philadelphia to the Sea, PA, NJ, & DE, Federal Navigation Project.** The existing Delaware River, Philadelphia to the Sea project was adopted in 1910 and has been modified several times since that date. The project extends from Allegheny Avenue in Philadelphia to deep water in Delaware Bay. Authorized channel depth is 40 feet MLLW, and widths range from 400 feet in Philadelphia Harbor to 1,000 feet in Delaware Bay. The channel is 800 feet wide in the general vicinity of Oakwood Beach. The project also provides for widening at critical bends, 19 anchorages, and 12 training dikes constructed to reduce shoaling in the channel and anchorages or minimize dredging and disposal costs.

178. Prior to 1885, there was no formal "Philadelphia to Sea" project; instead, shoal locations in the Delaware River and Bay were considered (and dredged) individually. The first systematic improvement was authorized in an 1885 Board of Engineers recommendation for 26 X 600 ft. channel, from Allegheny Avenue in Philadelphia to naturally deep water in the bay. This improvement was completed by 1898. Subsequently, a March 1899 plan was adopted to deepen the channel from Philadelphia to naturally deep water in the bay, with dimensions of 30 X 600 feet. The June 1910 River and Harbor Act (House Document 61-733) adopted a plan to further deepen the channel from Allegheny Avenue to deep water in the bay to 35 X 800 feet, with widening to 1000 or 1200 feet at several locations. This project was completed in 1934, and the dredged 35 X 800 feet channel length thus extended 63 miles from Philadelphia Harbor to the lower end of Liston Range, south of the location of Oakwood Beach. The June 1938 River and Harbor Act (SD 75-159) authorized additional deepening from the Philadelphia-Camden Bridge to the Philadelphia Navy Yard to 37 feet, and from the Navy Yard to deep water in the bay to 40 X 800 feet and 40 X 1,000 feet. Most of the 40 ft. project dredging from the Navy Yard to deep water in the bay was accomplished between December 1940 and February 1942.

179. In addition to the dredged improvements to the Delaware River navigation channel in this period, there were also a number of other modifications made in or adjacent to the river. These improvements included in-river training dikes, and shore-connected dikes constructed for the purpose of creating confined upland dredged material disposal sites. Within a distance of about

5 miles upstream and downstream of Oakwood Beach, these improvements included: the construction of Artificial Island in 1900, as Baker Shoal and Stony Point Shoal were enclosed by bulkheads to create a disposal area; the construction of Reedy Island Dike in 1917 (an in-river training dike); construction of Bulkhead Bar and Killkohook Dikes by 1926, also for purposes of creating additional dredging disposal area; and the construction of Pea Patch Island (training) dike in 1932.

180. **Salem River, NJ Federal Navigation Project.** The Salem River navigation project was adopted in 1871 to provide access between the Delaware River and the Port of Salem. The port facilities are located approximately 1.5 miles above the entrance to Salem River, which lies at the northeast end of Oakwood Beach. The earliest improvements included removal of shoals in Salem Cove between 1871 and 1880. Salem Cove is the name of the broad, shallow embayment on the east side of the Delaware River, bounded by the deep water of the Delaware River main channel on the west and the shoreline of Oakwood Beach on the east. In 1909, a 9 X 100 ft. channel was completed across Salem Cove to a point about 1 mile above the port. Between 1927 and 1928, the project dimensions were enlarged to 12 X 150 ft. for the approach channel across Salem Cove, parallel to the Oakwood Beach shoreline, and to 12 X 100 ft. for the channel from Salem Cove to the upstream end of the project. The 12 ft. channel was dredged for maintenance purposes several times between 1928 and 1992, with most of the dredged material discharged on the west side of the Salem River channel in Salem Cove. In 1995 and 1996, project dimensions were enlarged to 16 X 150 ft. from the entrance channel upstream to the port facilities in Salem.

181. The Salem River navigation channel across Salem Cove is generally parallel to the Oakwood beach shoreline, at a distance of between 1,600 and 2,200 feet. The zone between the Oakwood beach shoreline and the channel is shallow, with depths increasing gradually from 0 at the shoreline to about 8 feet below MLLW immediately east of the dredged Salem River project channel. The Salem project has no structural features comparable to the training dikes or diked disposal areas of the Delaware River, Philadelphia to the Sea project. However, there are several man-made islands and intertidal flats located on the north and west side of the Salem channel across Salem Cove. These features were created through the disposal of dredged material from new work and maintenance dredging on the Salem project.

182. Local interests from Oakwood Beach alleged that the gradual shoreline erosion of their community resulted at least in part from the cumulative effects of improvements in the Delaware River and Salem River navigation projects in the period from about 1900 to the present. This investigation was designed to assess the potential changes in currents and water levels at Oakwood Beach attributable to navigation improvements in the Delaware and Salem Rivers.

183. **OAKWOOD BEACH SHORELINE HISTORY.** Narrow beach widths and a small background erosion trend for about the last century have characterized the shoreline history of much of the Oakwood Beach study area. Topographic maps, nautical charts, historical picture postcards, and aerial photographs were reviewed in order to quantify the study area erosion rates. A review of this shoreline position information revealed that there have been periods of small accretion interspersed with periods of small erosion. The overall condition at Oakwood Beach

has involved less than 100 feet of shoreline retreat from the date of the earliest mapped shoreline (1843) to the most recent (1996), for an average long-term erosion rate of less than one foot per year.

184. Although the background erosion rate for Oakwood Beach is small compared to other sites on Delaware Bay and the Atlantic Ocean coast, the relatively narrow, sandy barrier strip, combined with the location of the bulkheads and seawalls protecting residential structures, has led to the present condition in which little or no beach width exists on the bay side of many of the structures. Even the comparatively small values of long-term erosion at Oakwood Beach are sufficient to increasingly expose existing structures to potential damage or loss during storm conditions.

185. There is a long but poorly defined history of sediment deficit along Oakwood Beach, with reported problems of little or no beach for portions of the shoreline over the past five decades or more. Reports by current residents of the study area suggest that there is a net northward transport of sandy sediment, and a pattern of small seasonal changes, with onshore transport during the summer and offshore transport in the winter. Residents also indicate that the southern end of the present "beach" zone has migrated northward at a rate on the order of 100 lineal feet per year for the past 5 to 10 years. This behavior is consistent with two principal fetch directions relative to the shoreline alignment. Wind from the northwest fetch direction generates waves that approach the shoreline nearly normal to the shore. Further, there are several dredged material disposal islands and shoals about 2,000 to 2,500 feet offshore of the subject shoreline that intercept some of the wave energy from the northwest. Wind from the south-southwest fetch direction generates waves that approach the shoreline obliquely and would lead to northward transport along Oakwood Beach.

186. **NAVIGATION PROJECT IMPACTS ON OAKWOOD BEACH.** The previous sections of this discussion have demonstrated that persistent erosion at Oakwood Beach occurred during a period of at least 50 years during which significant modifications were made to adjacent portions of the Delaware River and Salem River projects in the interest of navigation. To determine if there is a plausible cause-and-effect relationship between the navigation improvements and the Oakwood Beach erosion problem, a hydraulic model investigation was conducted.

187. This problem was addressed through application of a 2-dimensional hydrodynamic model of the entire Delaware Estuary, with emphasis on the portion of the estuary adjacent to the Oakwood Beach study area. The analysis was conducted using RMA-2V, a two-dimensional finite element hydrodynamic model that has been applied in a wide range of estuarine and fluvial hydraulic investigations within the Corps of Engineers and by others. The original purpose of this application of the model was to provide boundary condition currents for a ship simulation study accomplished as part of the Delaware River Main Channel deepening project in 1993-94. However, the model scale, resolution, and coverage, combined with model geometry representing the existing 40 ft. channel, made the model ideal for determining if historic

navigation improvements had caused current velocity changes, and thus increased shoreline erosion potential.

188. In addition to the "existing conditions" (i.e., 1996) model geometry, a second model geometry was constructed to reflect channel and shoreline conditions that existed in 1890 in the Delaware River and Bay. The 1890 geometry thus reflected conditions that existed prior to most of the numerous improvements made in the interest of navigation, including incremental channel deepening projects and construction of in-river training dikes and diked disposal areas.

189. Boundary conditions for the model runs consisted of 70 hours (approximately 3 days) of observed tide data from October 1992 applied at the bay mouth. Tide conditions experienced during this time interval approximated spring tides in terms of semi-diurnal range. There were no significant deviations from predicted astronomical tides at the bay mouth. The analysis was conducted by selecting five model nodes at which model-predicted current and water level data were saved. Four of the nodes were located along the approximately 9,000 foot long Oakwood Beach shoreline, and the fifth node was located on the west side of the Delaware River navigation channel. The model was run first with existing conditions (1996) geometry, and then with the 1890 geometry. Velocity and head values were saved and incorporated into a spreadsheet database. The current and water level data from the two model runs were then plotted and compared. The complete set of plots displaying current and water level comparisons is included in the Engineering Technical Appendix B, Section 2. The current and water level data were evaluated to determine the magnitude of velocity or water level differences between the two model runs. Velocity differences between the 1996 and 1890 model runs are small enough, with no consistent pattern of increased current velocity, to reasonably attribute the Oakwood Beach erosion to current changes arising from the modification to the Philadelphia to the Sea and Salem River navigation projects between 1890 and the present.

PLAN FORMULATION

190. The purposes of this section are to provide the background on the criteria used in the formulation process and to present the procedures followed from the identification of the study objectives to the designation of the selected plan. The formulation process involved establishment of plan formulation rationale, identification and screening of management measures, and assessment and evaluation of detailed plans which are responsive to the identified problems and needs.

FEDERAL OBJECTIVES

191. The Federal objective of water and related land resources project planning is to contribute to the national economic development (NED) consistent with protecting the nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements. The objective was established by the U.S. Water Resources Council's Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies on 10 March 1983.

PLANNING OBJECTIVES

192. General planning objectives for the Delaware Bay study area are to take an integrated approach to the solution of erosion and inundation problems and storm vulnerability. Specific objectives include the following:

* Provide shore protection measures to reduce shoreline erosion, and potential storm and inundation damages at Oakwood Beach.

* Minimize degradation of the natural environment in areas impacted by such shore protection measures and protect fish and wildlife resources. Where possible, the environmental character of the study area will be preserved and maintained. This will include such considerations as aesthetic, environmental and social concerns, as directly related to plans formulated for implementation by the Corps.

PLANNING CONSTRAINTS

193. The formulation and evaluation of alternative plans are constrained by technical and economic considerations, socio-environmental awareness and institutional policies. The following constraints affect the formulation and evaluation of plans of improvement:

* Analyses of project benefits and costs are to be conducted in accordance with Corps of Engineers' regulations and must assure that any plan is complete within itself, efficient and safe, and economically feasible in terms of current prices.

* Any project resulting from this study must comply with the policies of Federal and state agencies having regulatory jurisdiction.

* Appropriate measures must be taken to ensure that any resulting project is consistent with local, regional and state plans, and that the necessary environmental permits/certificates and approvals are obtained.

194. **TECHNICAL CRITERIA.** These constraints include physical or operational limitations. The following criteria, within a planning framework, were adopted for use in plan formulation:

* Natural berm elevations and foreshore beach slopes, including marsh/wetland locations and elevations, should be used at least as a preliminary basis for the restoration of beach profiles. The design of protective structures should be constructed to adequate dimensions so as to minimize the effect of shoreline erosion processes. A beach berm, if included in the plan of protection, should have height and width dimensions adequate to dissipate the storm wave energy and resist erosion.

* Federal participation in the cost of restoration of beaches shall be limited so that the proposed beach will not extend seaward of the historical shoreline of record.

* Plans must represent sound, safe, acceptable engineering solutions.

* Plans must comply with Corps requlations.

195. **ECONOMIC CRITERIA.** Economic constraints limit the range of alternatives considered. The following items constitute the economic constraints foreseen to impact the formulation of alternative plans:

* Tangible benefits should exceed project economic costs for NED analyses. Any project recommended shall be based on the NED benefit-cost ratio being greater than 1.0 and maximized net benefits, unless there are overriding reasons for recommending another plan, based on other Federal, State, or local concerns.

* The benefits and costs of all alternatives are expressed in comparable economic terms to the maximum practical extent. Costs for the alternative plans are based on preliminary designs and investigations, estimates of quantities, and a December 1996 price level. Costs for the Selected Plan are based on a March 1998 price level. Annual costs are based on a 50 year amortization period and a discount rate of 7.125 percent. These costs include interest during construction and operation and maintenance costs throughout the project life.

196. **INSTITUTIONAL CRITERIA.** According to the Planning Guidance Notebook (ER 1105-2-100), Section IV--Shore Protection, "Current shore protection law provides for Federal participation in restoring and protecting publicly owned shores available for use by the general public". Typically, beaches must be either public or private with public easements/access to allow Federal involvement in providing shoreline protection measures. Private property can be included, however, if the "protection and restoration is incidental to protection of publicly owned

shores or if such protection would result in public benefits". Items which can affect the designation of beaches as public include the following:

* A reasonable beach user fee, uniformly applied to all, may be established to offset the local share of project costs.

* Sufficient parking facilities for the general public (including non-resident users) must be available within a reasonable walking distance on free or reasonable terms. Public transportation may substitute for, or compliment, local parking. Street parking may only be used if it will accommodate existing and anticipated demands.

* Federal aid to private shores owned by beach clubs and hotels is not compatible with the law if the beaches are limited to use by members or paying guests.

* Reasonable public access must be furnished to comply with the planned recreational use of the area.

* Publicly owned beaches which are limited to use by residents of the community are not considered to be open to the general public and cannot be considered for Federal involvement.

197. **SOCIO-ENVIRONMENTAL CRITERIA.** The following social well-being and environmental criteria were considered in the formulation of alternative plans.

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

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

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

(1) Air, noise, and water pollution;

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

(3) Adverse effects on employment as well as the tax base and property values;

(4) Displacement of people, businesses, and livelihoods; and,

(5) Disruption of normal and anticipated community and regional growth.

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

(1) Water quality;

(2) Wetlands;

(3) Sand as a geological resource;

(4) Commercially important aquatic species and their habitats;

(5) Migratory shorebird and waterfowl habitat.

CYCLE 1 - SCREENING OF MEASURES

198. Alternative measures considered for implementation in the study area are classified under non-structural and structural measures. Non-structural measures are those measures which control or regulate the use of land and buildings such that damages to property are reduced or eliminated. No attempt is made to control the erosion and/or physically reduce the potential inundation and wave damage. Structural measures are generally those which act to block or otherwise interfere with erosive coastal processes and/or control the inundation and wave damage.

199. Measures were evaluated individually and in combination on the basis of their suitability, applicability, and merit in meeting the specific objectives of the study. In addition, technical and economic feasibility and environmental and social acceptability were of significant concern in the screening of the measures.

200. The alternative measures considered during the screening of measures are as follows:

a. Non-structural measures

(1) No Federal Action
(2) Floodplain Management
(3) Permanent Evacuation

b. Structural measures

(1) Berm Restoration
(2) Berm Restoration With Dune
(3) Groins
(4) Bulkheads
(5) Offshore Detached Breakwater
(6) Seawall

(7) Perched Beach
(8) Revetment

201. **NON-STRUCTURAL MEASURES.** A general discussion of the non-structural measures considered during the screening of measures is presented in the following paragraphs.

202. **No Federal Action.** The no Federal action alternative does not involve any Federal measure to provide erosion control or storm and inundation damage protection to structures landward of the bayfront. This alternative would not stop or reduce the continuing erosion of the beach, nor would it prevent property from being subjected to higher storm damages from beach recession, flooding, and wave attack. This measure fails to meet any of the objectives or needs of the study and is used as a basis of comparison for any alternatives analyzed.

203. **Floodplain Management.** Floodplain management consists of the implementation of land use control ordinances, flood insurance participation, and comprehensive planning that prevents flood damage to future development and reduces flood damage to existing development.

204. Participation in the National Flood Insurance Program provides a means of compensation for flood damages suffered and also requires restrictions on floodplain development. Insurance does not reduce flood damages but lessens the economic impacts on participants. The Township of Elsinboro participates in the National Flood Insurance Program administered by the Federal Emergency Management Agency. Floodplain land use controls have traditionally been within the purview of local interests. This measure only partially meets the study objective to reduce storm damages to the Township of Elsinboro and should be retained as part of any formulated Federal plan.

205. **Permanent Evacuation.** Permanent evacuation of existing developed areas subject to potential storm damage involves the acquisition of lands and structures thereon either by purchase or through the exercise of powers of eminent domain, if necessary. Following this action, all commercial and industrial developments and residential property in areas subject to storm damage potential are either demolished or relocated to another site. Due to the obvious social and economic costs of this measure it was not considered a practical measure and will be given no further consideration in Cycle 2.

206. **STRUCTURAL MEASURES.** A general discussion of the structural measures considered during the screening of measures is presented in the following paragraphs.

207. **Berm Restoration.** This measure involves the placement of sand directly onto the eroded beach. Usually, the sand is pumped onto the existing shore using a dredge and an offshore borrow source. The Delaware River main channel was assumed as the borrow source for beachfill for initial screening purposes.

208. An appropriate design uses borrow material that has similar properties to the existing beach sand. In addition, the restored beach is graded to a specific design elevation and width to provide the desired level of storm protection. This alternative requires renourishment on a periodic basis to maintain the design berm width and elevation. Berm restoration has a relatively low cost and is a technically feasible measure to address the erosion problem. For these reasons, this measure will be given further consideration in Cycle 2.

209. **Berm Restoration With Dune.** This measure provides the berm restoration described above with additional beachfill material to create a dune at a specific elevation and width beyond that required for berm restoration. The dune will provide storm surge protection in addition to the erosion protection provided by the berm. However, due to the limited damage potential from inundation this measure would not be economically feasible. The existing bulkheads and seawall currently provide protection from inundation. The height of the dune would need to be higher than existing shore protection structures to provide additional protection. Inundation reduction benefits will not offset the cost of a dune. Therefore this measure will be given no further consideration.

210. **Groins.** Groins are structures built perpendicular to the shoreline that extend from the upper beach face into the surf zone. In many instances, groins are made up of a timber bulkhead type structure at the landward end and a rubble mound stone structure at the outer end extending into the water. A properly designed groin field will reduce erosion by trapping some of the littoral drift, thereby reducing the need for renourishment. However, a groin field built on an eroded beachface will not necessarily provide adequate storm surge protection, unless it is combined with a properly designed berm and dune restoration. Groins would only be included in the Federal project if their costs are offset by a savings realized from a decrease in cost for periodic nourishment of the berm. This measure is not feasible due the configuration of the shoreline and the limited beach width required to resist erosion and inundation. Therefore no further consideration will be given to this measure.

211. **Bulkheads.** Bulkheads are structures placed parallel, or nearly parallel, to the shoreline to separate a land area from a water area. The primary purpose of a bulkhead is to retain land or prevent landsliding, with the secondary purpose of affording protection to the upland against damage by wave action. Bulkheads are normally vertical walls of concrete, timber, or steel sheetpile. Depending on the wave climate to which bulkheads are exposed, beach nourishment or revetment toe protection may be required in front of the bulkhead. This measure meets the study objectives and is technically feasible. However, it has a relatively high cost. Despite the high cost, this measure will be given further consideration. Shore Guard vinyl sheetpile bulkheading was recently installed along 10 properties at Oakwood Beach in the Fall of 1996.

212. **Offshore Detached Breakwaters.** A breakwater is an offshore structure which reduces the wave energy and beach erosion on landward beaches. Breakwaters have been constructed using a variety of materials. As part of the Section 54 Program (Low Cost Shore Protection), floating tire breakwaters were installed in the Delaware Bay at Pickering Beach, DE. Three types of fixed offshore breakwaters: rubble mound; nylon sandbags; and precast concrete boxes

were constructed at Kitts Hummock, Delaware under the Section 54 Program. The breakwaters at Kitts Hummock were partially effective in preventing loss of the beachfill at the end of the Section 54 monitoring period in 1980. The sandbag breakwater is no longer visible. The low concrete and rubble mound breakwaters are submerged during highwater and are a navigation hazard. The State of Delaware plans to place more buoy markers around the breakwaters. In order for this measure to be justified, the costs of this measure would have to be offset by the savings from a decrease in periodic nourishment costs and reduced wave energy during storms. The cost of this measure will not offset the cost of periodic nourishment in the study area hence no further consideration will be given to this measure.

213. **Seawalls.** These structures are similar in nature and construction to bulkheads, though typically more massive. Unlike bulkheads, seawalls are designed to withstand direct wave attack and to dissipate or deflect the wave energy. Costs of constructing a seawall could be prohibitively high, with values of thousands of dollars per linear foot not uncommon. Construction of a seawall without a periodic beach nourishment program creates potential for impairing natural sediment transport processes which in turn can result in narrowing and deepening of the downdrift beaches in the vicinity of a seawall. Also, scouring in front of the seawall and increased erosion can be expected during storms due to the reflection of waves. The widening and maintenance of the beach in front of the structures would be necessary to reduce scour. Due to the high maintenance and prohibitive cost of seawalls, no further consideration will be given to this measure.

214. **Perched Beach.** A perched beach consists of a submerged structure or sill, usually rubble mound, which is used to trap sediment carried by incoming waves. This eliminates the outer part of the beach restoration profile near its closure with the ocean bottom. Therefore, the actual amount of fill material to be placed is less than in a typical beachfill. A perched beach was constructed at Slaughter Beach, Delaware as part of the Section 54 Program but its effectiveness was determined to be negligible. The sill did not fill with sand as expected due to the lower wave energy and limited sediment transport of the Delaware Bay. The Town of Slaughter Beach has requested that the State remove the sill. They believe that the sill is not having a positive effect and is a navigation hazard. Because the perched beach is unsuitable for the Delaware Bay environment, and the expense of high maintenance, this measure will not be considered further.

215. **Revetment.** A revetment is, in general, a stone or concrete face placed to protect an embankment or existing shore protection structure against erosion by wave action or currents. Revetments are similar in nature and construction to seawalls, though they are typically sloped structures along a beach, dune, or bluff. Revetments, like seawalls, are designed to stand up to and dissipate wave energy. Revetments depend on the underlying soil for support, therefore, there is a vulnerability to damage and failure due to undermining. This measure meets the study objectives, is technically feasible, and has a relatively moderate cost. For these reasons, this measure will be given further consideration.

APPLICABILITY SCREENING

216. During the applicability screening the management measures discussed in the previous section were reviewed to determine the acceptability and potential to control erosion, wave attack, and inundation in the problem area. Consideration was given to factors such as potential technical performance, whether it meets the study objectives and relative cost. Based on the information shown in Table 24, the alternative measures were screened and only those measures which were considered to have potential viability were carried forward as plans or features of plans in initial formulation analyses.

TABLE 24
CYCLE 1- SCREENING OF MEASURES

ALTERNATIVES	MEETS STUDY OBJECTIVES?	TECHNICALLY FEASIBLE AND EFFECTIVE?	RELATIVE COST	CONSIDER FURTHER?
NON-STRUCTURAL				
No Federal Action	No	N/A	N/A	No
Floodplain Management	Partially	N/A	N/A	No
Permanent Evacuation	Partially	No	High	No
STRUCTURAL				
Berm Restoration	Berm provides erosion protection but no storm damage protection.	Yes	Low	Yes
Berm Restoration with Dune	Berm provides erosion protection and dune provides additional storm damage protection.	No	Low	No
Groins	Yes	No	High	No
Bulkheads	Yes	Yes	High	Yes
Offshore Detached Breakwaters	Partially	No	High	No
Seawalls	Yes	Yes	High	No
Perched Beach	Partially	No	Moderate	No
Stone Revetment	Yes	Yes	Moderate	Yes

CYCLE 2 - INITIAL EVALUATION OF ALTERNATIVES

217. **GENERAL.** The objective of initial evaluation of alternatives is to evaluate and compare alternatives resulting from Cycle 1 - Screening of Measures. During Cycle 2, the alternative plans were evaluated over two different project lengths. Since there were no potential damages associated with Reach 4, consideration was given to placement of a project in Reaches 1 through 5 (9500 ft) and Reaches 1 through 3 (7300 ft). In the case of the beachfill plans, the optimal project length was associated with Reaches 1-5, as was also the case with the stone revetment plan. The optimal bulkhead length was associated with Reaches 1-3, however neither bulkhead plan had a benefit-cost ratio greater than one. As a result, further analyses focused on placement of a project in Reaches 1-5 only. The details of the Cycle 2 screening analyses are shown for a project in Reaches 1-5 only. Evaluations were based on design, environmental, and socio-economic considerations as well as preliminary cost comparisons. Table 25 summarizes the design, environmental, and socio-economic considerations, as well as the annualized costs and benefit-cost ratios associated with each alternative plan.

218. **DESCRIPTION OF ALTERNATIVE PLANS.** The following paragraphs provide descriptions of the alternative plans.

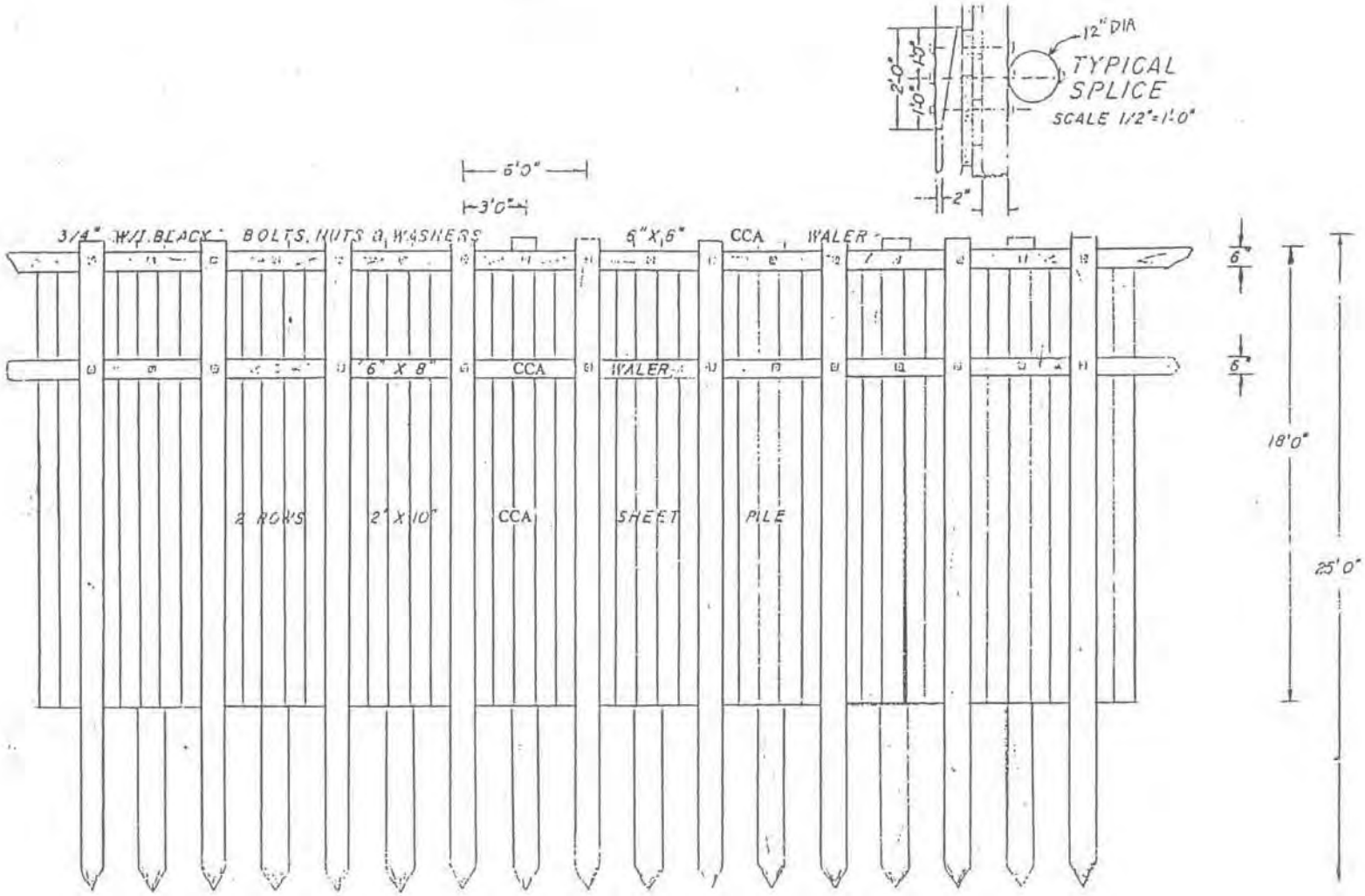
219. **Bulkhead.** This alternative consists of 9,500 linear feet of timber bulkhead with a top elevation of +8.0 ft NAVD along Oakwood Beach which would provide a continuous level of storm protection in the study area. This alternative was designed similar to the timber bulkhead shown in Figure 21. With bulkheading, it is expected that the existing beach would eventually be lost due to scouring in the front of the bulkhead proving this to be an unacceptable alternative. Table 25 shows that this alternative will be given no further consideration.

220. **Stone Revetment.** This alternative consists of a 9,500 foot-long stone revetment plan designed with a top elevation of +3.0 ft NAVD. The revetment plan has a top width of 5 feet with a 1V:2H bayward slope and a 2 foot by 2 foot toe protection. The revetment plan will provide protection from erosion by waves and currents and stabilize the existing shoreline. A typical cross section is shown in Figure 22. Table 25 shows that this alternative will be considered further in Cycle 3.

221. **Berm Restoration.** The berm along Oakwood Beach will be restored for approximately 9500 feet. Two different berm widths, 25 feet and 50 feet, both at an elevation of +6.0 feet NAVD were analyzed. The beach quantities used for cost estimating purposes were obtained using typical cross sections and a project length of 9500 feet. The initial quantities required for the 25 and 50 ft wide berms, including advanced nourishment, are 430,000 and 527,000 cubic yards respectively. Periodic nourishment is estimated at 30,000 cubic yards every six years throughout the life of the project. The sand for both the initial quantity and periodic nourishment was assumed to come from the Reedy Island range of the Delaware River main channel. A fill factor of 1.25 is assumed. Reedy Island range provides the closest source of suitable quality and quantity of sand for beachfill at Oakwood Beach. Typical cross sections for the plans are shown in Figure 23. Table 25 shows that this alternative will be considered further in Cycle 3.

TABLE 25
CYCLE 2 - INITIAL EVALUATION OF ALTERNATIVES

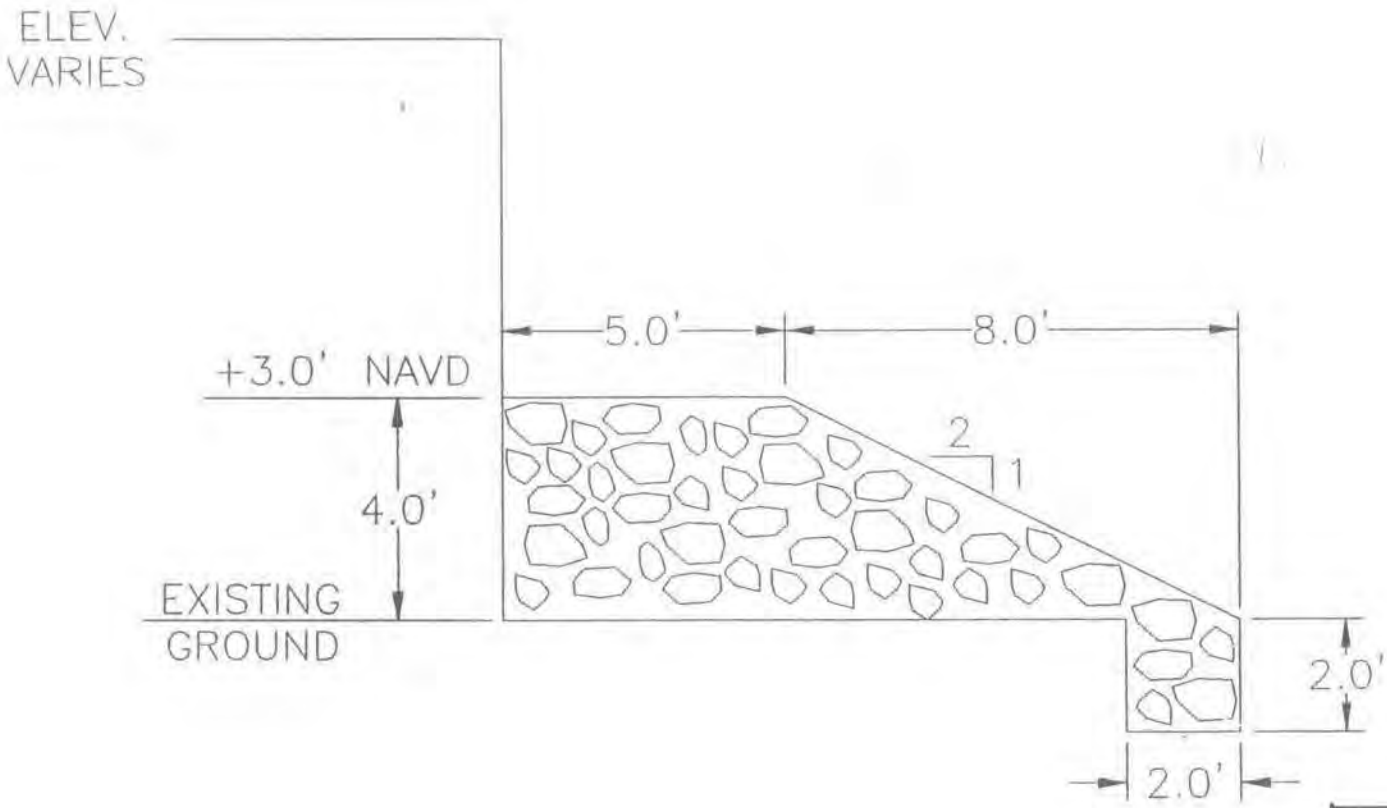
Alternative	Design Considerations	Environmental Considerations	Socio-Economic Considerations	Preliminary Annualized Costs	Total Without Project Annualized Damages	Preliminary Benefit-Cost Ratio	Further Consideration in Cycle 3?	Remarks
Berm Restoration	25 ft wide berm at elev. +6.0 ft NAVD over 9500 linear feet	Temporary destruction of benthic habitat in borrow area. A minor increase in turbidity in construction area. Increases beach habitat.	Provides useable beach area and reduces erosion and wave damages.	$467,500 (includes periodic nourishment over 50 year project life)	$884,000	0.78	Yes. Potential for dredge mob & demob cost reductions if coincidental maintenance dredging of the Delaware River main channel is assumed.	Adverse environmental impacts may be minimized through coordination with environmental agencies. Another potential benefit category includes reduced Federal maintenance dredging costs if the Delaware River main channel is the borrow source for beachfill.
	50 ft wide berm at elev. +6.0 ft NAVD over 9500 linear feet	Same as above.	Same as above.	$505,700 (includes periodic nourishment over 50 year project life)	$884,000	1.01	Yes. Potential for dredge mob & demob cost reductions if coincidental maintenance dredging of the Delaware River main channel is assumed.	Same as above
Stone Revetment	9500 linear feet top width = 5 ft elev. = +3.0 ft NAVD	A minor increase in turbidity in construction area. Reduces sandy environment.	Provides protection against erosion by wave action or currents.	$353,600	$884,000	1.44	Yes	
Bulkhead	9500 linear feet elev. = +8.0 ft NAVD	A minor increase in turbidity in construction area.	Provides protection against erosion by wave action or currents. Also reduces inundation.	$793,000	$884,000	0.89	No	



Delaware Bay Coastline, DE & NJ
Oakwood Beach, NJ
Feasibility Study

TYPICAL CROSS-SECTION
TIMBER BULKHEAD (CYCLE 2)

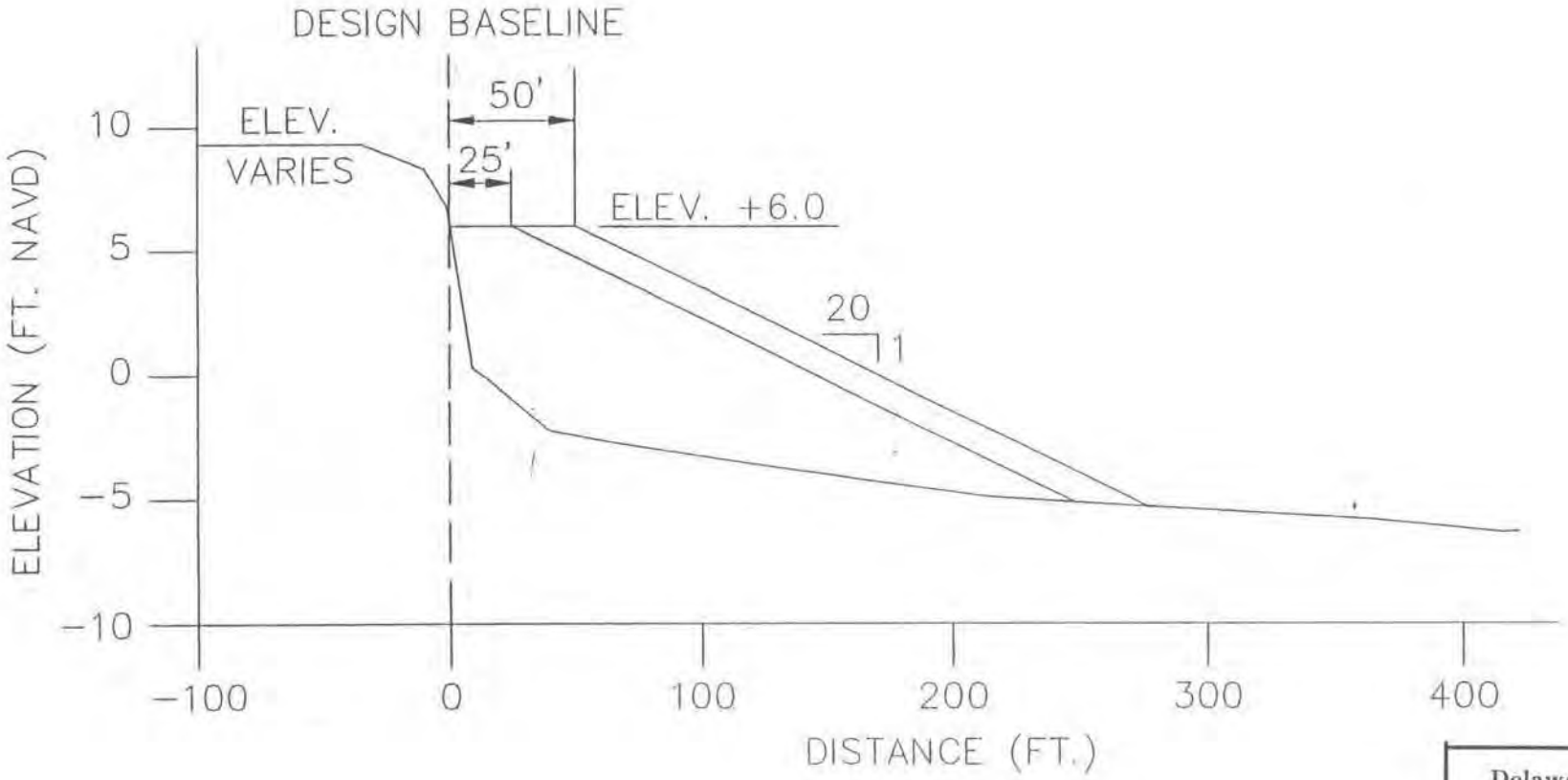
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS



Delaware Bay Coastline, DE & NJ
Oakwood Beach, NJ
Feasibility Study

TYPICAL CROSS-SECTION
STONE REVETMENT (CYCLE 2)

PHILADELPHIA DISTRICT, CORPS OF ENGINEERS



Delaware Bay Coastline, DE & NJ
Oakwood Beach, NJ
Feasibility Study

TYPICAL CROSS-SECTION
BEACHFILL (CYCLE 2)

PHILADELPHIA DISTRICT, CORPS OF ENGINEERS

222. **ENVIRONMENTAL EVALUATION OF ALTERNATIVE PLANS.** The following paragraphs describe the environmental impacts associated with the alternative plans. Impacts associated with the No Action alternative are also described.

223. **Impacts on Vegetation.**

224. No Action: The no action alternative would cause a slow erosion and loss of terrestrial environment. A catastrophic failure of the present shore protection structures would cause loss of vegetated yards.

225. Bulkheads: Bulkheads should have no adverse impact on the vegetation of the area. The bulkheads would prevent the erosion of the shore and thus prevent the loss of vegetated yards.

226. Stone Revetment: Stone revetment should have no adverse impact on the vegetation of the area. The revetment would prevent the erosion of the shore and thus the loss of vegetated yards.

227. Berm Restoration: Berm restoration would prevent the erosion of the shore and thus prevent the loss of vegetated yards. The berm would provide a new habitat for beach plants to colonize.

228. **Impacts on Wetlands.** Since there are no wetlands on the site none of the alternatives will have an impact on wetlands.

229. **Impacts on Water Quality.**

230. No Action: The no action alternative may lower water quality by allowing erodible material to enter the water column. These materials may be a source of chemical pollutants. The erodible material may increase the turbidity levels for an extended period of time. High turbidity levels can stress aquatic organisms by clogging respiratory organs. The turbidity may also decrease the hunting capacity of visual predators. With the eventual failure of the shore protection structures would come an increase in contact with non-point source pollution from the surrounding areas. These sources would allow heavy metals, pesticides, fertilizers, discarded oils, detergents, yard wastes and debris to enter the water.

231. Bulkheads: Bulkhead placement may have a short-term effect on turbidity levels during the limited excavation and the placement of timbers. The river current in this area should carry the limited turbidity out of the area in a short time period. High turbidity levels can stress aquatic organisms by clogging respiratory organs. The turbidity may also decrease the hunting capacity of visual predators. This alternative should have limited or no impact on pH, nutrient levels, bacteria, or dissolved oxygen (DO). It also should not change the DRBC characterization of the water as fair to good.

232. Stone Revetment: Stone revetment construction may have a short-term effect on turbidity levels during the limited excavation and the placement of stones. The river current in this area should carry the limited turbidity out of the area in a short time period. High turbidity levels can stress aquatic organisms by clogging respiratory organs. The turbidity may also decrease the hunting capacity of visual predators. This alternative should have limited or no impact on pH, nutrient levels, bacteria, or DO. It also should not change the DRBC characterization of the water as fair to good.

233. Berm Restoration: Berm restoration may have a short-term effect on turbidity levels during both excavation of the borrow site and the placement of sand along the shore. Elevated levels of particulate concentrations at the discharge location may also result from "washout" after beachfill is placed. The river current in this area should carry the limited turbidity out of the area in a short time period. High turbidity levels can stress aquatic organisms by clogging respiratory organs. The turbidity may also decrease the hunting capacity of visual predators.

234. Short-term adverse impacts to water quality in the immediate vicinity of the dredging and placement site can occur. Aquatic ecosystems concentrate biological and chemical substances such as organic matter, nutrients, heavy metals, and toxic chemical compounds in bottom sediments. When introduced into the water column, these substances tend to bind with suspended particulate matter and eventually settle to the bottom. Dredging operations typically elevate levels of suspended particulates in the water column through excessive agitation of the sediment. Adverse impacts to the water quality may include oxygen depletion and the release of chemical substances, making them biologically available to aquatic organisms through ingestion or respiration.

235. The borrow material is not expected to be chemically contaminated. The use of sand, coupled with the absence of nearby dumping activities, industrial outfalls, or contaminated water infer the low probability that the borrow material is contaminated by pollutants.

236. This alternative should have limited or no impact on pH, nutrient levels, bacteria, or DO. It also should not change the DRBC characterization of the water as fair to good.

237. **Impacts on Finfish.**

238. No Action: This alternative may impact finfish in the area by allowing the introduction of non point source pollution. These chemicals may have an impact on the reproductive capability, and survivability of finfish. The turbidity may also decrease the hunting capacity of visual predators

239. Bulkheads: This alternative will have a limited and short-term impact on finfish. Fish are transient and mobile by nature, this will lead to them avoiding the construction area.

240. Stone Revetment: This alternative will have a limited and short-term impact on finfish. Fish are transient and mobile by nature, this will lead to them avoiding the construction area. The

primary impact to fisheries will be felt from the disturbance of benthic and epibenthic communities. The loss of the benthos and epibenthos smothered during stone placement will disrupt the food chain in the impact area. This effect is expected to be significant as these areas can not become recolonized by pioneering species due to the covering of the benthic sediment with stones. Some colonization of the stone may occur which would provide a unique hard bottom habitat to the area. Post construction the stone revetment would provide structure and hiding places for small fish during high tide.

241. Berm Restoration: This alternative will have limited and short-term impact on finfish. With the exception of some small finfish, most bottom dwelling and pelagic fishes are highly mobile and should be capable of avoiding turbidity impacts due to placement and dredging operations. It is anticipated that some finfish may become attracted to the turbidity plume due to the suspension of food particles in the water column. The primary impact to fisheries will be felt from the disturbance of benthic and epibenthic communities. The loss of the benthos and epibenthos smothered during berm construction and removal during borrow activity will temporarily disrupt the food chain in the impacted areas. These effects are expected to be temporary as these areas become rapidly recolonized by pioneering species. Coordination will occur to prevent construction during critical spawning and over wintering periods.

242. **Impacts on Benthos.**

243. No Action: The no action alternative may have an impact on the benthic community. With the eventual failure of the existing shore protection structures would come an increase in contact with non-point source pollution from the surrounding areas. These sources allow heavy metals, pesticides, fertilizers, discarded oils, detergents, yard wastes and debris to enter the water. Some of these materials may settle out and become incorporated into the benthic sediments or ingested by benthic organisms. There would be a continued loss of sandy substrate, leading to larger areas of exposed clay, thus less suitable habitat.

244. Bulkheads: Only a small area of the intertidal benthic zone would be impacted by placement of bulkheads. There could be a continued loss of sandy substrate, leading to larger areas of exposed clay thus less suitable habitat.

245. Stone Revetment: Placement of stone revetment would impact a large area of intertidal and nearshore habitat. The organisms in the sediment would be buried and/or crushed. This benthic habitat would be transformed from a soft bottom sand habitat to a rocky intertidal habitat. There is no natural rocky intertidal habitat in the Delaware Estuary. This area is not likely to be colonized since there are few species in the estuary that are adapted for this habitat type.

246. Berm Restoration: The primary ecological impacts of dredging the sand borrow site will be the complete removal of the existing benthic community through entrainment into the dredge. Mortality of the benthic and epibenthic organisms will occur as they pass through the dredge and/or as a result of being transplanted into an unsuitable habitat. A benthic study performed for

the Delaware Estuary Program did not show significant differences between the navigation channel and the shallow/intermediate zone. The navigation channel should recover to predredged conditions. Benthic pioneer species will move in from neighboring areas. There will be an impact due to burial of the benthic community during placement activities in the intertidal and nearshore zone. The Delaware Estuary Program's study showed that this area had a lower density and biomass of benthic organisms than the other areas. This habitat should recover due to recruitment from surrounding areas.

247. **Impacts on Shellfish .**

248. No Action: The no action alternative would lead to a continued loss of sandy substrate, leading to larger areas of exposed clay thus less suitable habitat.

249. Bulkheads: Only a small area of the intertidal benthic zone would be impacted by placement of bulkheads. There could be a continued loss of sandy substrate, leading to larger areas of exposed clay thus less suitable habitat.

250. Stone Revetment: Placement of stone revetment would impact a large area of intertidal and nearshore habitat. The organisms in the sediment would be buried and/or crushed. This benthic habitat would be transformed from a soft bottom sand habitat to a rocky intertidal habitat. The blue crab and other crustaceans would be able to utilize the spaces between the rocks as protective spaces.

251. Berm Restoration: There will be a short-term impact due to burial of bivalves during placement activities in the intertidal and nearshore zones. This habitat should recover due to recruitment from surrounding areas and vertical migration through the sediment. The more mobile shellfish such as the blue crab will avoid the area during placement.

252. **Impacts on Wildlife.**

253. No Action: The no action alternative will have little or no effect on wildlife, since the area is already highly disturbed.

254. Bulkheads: The bulkhead alternative will have only short-term effects on wildlife. Most of the wildlife will avoid the construction area due to the noise of the construction activity. The wildlife will return to the area quickly after completion of the work.

255. Stone Revetment: The placement of stone revetment will have only short-term effects on wildlife. Most of the wildlife will avoid the construction area due to the noise of the construction activity. The wildlife will return to the area quickly after completion of the work.

256. Berm Restoration: Berm restoration will have only short-term effects on wildlife. Most of the wildlife will avoid the construction area due to the noise of the construction activity. The wildlife will return to the area quickly after completion of the work.

257. **Impacts on Threatened and Endangered Species.**

258. No Action: The increased turbidity and runoff caused by the no action alternative may make the area less suitable as a feeding area for Federally listed species. Most of the present shoreline protection structures prevent diamondback terrapins access to the area.

259. Bulkheads: The bulkhead alternative should have no effect on Federally listed threatened or endangered species. The occasional transients will avoid the construction activity. The diamondback terrapin occurs primarily in emergent wetlands and shallow water habitat. Bulkheads would prevent terrapins from coming out of the water along the project site.

260. Stone Revetment: The stone revetment alternative should have no effect on Federally listed threatened or endangered species. The occasional transients will avoid the construction activity. The diamondback terrapin occurs primarily in emergent wetlands and shallow water habitat. Stone revetment would prevent terrapins from coming out of the water along the project site.

261. Berm Restoration: The berm restoration alternative should have no effect on Federally listed threatened or endangered species. The occasional transients will avoid the construction activity. Dredging and placement will be timed and performed in such a manner as to limit the impact to sea turtles and shortnose sturgeon.

262. The diamondback terrapin occurs primarily in emergent wetlands and shallow water habitat. It is expected that this species will not benefit from a berm restoration project, but will not be adversely impacted by a berm restoration project.

263. **Visual Impacts.**

264. No Action: The no action alternative may allow the visual integrity of the area to degrade further. As the present shore protection structures fail, rubble and sediment may be spread out and interrupt the visual flow of the shoreline and mud flats.

265. Bulkheads: The bulkhead will provide a continuous vista, made up of one type of shore protection structure. It will remove the haphazard view that is there presently.

266. Stone Revetment: Stone Revetment will provide a continuous vista of one type of shore protection structure. It will remove the haphazard view that is there presently.

267. Berm Restoration: The berm restoration will provide a continuous vista, made up of one type of shore protection structure. It will remove the haphazard view that is there presently. It will also provide a more natural look to the shoreline.

268. **Impacts on Air Quality and Noise Level.**

269. No Action: The no action alternative will have no impact on the air and noise quality of the project area.

270. Bulkheads: Minor short-term impacts to air quality and noise levels would result from the construction phase of the bulkhead alternative. Grading and pile driving equipment would produce noise levels in the 70 to 90 dBA (50 feet from the source) range. The noise would dissipate with distance. Ambient air quality would also be temporarily degraded, but emission controls and limited duration aid in minimizing the effects. The noise levels and air quality impacts would be limited to those produced by heavy equipment. No long-term significant impacts to the local air quality are anticipated.

271. Stone Revetment: Minor short-term impacts to air quality and noise levels would result from the construction phase of the stone revetment alternative. Stone placement and grading equipment would produce noise levels in the 70 to 90 dBA (50 feet from the source) range. The noise would dissipate with distance. Ambient air quality would also be temporarily degraded, but emission controls and limited duration aid in minimizing the effects. The noise levels and air quality impacts would be limited to those produced by heavy equipment. No long-term significant impacts to the local air quality are anticipated.

272. Berm Restoration: Minor short-term impacts to air quality and noise levels would result from the construction phase of the berm restoration alternative. Dredging activities and grading equipment would produce noise levels in the 70 to 90 dBA (50 feet from the source) range. The noise would dissipate with distance. Ambient air quality would also be temporarily degraded, but emission controls and limited duration aid in minimizing the effects. The noise levels and air quality impact would be limited to those produced by heavy equipment. No long-term significant impacts to the local air quality are anticipated.

273. **Impacts on Recreation.**

274. No Action: The no action alternative should not impact recreational use of the project area.

275. Bulkheads: The bulkhead alternative would provide a feature from which to fish and bird watch.

276. Stone Revetment: The placement of stone revetment would provide a feature from which to fish and bird watch. The revetment may also provide greater finfish catches due to its sheltering nature.

277. Berm Restoration: The berm restoration would provide opportunities for bird watching and fishing. There might be an increase in use of the area by nonresidents due to public access points being provided.

ALTERNATIVE PLANS RECOMMENDED FOR CYCLE 3 - DETAILED OPTIMIZATION ANALYSES

278. The Cycle 1 and 2 screening processes eliminated many of the measures considered in this study. The alternatives recommended for further study in Cycle 3 include:

a. Berm Restoration; and
b. Stone Revetment

279. In Cycle 3, detailed designs will be formulated and optimized to develop the NED plan for this study area. For beachfill alternatives, the evaluation will examine berm width, periodic nourishment cycle lengths, and dredging methods. During Cycle 3, the smallest scale plan possible for the stone revetment alternative will also be evaluated. This plan will then be compared with the beachfill alternatives.

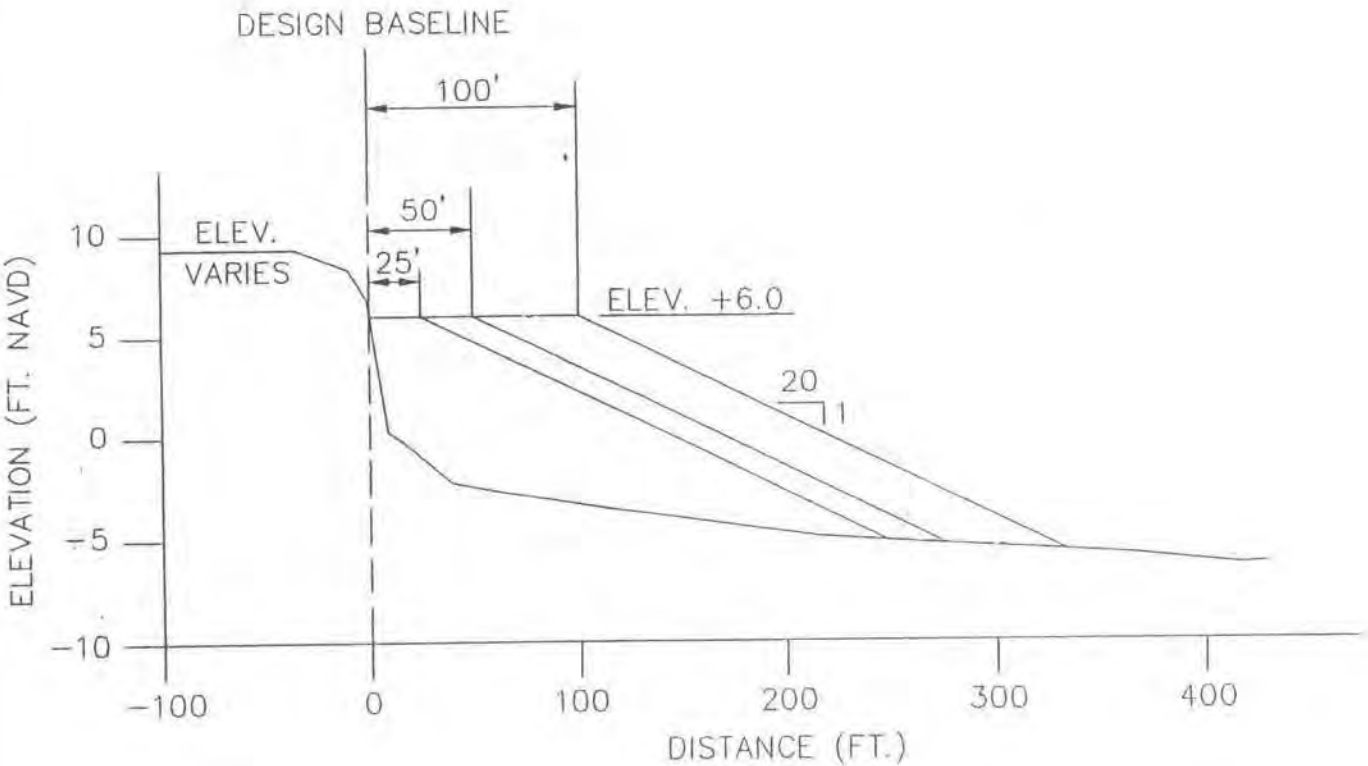
CYCLE 3 - DETAILED OPTIMIZATION OF ALTERNATIVE PLANS

280. Alternative plan evaluations are focused on the berm restoration and stone revetment plans. The berm restoration plans evaluated during Cycle 3 include periodic nourishment every six years. A fill factor of 1.25 is assumed for screening purposes. Upon identification of the NED plan, consideration will be given to optimization of periodic nourishment requirements, if applicable.

281. **DESIGN TEMPLATE PARAMETERS.** Beach restoration alternatives require optimization of the berm width. The methodology followed to optimize these features is accomplished by varying parameters between a set of boundary conditions established at the beginning of the analysis. Design of the beach restoration alternatives was done in accordance with CETN-II-5 "Selecting Construction Profiles for Initial Placement of Beach Fills", the Shore Protection Manual, and accepted engineering practice. In addition, the smallest-scale stone revetment plan (toe protection) practical was evaluated and was designed in accordance with EM 1110-2-1614 and accepted engineering practice. Listed below are the boundary conditions utilized to construct a logical methodology to efficiently identify the optimal plan.

282. **Design Baseline.** A design baseline was established along the length of the study area in order to determine the alignment of the proposed alternatives. The location of the design baseline was based on a line parallel to the most bayward structure in the study area.

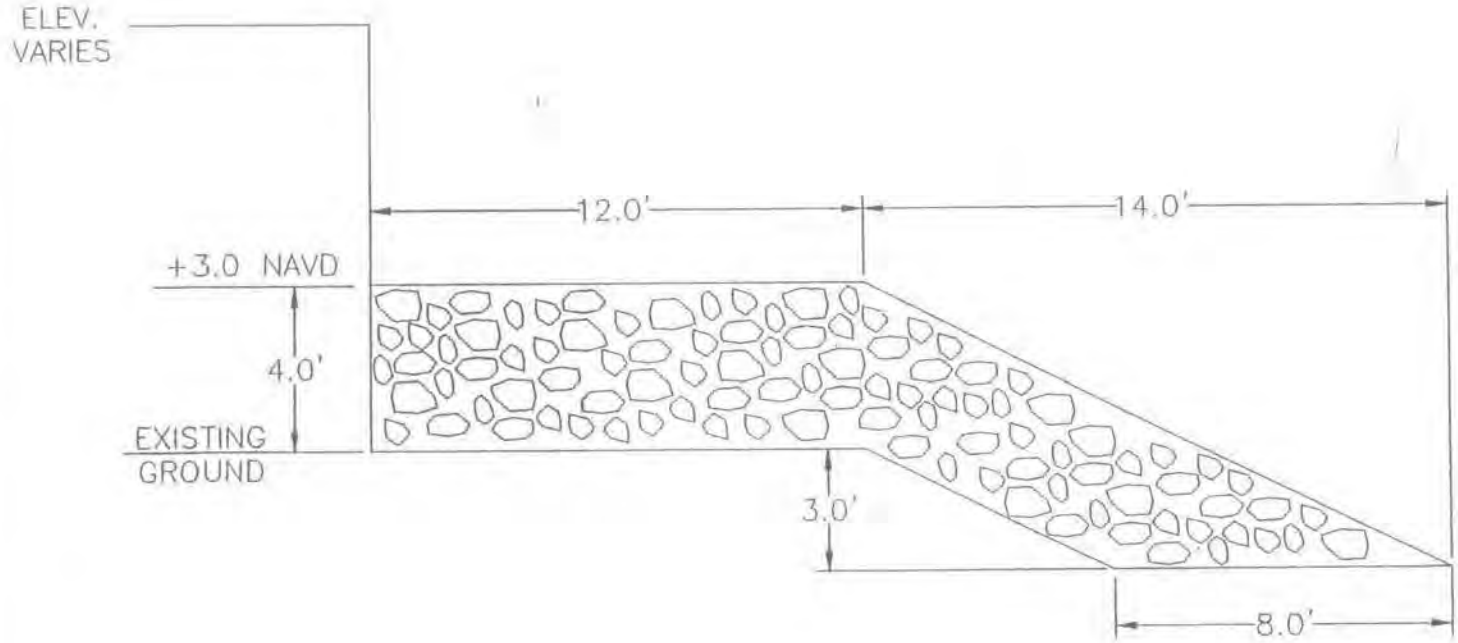
283. **Design Elevation.** Design berm heights for each beachfill alternative have an elevation of +6.0 feet NAVD as determined by historical profiles. Refer to Figure 24 for typical cross sections. The design top elevation of the stone revetment plan (toe protection) is +3.0 ft NAVD. Refer to Figure 25 for a typical cross section.



Delaware Bay Coastline, DE & NJ
Oakwood Beach, NJ
Feasibility Study

TYPICAL CROSS-SECTION
BEACHFILL (CYCLE 3)

PHILADELPHIA DISTRICT, CORPS OF ENGINEERS



Delaware Bay Coastline, DE & NJ
Oakwood Beach, NJ
Feasibility Study

TYPICAL CROSS-SECTION
STONE REVETMENT (CYCLE 3)

PHILADELPHIA DISTRICT, CORPS OF ENGINEERS

284. **Design Width.** The minimum design berm width considered is 25 feet. This design alternative requires beachfill to establish a consistent berm height, and includes advanced nourishment along the entire area to ensure a constant design template between nourishment cycles.

285. Various berm widths are evaluated to determine the optimal berm width. The berm widths are set wide enough to discern significant differences in costs and benefits between alternatives, but not so great that the NED plan cannot be accurately determined. In order to satisfy these criteria, the 25 ft, 50 ft, and 100 ft berm plans were evaluated. The 75 ft berm plan was also evaluated however the hydraulic performance of the 25 ft increment was indistinguishable from the hydraulic performance of the 50 and 100 ft berm plans. No further consideration was given to the 75 ft berm plan.

286. The design top width of the smallest-scale stone revetment plan practical is 12 feet. This width allows for vehicular access during construction.

287. **Design Length.** The design length (excluding tapers) for all alternatives is approximately 9000 feet.

288. **Design Tapers.** All alternatives include a taper at each project terminus to transition the constructed project into the existing beach outside the project area. A 250 ft. taper was used at both the northern and southern limits of the project area.

289. **Design Slope.** The beachfill alternatives have a bayward slope from the edge of the berm to the existing ground of 1V:20H. The stone revetment plan has a 1V:2H bayward slope.

290. **Design Quantities.** To determine quantities for each alternative, the proposed design templates were drawn on the existing beach survey cross sections. Average end area methods were used to compute volumes. Initial construction volumes presented in this report include quantities required to attain the design profile. Initial beachfill quantities also include advanced periodic nourishment.

291. **Periodic Nourishment.** In order to maintain the design profile for the beachfill alternatives, an advanced nourishment fill is placed during initial construction in addition to the initial design beachfill. The nourishment volume is sacrificial and protects the design beachfill. At the end of the periodic nourishment cycle, the design profile remains.

292. **OPTIMIZATION OF ALTERNATIVE PLANS.** Benefits and costs for Oakwood Beach were developed for the alternative plans in order to identify the NED plan. This was accomplished using the same methods as described in the without-project analysis. Reduced damages based on the predicted reduction in storm impacts due to the with-project alternatives, were compared to the without-project results to generate project benefits. Costs for each alternative were estimated based on standard construction practices and District experience in the construction of such projects.

293. **Storm Impacts.** The with-project conditions are the conditions that are expected based on the predicted impacts of storm events on the various project alternatives. The periodic nourishment associated with the beachfill alternatives is designed to ensure the integrity of the project design. This ensures the project design cross-section will be maintained and the elimination of shoreline recession due to long-term erosion. However, coastal processes will continue to impact the shoreline along the project area. Storm-induced erosion and inundation were evaluated for the with-project conditions using the same methodologies described in the without-project conditions.

294. Storm-Induced Erosion Analysis (With Project). As in the without-project condition, storm events from the 2- to 500-year frequency were evaluated for the with-project alternatives using the same methodology as described in the without project conditions. A failure frequency was assigned to each shore protection structure category under with project conditions. Refer to Table 26.

TABLE 26
WITH PROJECT CONDITION
SHORE PROTECTION STRUCTURE FAILURE CATEGORIES BY FREQUENCY

RETURN PERIOD (yrs)	Stone Revetment Alternative	25 ft Berm Alternative	50 ft Berm Alternative	100 ft Berm Alternative
2	none fail	none fail	none fail	none fail
5	none fail	none fail	none fail	none fail
10	none fail	none fail	none fail	none fail
20	none fail	Category 1	none fail	none fail
50	Category 1	Category 1	Category 1	none fail
100	Categories 1 & 2	Categories 1, 2, & 3	Categories 1 & 2	Categories 1 & 2
200	Categories 1, 2, & 3	Categories 1, 2, & 3	Categories 1, 2, & 3	Categories 1, 2, & 3
500	Categories 1, 2, & 3	Categories 1, 2, & 3	Categories 1, 2, & 3	Categories 1, 2, & 3

295. Storm-Inundation Analysis (With Project). The stage-frequency data used to assess the impacts of the alternative plans was the same as that used to assess the without-project conditions. The with-project inundation analysis indicated that there was no difference between the with and without project conditions for all of the alternative plans. None of the alternative plans reduce the limited inundation potential in the study area.

296. **Periodic Nourishment.** In order to maintain the integrity of the design for the beachfill alternatives, beachfill nourishment must be included in the project design. If periodic nourishment is not performed throughout the life of the project, longshore and cross shore sediment transport mechanisms will act to erode the design beach. This erosion will reduce the protection from storm damage afforded by the project. The nourishment quantities are considered sacrificial material which acts to protect the design fill volume. Various coastal processes were considered in order to develop an estimate of the required annual nourishment fill volumes.

297. The nourishment rates for design were developed considering long term historic erosion losses, volumetric analysis of recent profiles, beachfill losses due to the predicted rate of sea level rise, and losses due to storm induced erosion. The results of these analyses were compared and the volumetric requirements were combined to obtain the total nourishment needs for the alternatives.

298. Periodic nourishment at Oakwood Beach was determined to be 5,000 cy/yr for all design alternatives. An overfill factor of 1.25 is applied to the periodic nourishment estimate. For purposes of screening the alternatives, a 6 year nourishment cycle was assumed.

299. Sea Level Rise. An evaluation was completed in accordance with current COE guidance ER-1105-2-100 section 5-25, which requires 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. COE policy calls for consideration of designs, which are most appropriate for a range of possible future rates of rise. Strategies such as beachfill, 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.

300. ER1105-2-100 recommends a sensitivity test be conducted to determine any effect sea level change would have on plan evaluation and selection. The analysis should use the extrapolation of the local, historical record of relative sea level rise as the low level and Curve III from the NRC report as the high level. Based on historical gauge records dating from 1900 at Philadelphia and from 1919 at Lewes, Delaware, relative sea level has risen at a rate of approximately 0.9 to 1.0 feet per century within the tidal portion of Delaware River and Bay. For practical purposes, this extrapolates to a 0.5 foot rise in sea level over a 50-year project life. Curve III of the NRC report indicates a 1.4 foot rise over a fifty year project life. The principal function of the proposed beachfill alternatives is to provide a buffer between the Delaware River and the nearly continuous line of aging protective structures along Oakwood Beach. There is no inundation-reduction purpose served by the beachfill. If the proposed beachfill alternatives experience some measure of accelerated sea level rise over the project life, it is reasonable to assume that a minor adjustment to the configuration the fill profile, or to the rate of periodic nourishment, will be adequate to offset any impacts from incremental sea level rise. It is concluded that the potential for accelerated sea level rise does not affect plan selection or plan justification.

301. **Economic Evaluation of Alternative Plans.** Economic benefits were derived from reduction in storm damages as well as reduced Federal maintenance dredging costs for the beachfill alternatives, and were used to determine the optimal plan. The benefits leading to project optimization are summarized below.

302. Storm Damage Reduction Benefits. The alternative plans will reduce storm damages by reducing profile recession. Damages for the with-project alternatives were calculated using the same methodologies and databases previously detailed for the without-project conditions. Table

27 shows the average annual damages for each alternative by damage category. The benefits for any given alternative are the difference between the without-project and with-project damages. Average annual storm damage reduction benefits (including reductions in improved property and shore protection structure damages) for each alternative plan are shown in Table 28. Table 29 shows the storm damage reduction benefits for each alternative adjusted to a March 1998 price level and 7.125% discount rate.

TABLE 27
AVERAGE ANNUAL DAMAGES FOR EACH ALTERNATIVE BY DAMAGE CATEGORY (DECEMBER 1996 PRICE LEVEL AND 7.375% DISCOUNT RATE)

Alternative Plans		Damage Category			
	Elevation (ft NAVD)	Structure (including contents)	Shore Protection Structures	Improved Property	Total
Stone Revetment	+3.0	$308,000	$45,000	$28,000	$381,000
25 ft berm	+6.0	$405,000	$70,000	$45,000	$520,000
50 ft berm	+6.0	$308,000	$45,000	$28,000	$381,000
100 ft berm	+6.0	$277,000	$37,000	$23,000	$337,000

TABLE 28
STORM DAMAGE REDUCTION BENEFITS BY ALTERNATIVE (DECEMBER 1996 PRICE LEVEL AND 7.375% DISCOUNT RATE)

Alternative Plan	Elevation (ft NAVD)	Without Project Average Annual Storm Damages	With Project Average Annual Storm Damages	Average Annual Storm Damage Reduction Benefits	Percent Reduced
Stone Revetment	+3.0	$884,000	$381,000	$503,000	57
25 ft berm	+6.0	$884,000	$520,000	$364,000	41
50 ft berm	+6.0	$884,000	$381,000	$503,000	57
100 ft berm	+6.0	$884,000	$337,000	$547,000	62

TABLE 29
STORM DAMAGE REDUCTION BENEFITS BY ALTERNATIVE
(MARCH 1998 PRICE LEVEL AND 7.125% DISCOUNT RATE)

Alternative Plan	Average Annual Storm Damage Reduction Benefits
Stone Revetment	$515,000
25 ft berm	$373,000
50 ft berm	$515,000
100 ft berm	$560,000

303. Reduced Federal Maintenance Dredging Benefits. Reduced Federal maintenance dredging benefits for the Reedy Island range of the Delaware River main channel is a benefit category applicable to the beachfill alternatives at Oakwood Beach. Use of the Delaware River main channel as a source of borrow for the beachfill at Oakwood Beach for both initial construction and periodic nourishment will reduce Federal maintenance dredging costs. Assuming the Delaware River 45 ft deepening project is completed in year 2000 prior to the completion of construction of the Oakwood Beach project alternatives in year 2002, the initial construction and subsequent periodic nourishment of the Oakwood Beach project alternatives will eliminate the need for maintenance dredging of the Reedy Island range for a number of years. Based on an estimated shoaling rate of 23,000 cy/yr and a 4 year maintenance dredging interval for the Reedy Island range (45 ft project), the Oakwood Beach project alternatives eliminate the need for maintenance dredging of Reedy Island through Oakwood Beach project year 18 for the 50 ft berm plan, project year 22 for the 50 ft berm plan, and project year 30 for the 100 ft berm plan. This results in average annual reduced Federal maintenance dredging benefits of $167,000, $181,000 and $199,000 for the 25 ft, 50 ft, and 100 ft berm plans respectively. Refer to Table 30.

TABLE 30
REDUCED FEDERAL MAINTENANCE DREDGING BENEFITS
(MARCH 1998 PRICE LEVEL AND 7.125% DISCOUNT RATE)

Alternative Plan	Quantity (cy)	Average Annual Reduced Federal Maintenance Dredging Benefits
25 ft berm	430,000	$167,000
50 ft berm	527,000	$181,000
100 ft berm	723,000	$199,000

304. **Economic Optimization of Alternative Plans.** Optimization of the alternatives is based on the benefit category of storm damage reduction benefits as well as reduced Federal maintenance dredging benefits for the beachfill alternatives. A periodic nourishment cycle of 6 years for the beachfill alternatives was assumed for screening purposes. The initial construction

costs for each alternative, as well as the periodic nourishment costs associated with the beachfill alternatives are shown in Table 31. For the beachfill alternatives, two different dredging methods were given consideration. Consideration was given to use of both a hopper dredge (coincident with maintenance dredging of the Delaware River main channel) and a hydraulic pipeline dredge (independent contract). Use of a hydraulic pipeline dredge was determined to be more economical for initial construction and use of a hopper dredge (coincident with maintenance dredging of the Delaware River main channel) more economical for periodic nourishment. Cost estimates are therefore based on use of a hydraulic pipeline dredge for initial construction and a hopper dredge (coincident with maintenance dredging of the Delaware River main channel) for periodic nourishment.

TABLE 31
INITIAL CONSTRUCTION AND PERIODIC NOURISHMENT QUANTITIES AND COSTS FOR EACH ALTERNATIVE

INITIAL QUANTITIES AND COSTS		
Alternative Elevation (ft NAVD)	**Initial Quantity (includes advanced nourishment for beachfill alternatives) (cubic yards of stone or sand)**	**Total Cost (March 1998 P.L.)**
Stone Revetment (+3.0 ft)	31,000	$5,976,000
25 ft berm (+6.0 ft)	430,000	$3,685,000
50 ft berm (+6.0 ft)	527,000	$4,116,000
100 ft berm (+6.0 ft)	723,000	$5,098,000
PERIODIC NOURISHMENT QUANTITIES AND COSTS (6 YR CYCLE)		
Alternative Elevation (ft NAVD)	**Quantity (cubic yards) (includes an overfill factor of 1.25)**	**Total Cost (March 1998 P.L.)**
25 ft berm (+6.0 ft)	30,000	$688,000
50 ft berm (+6.0 ft)	30,000	$688,000
100 ft berm (+6.0 ft)	30,000	$688,000

305. Initial construction costs for each with-project alternative, including periodic nourishment costs for the beachfill alternatives, are annualized for comparison to the average annual benefits for each alternative. Costs are annualized over a 50 year project life at an FY 1998 discount rate of 7.125%. The average annual costs are subtracted from average annual benefits to calculate net benefits and determine the optimal plan which maximizes net benefits. Table 32 shows average annual benefits and costs, net benefits and the benefit-cost ratios associated with each alternative.

TABLE 32
BENEFIT/COST MATRIX FOR WITH-PROJECT ALTERNATIVES
(MARCH 1998 PRICE LEVEL AND 7.125% DISCOUNT RATE)

	Stone Revetment	25 ft Berm	50 ft Berm	100 ft Berm
Average Annual Benefits				
Storm Damage Reduction	515,000	373,000	515,000	560,000
Reduced Federal Maintenance Dredging Costs		167,000	181,000	199,000
Total Average Annual Benefits	515,000	540,000	696,000	759,000
Average Annual Costs	479,000	393,000	425,000	498,000
Net Benefits	36,000	147,000	271,000	261,000
Benefit-Cost Ratio	1.1	1.4	1.6	1.5

Average Annual Costs include Interest During Construction (IDC) and Real Estate costs.

306. **IDENTIFICATION OF THE NED PLAN.** The National Economic Development (NED) plan is defined as the plan that maximizes beneficial contributions to the Nation while meeting the planning objectives. The NED plan is the plan that maximizes net benefits. The 50 ft berm plan is identified as the NED plan. This plan provides the maximum net benefits.

307. **ECONOMICS OF THE NED PLAN.** Table 33 shows the average annual residual damages for the structures (including contents) for the NED plan by reach and damage mechanism. Table 34 shows the total average annual residual damages (including structures, contents, shore protection structures, and improved property) for the NED plan. The residual damages for the NED plan equal $385,000 on an average annual basis. Table 35 presents the economics of the NED plan.

TABLE 33
AVERAGE ANNUAL DAMAGES FOR STRUCTURES FOR NED PLAN
(MARCH 1998 PRICE LEVEL & 7.125% DISCOUNT RATE)

	Erosion	Inundation	Total
Reach 1	88,000	38,000	126,000
Reach 2	51,000	63,000	114,000
Reach 3	37,000	13,000	50,000
Reach 4	0	0	0
Reach 5	17,000	7,000	24,000
Total	193,000	121,000	314,000

TABLE 34
AVERAGE ANNUAL DAMAGES
(STRUCTURES, SHORE PROTECTION STRUCTURES, & IMPROVED PROPERTY)
(MARCH 1998 PRICE LEVEL & 7.125% DISCOUNT RATE)

	Structures	Shore Protection Structures	Improved Property	Total
Reach 1	126,000	21,000	12,000	159,000
Reach 2	114,000	9,000	7,000	130,000
Reach 3	50,000	6,000	4,000	60,000
Reach 4	0	0	0	0
Reach 5	24,000	8,000	4,000	36,000
Total	314,000	44,000	27,000	385,000

TABLE 35
ECONOMICS OF NED PLAN

Average Annual Benefits	696,000
Average Annual Costs	425,000
BCR	1.6
Net Benefits	271,000

308. **ECONOMIC OPTIMIZATION OF PERIODIC NOURISHMENT CYCLE.** Once the NED plan was identified, the periodic nourishment cycle was economically optimized. Quantities for the 2 through 9 year nourishment cycles are shown in Table 36. Initial construction and periodic nourishment costs were computed for the cycles. Table 37 shows the economic comparison of the nourishment cycles including average annual costs, average annual benefits, net benefits and BCR. The 8 year cycle is the economically optimal cycle. Cost estimates for placement of beachfill at Oakwood Beach in 4 year intervals assume reductions in costs due to coincidental Federal maintenance dredging operations in the Delaware River at Reedy Island range.

TABLE 36
PERIODIC NOURISHMENT QUANTITIES (CUBIC YARDS)
(2 THROUGH 9 YEAR NOURISHMENT CYCLES)

Nourishment Cycle (years)	Initial Construction Quantities (includes advanced nourishment) (cubic yards)	Periodic Nourishment Quantities (cubic yards)
2	507,000	10,000
3	512,000	15,000
4	517,000	20,000
5	522,000	25,000
6	527,000	30,000
7	532,000	35,000
8	537,000	40,000
9	542,000	45,000

TABLE 37
BENEFIT-COST COMPARISON FOR PERIODIC NOURISHMENT
(2 THROUGH 9 YEAR CYCLES)
(7.125%, MARCH 1998 PRICE LEVEL)

Nourishment Cycle (years)	Average Annual Benefits	Average Annual Costs	Net Benefits	BCR
2	696,000	568,000	121,000	1.21
3	696,000	531,000	158,000	1.30
4	696,000	418,000	271,000	1.65
5	696,000	457,000	232,000	1.51
6	696,000	433,000	256,000	1.59
7	696,000	432,000	257,000	1.59
8	696,000	377,000	312,000	1.83
9	696,000	407,000	282,000	1.69

309. **REFINEMENT IN DESIGN OF NED PLAN.** Prior to the final design of the NED plan it was determined that the slope of the berm foreshore could be steepened from 1V:20H to 1V:10H. This resulted in an approximately 37% reduction in quantity and a 19% reduction in average annual costs of the NED plan. Prorating the quantities and costs of the other beachfill alternatives based upon these reductions and comparing them to associated reductions in potential benefits did not affect the outcome of the optimization analyses. The storm damage reduction benefits did not change as a result of the change in slope, however, the average annual reduced Federal maintenance dredging benefits were reduced from $181,000 to $149,000 due to the lesser quantity of material being removed from the channel. The 50 ft-wide berm was still identified as the NED plan. Design of the NED plan then proceeded with a berm slope of 1V:10H rather than 1V:20H.

310. Average annual reduced Federal maintenance dredging benefits were further decreased from $149,000 to $130,000 following an adjustment made to have the maintenance dredging

cycle coincide with the periodic nourishment of the project. Assuming the Reedy Island range of the Delaware River 45 ft deepening project is completed in year 2002, the same year as the Oakwood Beach project, the initial construction and subsequent periodic nourishment of the Oakwood Beach project will eliminate the need for maintenance dredging of the Reedy Island range for a number of years. Based on an estimated shoaling rate of 23,000 cy/yr and a 4 year maintenance dredging interval for the Reedy Island range (45 ft project), the Oakwood Beach project eliminates the need for maintenance dredging of Reedy Island range up to Oakwood Beach project year 20. This corresponds to the elimination of four O&M dredging cycles. Should construction of the Reedy Island range of the Delaware River 45-foot Project never occur, reduced Federal maintenance dredging benefits would still accrue to a lesser degree under existing conditions. The proposed plan at Oakwood Beach would still be justified without deepening the Delaware River main channel. Appendix C (Economic Analysis) of the main report includes a benefit to cost analysis which assumes that the deepening project is not constructed.

SELECTED PLAN

DESCRIPTION OF SELECTED PLAN

311. The selected plan is a beachfill restoration. The beachfill will consist of a 50-foot wide berm with a top elevation of +6.0 feet NAVD over a total project length of 9500 feet. The beachfill extends from the southernmost structure at Oakwood Beach (southern end of Salem-Ft. Elfsborg Road) to the northernmost structure (northern end of Slape Avenue) for a distance of approximately 9000 feet. The plan also includes two 250-foot tapers at each project terminus to tie into the existing beach. The slope of the beachfill is 1 vertical foot to 10 horizontal feet from the edge of the berm to the depth of closure. The plan also provides for the extension of two existing outfalls. Figures 26 and 27 show the limits of the selected plan including the tapers, and a typical cross-section of the beachfill is shown in Figure 28.

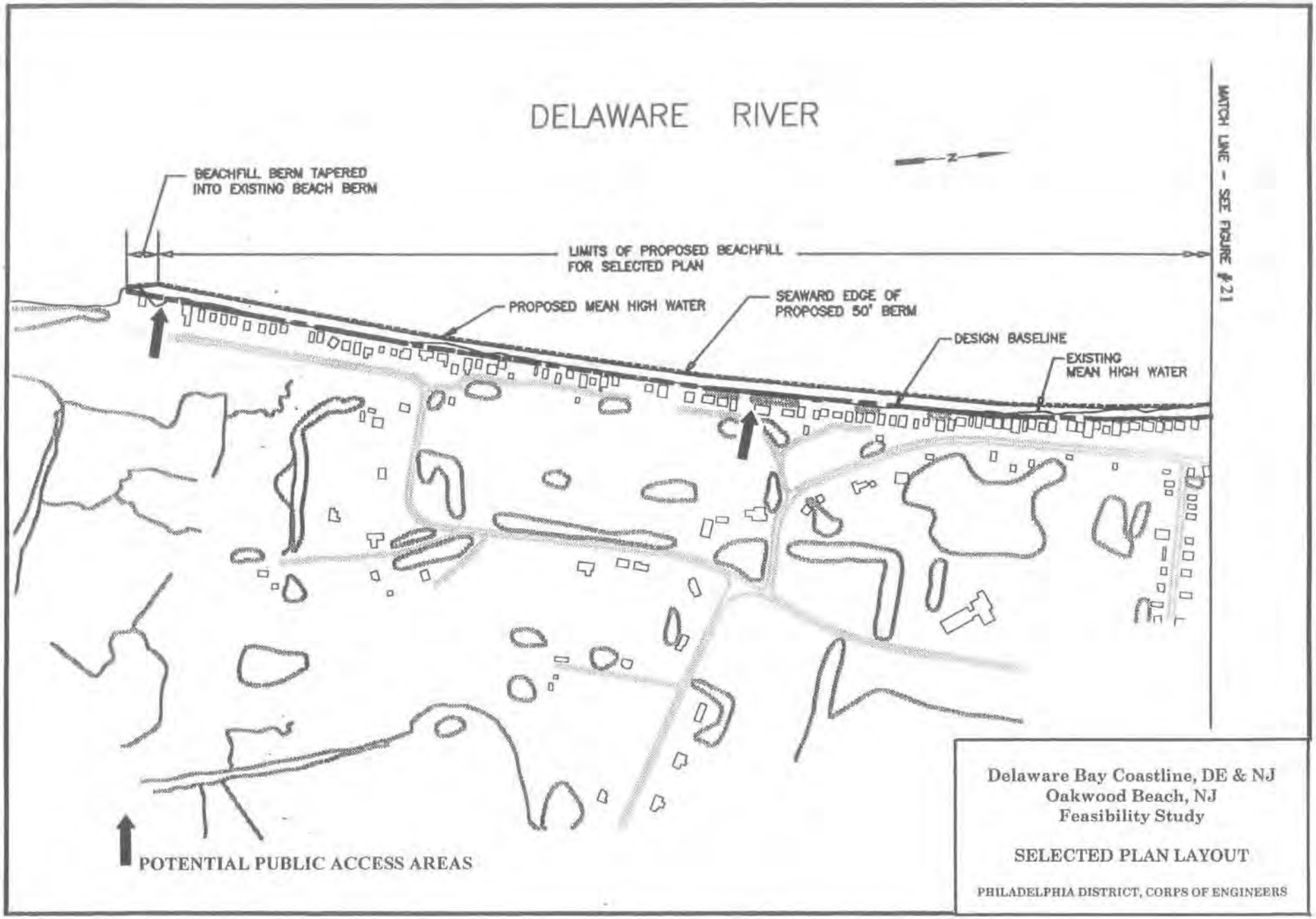
312. Historic sources of information, including maps and photographs, were investigated to determine historic shoreline location and beach widths at Oakwood Beach. The best estimate of historic (within the past century) beach width from these sources is approximately 100 feet. The selected plan provides for a beach width of 50 feet. The selected plan does not exceed the width of the historic beach at this location.

313. A total initial volume of 332,000 cubic yards of sand fill will be placed along the project area. This fill volume includes initial design fill requirements and advanced nourishment. The Reedy Island range of the Delaware River main navigation channel provides the closest source of suitable quality and quantity of sand for beachfill at Oakwood Beach. Periodic nourishment of 32,000 cubic yards of sand dredged from the Delaware River main channel will be placed every 8 years. Periodic nourishment will be accomplished through dredged material from maintenance of the Delaware River main channel. This would be accomplished on approximately an 8 year cycle coincidental with normal maintenance activities. Total quantities for the selected plan are shown in Table 38.

TABLE 38
TOTAL QUANTITIES FOR SELECTED PLAN

Feature	Quantity
Beachfill (c.y.)	
Berm	300,000
Advanced Nourishment	32,000
Total Initial Quantity	332,000
Periodic Nourishment (c.y.) (8 year cycle)	32,000

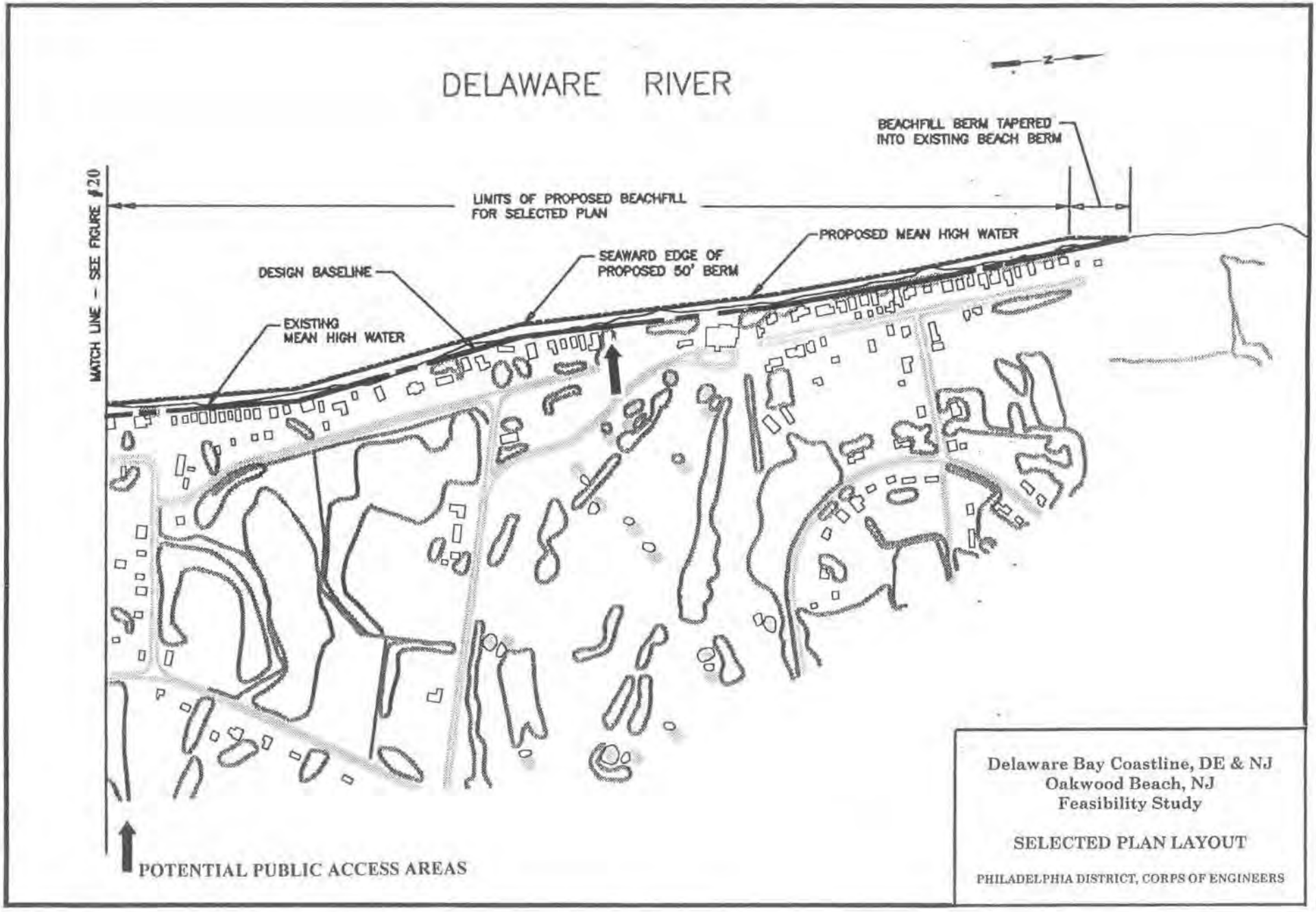
FIGURE 26



Delaware Bay Coastline, DE & NJ
Oakwood Beach, NJ
Feasibility Study

SELECTED PLAN LAYOUT

PHILADELPHIA DISTRICT, CORPS OF ENGINEERS



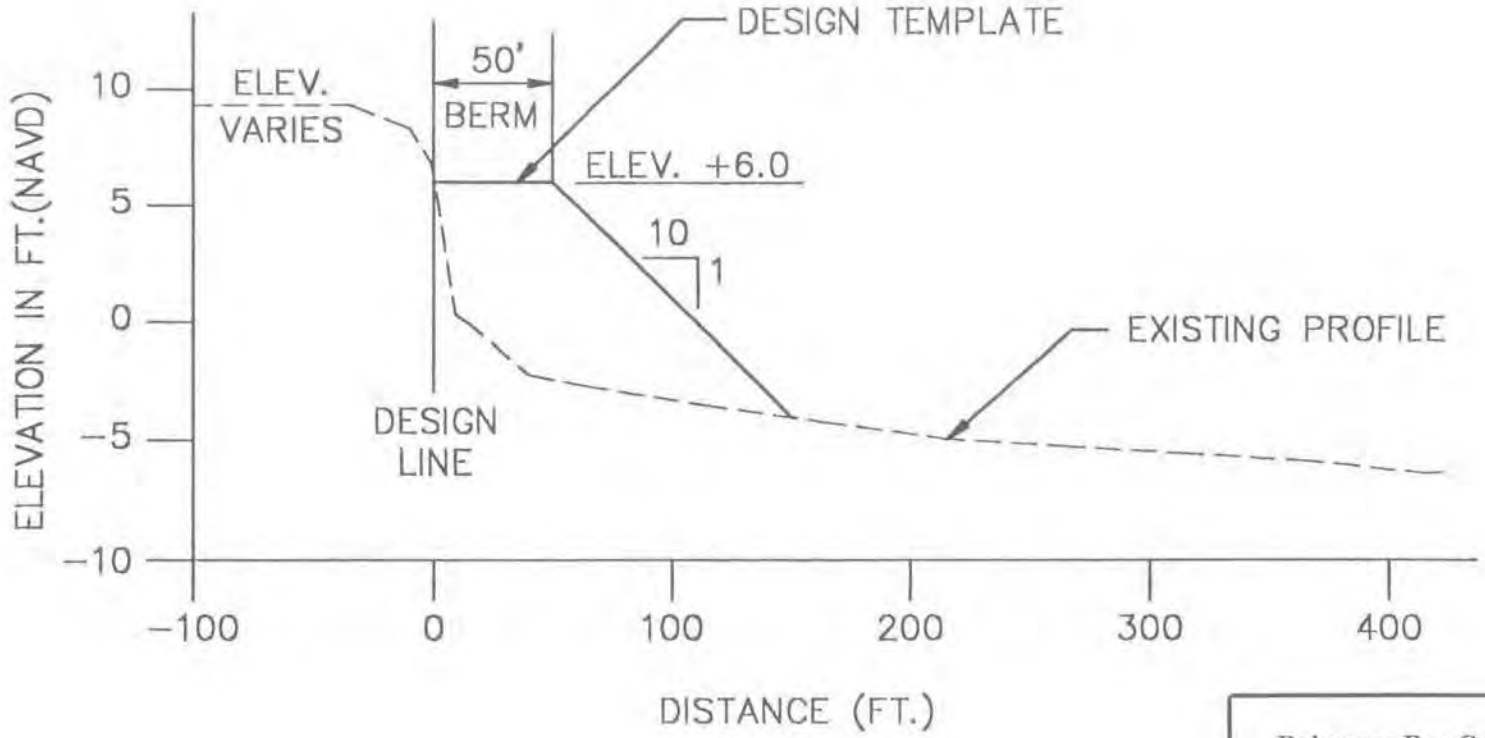
Delaware Bay Coastline, DE & NJ
Oakwood Beach, NJ
Feasibility Study

SELECTED PLAN LAYOUT

PHILADELPHIA DISTRICT, CORPS OF ENGINEERS

FIGURE 27

FIGURE 28



Delaware Bay Coastline, DE & NJ
Oakwood Beach, NJ
Feasibility Study

SELECTED PLAN
DESIGN TEMPLATE

PHILADELPHIA DISTRICT, CORPS OF ENGINEERS

314. The granular material located in the proposed project borrow area may be classified as a poorly graded medium to coarse sand with some gravel. The borrow material is coarser than the granular material currently located on Oakwood Beach, and is significantly coarser than any other source of borrow used by the Philadelphia District anywhere in its beachfill program. As such, it is expected that the borrow material will have a long residence time on the beach. Based upon experience and additional vibrocore information, an overfill factor of 1.0 is applied to the selected plan quantities. More than enough quantity has been identified to provide the Oakwood Beach project with beach-quality sand for the entire life of the project.

REAL ESTATE

315. Refer to the Real Estate Plan as prepared by the Baltimore District in Appendix D which includes an assessment of the non-Federal sponsor's acquisition capabilities, baseline Real Estate cost estimate, and the Real Estate mapping.

PUBLIC USE AND ACCESS

316. **SHORELINE OWNERSHIP.** The shoreline at Oakwood Beach consists of seventy-five privately-owned parcels and one commercially owned parcel. The owners of these properties own the land out to the Mean High Water Line (MHWL). The bayward edge of these properties will be impacted by the proposed project. The construction, operation and maintenance of the proposed project will require a standard perpetual beach nourishment easement over 3.34 acres. Submerged lands below the Mean High Water Line (MHWL) of the Delaware River to the Mean Low Water Line (MLWL) are owned by the State of New Jersey and managed by the NJDEP Bureau of Tidelands Management. The MLWL demarcates the state boundary between New Jersey and Delaware with Delaware owning the submerged land from the MLWL on the New Jersey shoreline to the MHWL on the shoreline of Delaware.

317. **PUBLIC USE.** Oakwood Beach is currently not a tourist destination nor is it anticipated to be following project construction. Recreational benefits are not being claimed for the project. The primary project purpose is hurricane and storm damage reduction. Changes in the visitation volume from the existing condition as a result of the project are anticipated to be minimal. Nearby townships that have small beaches along the Delaware River do not attract visitors from outside the immediate area. Nearby street parking is unrestricted and is expected to accommodate all anticipated public use. Non-residents that use the area now are primarily boaters that use the Salem River and Cove.

318. **PUBLIC ACCESS.** Public pedestrian access to the beach will be provided approximately every one-half mile. The non-Federal sponsor is responsible for maintaining the access ways. The final location and dimensions of these access points will be coordinated with the sponsor and the local community during the development of plans and specifications. The most likely locations as proposed by local township officials to date are shown on Figures 26 and 27. Coordination is ongoing to identify other areas as well. The easements required to provide public use of and access to the beach are interests beyond those required to construct, operate,

and maintain the project. The value of such easements is not included in total project costs and credit shall not be provided to the non-Federal sponsor.

PROJECT MONITORING PLAN

319. A beachfill project has a limited longevity and must undergo periodic inspection, maintenance and renourishment in order to preserve project functionality over the designed lifetime. The project monitoring plan will evaluate beachfill performance and determine conditions within the borrow areas over the project life. Periodic assessments and monitoring data analysis will assist in producing recommendations for modifications to the quantities, locations, and cycle of future fills based on actual trends of fill behavior. The monitoring program for Oakwood Beach was developed in accordance with ER-1110-2-1004, ER-1110-2-1407, CETN-II-26, and CETN-II-35. The following items are to be included in the project monitoring plan: Pre- and post-construction beach profile surveys, annual monitoring profile surveys, sediment sampling of beach and borrow areas, aerial photography, and vibrocore testing in the borrow area. The field data collection will be followed up by lab and data analyses. The proposed monitoring program will begin at the initiation of pre-construction efforts and will continue throughout the project life. The project monitoring plan is associated with the continuing construction of the project and will be cost-shared as a project cost. Costs of the project monitoring plan are estimated at $9,000 annually.

NED BENEFITS SUMMARY

320. Table 39 presents a summary of the average annual NED benefits associated with the selected plan.

TABLE 39
AVERAGE ANNUAL NED BENEFITS OF SELECTED PLAN
MARCH 1998 PRICE LEVEL
FY 98 DISCOUNT RATE OF 7.125%

Benefit Category	Benefits
Structures and Contents	$365,000
Shore Protection Structures	$ 98,000
Improved Property	$ 55,000
Total Storm Damage Reduction Benefits	$518,000
Reduced Federal Maintenance Dredging Costs	$130,000
TOTAL	$648,000

PROJECT IMPACTS

321. **IMPACTS TO ENVIRONMENTAL RESOURCES.** The following paragraphs describe the environmental impacts associated with the selected plan. As part of the berm restoration approximately 23.7 acres will be covered, of this approximately 3.3 acres will be intertidal and 20.4 acres will be below mean water.

322. **Impacts on Vegetation.** The selected plan will prevent the erosion of the shore and thus prevent the loss of vegetated yards. The berm would provide a new habitat for beach plants to colonize.

323. **Impacts on Wetlands.** Since there are no wetlands on the site none will be impacted.

324. **Impacts on Water Quality.** The selected plan may have a short-term effect on turbidity levels during both excavation of the borrow site and the placement of sand along the shore. Elevated levels of particulate concentrations at the discharge location may also result from "washout" after beachfill is placed. The river current in this area should carry the limited turbidity out of the area in a short time period. High turbidity levels can stress aquatic organisms by clogging respiratory organs. The turbidity may also decrease the hunting capacity of visual predators. To minimize these effects, a proper erosion and sediment control plan shall be implemented during the construction phase.

325. Short-term adverse impacts to water quality in the immediate vicinity of the dredging and placement site can occur. Aquatic ecosystems concentrate biological and chemical substances such as organic matter, nutrients, heavy metals, and toxic chemical compounds in bottom sediments. When introduced into the water column, these substances tend to bind with suspended particulate matter and eventually settle to the bottom. Dredging operations typically elevate levels of suspended particulates in the water column through excessive agitation of the sediment. Adverse impacts to the water quality may include oxygen depletion and the release of chemical substances, making them biologically available to aquatic organisms through ingestion or respiration.

326. The borrow material has very little chemical contamination. The use of sand, coupled with the absence of nearby dumping activities, industrial outfalls, or contaminated water infer the low probability that the borrow material is highly contaminated by pollutants.

327. The selected plan should have limited or no impact on pH, nutrient levels, bacteria, or DO. It also should not change the DRBC characterization of the water as fair to good.

328. **Impacts on Finfish.** The selected plan will have limited and short-term impact on finfish. With the exception of some small finfish, most bottom dwelling and pelagic fishes are highly mobile and should be capable of avoiding turbidity impacts due to placement and dredging operations. It is anticipated that some finfish may become attracted to the turbidity plume due to the suspension of food particles in the water column. The primary impact to fisheries will be felt from the disturbance of benthic and epibenthic communities. The loss of the benthos and epibenthos smothered during berm construction and removal during borrow activity will temporarily disrupt the food chain in the impacted areas. These effects are expected to be temporary as these areas become rapidly recolonized by pioneering species. Coordination with appropriate state and Federal agencies will occur to prevent construction during critical spawning and over wintering periods.

329. **Impacts on Benthos.** The primary ecological impacts of dredging the sand borrow site will be the complete removal of the existing benthic community through entrainment into the dredge. Mortality of the benthic and epibenthic organisms will occur as they pass through the dredge and/or as a result of being transplanted into an unsuitable habitat. A benthic study performed for the Delaware Estuary Program did not show significant differences between the navigation channel and the shallow/intermediate zone. The navigation channel should recover to predredged conditions. Benthic pioneer species will move in from neighboring areas. There will be an impact due to burial of the benthic community during placement activities in the intertidal and nearshore zone. The Delaware Estuary Program's study showed that this area had a lower density and biomass of benthic organisms than the other areas. This habitat should recover due to recruitment from surrounding areas.

330. **Impacts on Shellfish.** There will be a short-term impact due to burial of bivalves during placement activities in the intertidal and nearshore zones. This habitat should recover due to recruitment from surrounding areas and vertical migration through the sediment. The more mobile shellfish such as the blue crab will avoid the area during placement.

331. **Impacts on Wildlife.** The selected plan will have only short-term effects on wildlife. Most of the wildlife will avoid the construction area due to the noise of the construction activity. The wildlife will return to the area quickly after completion of the work.

332. **Impacts on Threatened and Endangered Species.** The selected plan should have no effect on Federally listed threatened or endangered species. The occasional transients will avoid the construction activity. Dredging and placement will be timed and performed in such a manner as to limit the impact to sea turtles and shortnose sturgeon.

333. The diamondback terrapin occurs primarily in emergent wetlands and shallow water habitat. It is expected that this species will not benefit from a berm restoration project, but will not be adversely impacted by a berm restoration project.

334. **Visual Impacts.** The selected plan will provide a continuous vista, made up of one type of shore protection structure. It will remove the haphazard view that is there presently. It will also provide a more natural look to the shoreline.

335. **Impacts on Air Quality and Noise Level.** Minor short-term impacts to air quality and noise levels would result from the construction phase of the selected plan. Dredging activities and grading equipment would produce noise levels in the 70 to 90 dBA (50 feet from the source) range. The noise would dissipate with distance. Ambient air quality would also be temporarily degraded, but emission controls and limited duration aid in minimizing the effects. The noise levels and air quality impact would be limited to those produced by heavy equipment. No long-term significant impacts to the local air quality are anticipated.

336. **Impacts on Recreation.** The selected plan will provide opportunities for bird watching and fishing. There might be an increase in use of the area by nonresidents when additional public access points are established.

337. **IMPACTS TO CULTURAL RESOURCES.** Proposed project construction has the potential to impact cultural resources in three areas. These are the existing beach shoreline, the submerged near-shore sand placement area and the channel borrow area. In the beach and near-shore sand placement areas, potential impacts to cultural resources could be associated with the placement and compaction of sand during berm construction. Dredging activities in the channel borrow area could impact submerged cultural resources.

338. On the basis of the current project plan, the Corps is of the opinion that sand placement within the 50 foot wide shoreline and near-shore areas will have no effect on significant cultural resources. The soil deposits within this very narrow 50 foot wide area have been severely eroded and reworked up to the existing shore protection structures. Because the likelihood for intact and undisturbed cultural resources is considered extremely minimal due to this disturbance, no cultural resources investigations were conducted in this area.

339. Project construction will be conducted on the river-side of the existing shore protection structures and will have no effect on existing residential structures located adjacent to the construction area.

340. The project borrow area was investigated for cultural resources in 1993 as part of the larger Delaware River Channel Deepening project (Cox 1995). Previously undredged areas in the channel borrow area, including selected channel and channel side-slope areas, were investigated by remote sensing. Results of this study showed that no significant targets exhibiting cultural resources characteristics were located in the borrow area.

341. Considering the severely eroded conditions of the project area shoreline and the results of previous cultural resources investigations in the project borrow area, the Philadelphia District finds that the proposed project, as detailed in the Feasibility Report, will have no effect on significant cultural resources. Under Section 106 consultation, both the New Jersey and Delaware State Historic Preservation Offices support the No Effect decision.

342. **GEOTECHNICAL IMPACTS.** The implementation of the selected plan will entail cutting a deeper channel into the Mount Laurel-Wenonah formation where it outcrops in the Delaware River main channel. A large portion of the Mount Laurel-Wenonah formation is currently directly exposed to the waters of the Delaware River in the vicinity of the project.

343. A review of available literature suggests that the Mount Laurel-Wenonah aquifer has already suffered some limited salt-water intrusion, by vertical leakage from the overlying Vincentown and Cape May formations and also potentially from where it currently daylights in the Delaware River main channel.

344. The hydraulic gradient of the aquifer runs from central New Jersey to the southwest and toward the Salem and Delaware Rivers. The potential for local reversal of this gradient exists due to overpumping, especially in the times of drought.

345. The selected plan will slightly increase the exposure of the Mount Laurel-Wenonah aquifer to waters of the Delaware River. However, the dredging action will not require the removal of any fine-grained sediment which would act as an aquiclude or an aquitard. The sediment which is proposed to be removed from the borrow area is a coarse sand with some gravel-sized particles. As such the hydraulic conductivity of the material can be estimated from literature as 30 to 3000 feet per day.

346. Since the high permeability Mount Laurel-Wenonah aquifer is already directly exposed to the Delaware River, the potential for salt-water intrusion into the aquifer in the vicinity of the project already exists. The minimal additional exposure of the aquifer to the brackish water of the Delaware River is considered negligible. However, in an effort to minimize the area exposed, dredged cut depths will be kept as small as possible. It is estimated that the additional area of aquifer exposed to the Delaware River will be approximately 50,000 square feet over a two-mile stretch of the river.

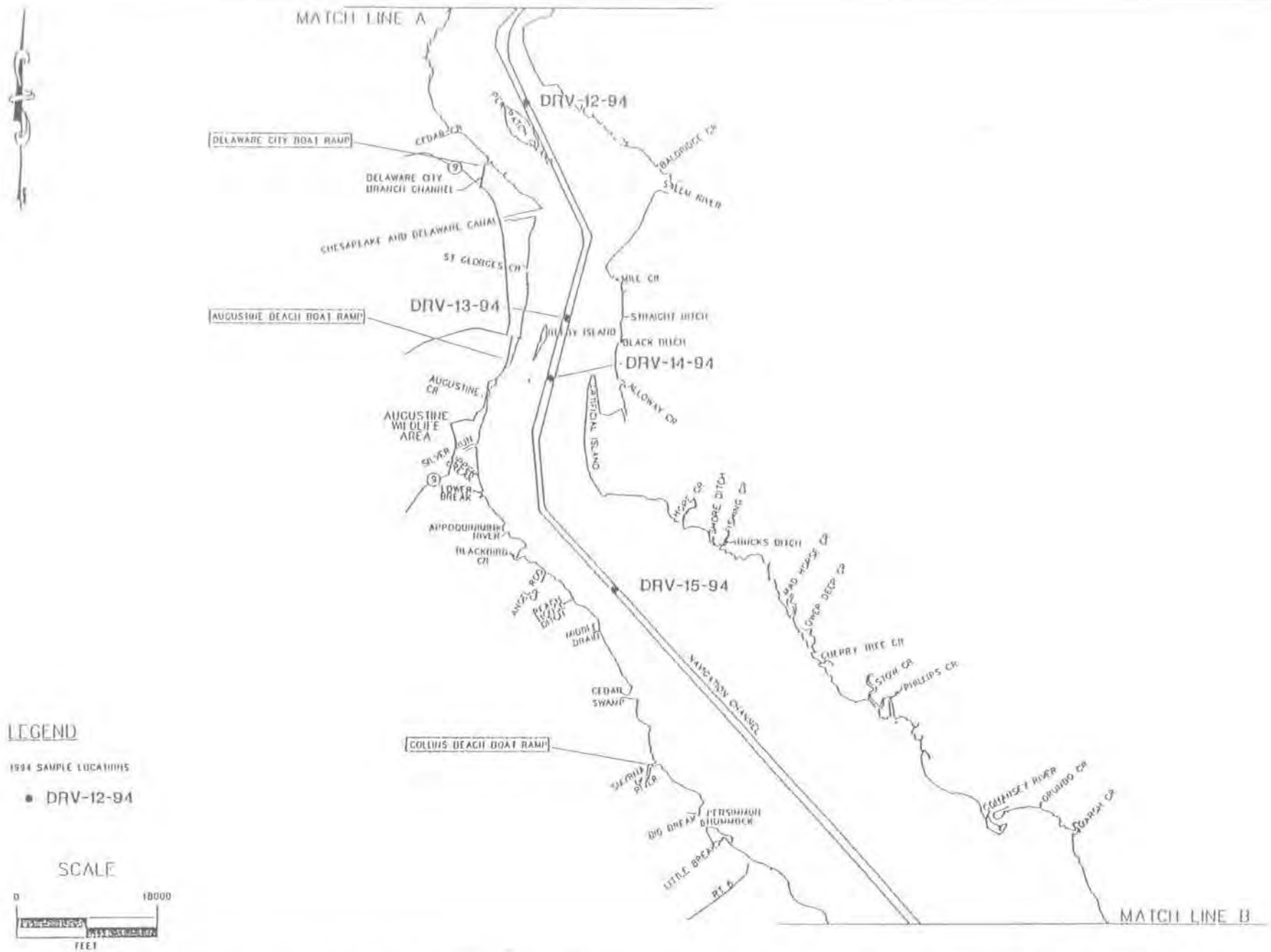
347. **HAZARDOUS, TOXIC AND RADIOLOGICAL WASTE ASSESSMENT.** In accordance with ER 1165-2-132 entitled Hazardous, Toxic and Radioactive Wastes (HTRW) Guidance for Civil Works Projects, dated 26 June, 1992, the Corps of Engineers is required to conduct investigations to determine the existence, nature and extent of hazardous, toxic and radioactive wastes within a project impact area. Hazardous, toxic and radioactive wastes are defined as any "hazardous substance" regulated under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), 42 U.S.C. 9601 et seq, as amended. Hazardous substances regulated under CERCLA include "hazardous wastes" under Section 3001 of the Resource Conservation and Recovery Act (RCRA), 42 U.S.C. 6921 et seq; "hazardous substances" identified under Section 311 of the Clean Air Act, 33 U.S.C. 1321, "toxic pollutants" designated under Section 307 of the Clean Water Act, 33 U.S.C. 1317, "hazardous air pollutants" designated under Section 112 of the Clean Air Act, 42 U.S.C. 7412, and "imminently hazardous chemical substances or mixtures" that EPA has taken action on under Section 7 of the Toxic Substance Control Act, 15 U.S.C. 2606.

348. A preliminary assessment was conducted for the Oakwood Beach study area to determine the potential of encountering HTRW during property acquisition and construction. A thorough literature search identified no areas of concern within a 2 mile radius of the Oakwood Beach shoreline. A report prepared by Environmental Risk Information and Imaging Services (ERIIS) for the U.S. Army Corps of Engineers Philadelphia District was the primary reference used to identify any HTRW concern sites in the study area. ERIIS is a service which provides information from numerous Federal and state environmental databases which monitor HTRW. As such, a Corps of Engineers project at Oakwood Beach will neither be impacted by nor will it impact upon any HTRW sites.

349. The Greely-Polhemus Group, Inc., prepared the report "Delaware River - Philadelphia to the Sea Chemical Analysis of Sediments" for the US Army Corps of Engineers (Urie and Ettinger, 1995). This report characterized chemically and geotechnically the sediment present in the navigational channel of the Delaware River. Sediment cores were obtained using vibrocore equipment from two sites (DRV-13-94 and DRV-14-94) in the Reedy Island range of the Delaware River, the location of the proposed project borrow area. Refer to Figure 29. The cores, which were approximately ten feet in length, were subdivided based on sediment stratification. Each sample was subjected to extensive chemical and geotechnical analysis. Bulk sediment analyses were conducted to quantify the levels of metals, pesticides, PCBs volatile organic compounds, semivolatile organic compounds, and total organic carbon (TOC). In addition, Toxicity Characteristic Leaching Procedure (TCLP) testing was conducted on the sediment to determine the potential for contaminant release. Particle size analysis was performed to characterize the nature (i.e., amounts of gravel, sand, and silt/clay) of the sediment at each sampling location.

350. Site DRV-13-94 was well oxygenated (9.0 mg/l). Sediment grain size distribution was dominated by sand and gravel to 38 mm, with very little (1.3%) silt/clay (grain size < 0.075 mm). Measured total organic carbon was 0.0% in the top 3.5 feet of sediment. The sediment grain size distribution below this was dominated by sand and gravel to 19 mm, with 6.0% smaller than 0.075 mm (silt/clay) in size. Site DRV-14-94 had a sediment grain size distribution that was dominated by sand and gravel to 19 mm, with 5.0% smaller than 0.075mm (silt/clay) in size, in the top 7.9 feet of sediment. Below this point the sediment grain size distribution was dominated by sand and gravel to 38 mm, with 3.3 % smaller than 0.075 (silt/clay) in size.

351. Table 40 lists the metals that were detected. Site DRV-13-94 showed a cadmium level (top segment - 1.100 mg/kg, bottom segment - 2.210 mg/kg) that was slightly higher than the Residential Criteria (1 mg/kg) but much lower than the Non-Residential Criteria (100 mg/kg). These Criteria are from the New Jersey Department of Environmental Protection's "The Management and Regulation of Dredging Activities and Dredged Material in New Jersey's Tidal Waters (October 1997). At both sites acetone was detected at a level that was below the Residential and Non-Residential Criteria (1000 mg/kg). The levels at DRV-13-94 were 0.0124 and 0.0131 mg/kg for the top and bottom segments respectively, while the levels at DRV-14-94 were 0.0111 and 0.0109 mg/kg for the top and bottom segments respectively. Acetone is a common laboratory solvent, and it is most likely that the detection of acetone is the result of laboratory contamination rather than contaminants in the sediments. No other chemical contaminants were detected. The New Jersey Department of Environmental Protection has approved use of this material for beach nourishment through issuance of a water quality certificate and a consistency determination with their Coastal Zone Management Regulations.



LEGEND

1994 SAMPLE LOCATIONS

• DRV-12-94

SCALE

0 10000

FEET

FIGURE 29 VIBROCORE AND BENTHIC MACROINVERTEBRATE SAMPLE LOCATIONS DELAWARE RIVER–PHILADELPHIA TO THE SEA, CHEMICAL ANALYSIS OF SEDIMENTS.

DRAWN BY:	SGS	DATE:	12/7/94
CHECKED BY:	TJK	DESIGN NO:	15029605
JOB NO:	15029.06	SCALE:	1"=10000'

TABLE 40
METALS DETECTED
DELAWARE RIVER – PHILADELPHIA TO THE SEA
CHEMICAL ANALYSIS OF SEDIMENTS

Parameters (mg/kg)	DRV-13-94		DRV-14-94	
	Above 3.5 feet	Below 3.5 feet	Above 7.9 feet	Below 7.9 feet
Arsenic	1.56	1.96	1.29	4.53
Barium	11.2	26.3	9.51	11.8
Beryllium	0.205	0.222	0.179	0.138
Cadmium	1.100*	2.210*	0.955	0.809
Copper	2.35	2.33	3.87	2.89
Nickel	4.34	4.26	5.11	4.73
Lead	7.29	12.10	5.38	9.37
Selenium	31.0	53.2	19.3	18.3
Vanadium	5.56	8.58	8.68	7.91
Zinc	14.1	15.4	12.9	29.5
* Above NJ Residential Criteria				

352. The State of New Jersey (1997) states that testing of dredged material for contaminants will not always be necessary. Case 1 - Sand: No further testing will be required if the material to be dredged is greater than 90% (grain size >0.0625). The percentage of sand in the sediment for Reedy Island Range of the Delaware River is above this criterion. Site DRV-13-94 top and bottom segments are 98.7 % and 94% sand (grain size > 0.075) respectively, while site DRV-14-94 top and bottom segments are 95% and 96.7% sand (grain size > 0.075) respectively.

353. **UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS.** The long-term adverse impact of the no action alternative would be continued erosion of the existing beach and loss of habitat and homes. Increased flooding would occur as beach loss continues. As the risk of storm damage increases, property values would decrease. The adverse impact of the proposed berm restoration would be the decreased benthic community standing stocks, which would be affected during the dredging and placement operation.

354. **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 biological productivity and the economy of the project area. The proposed berm restoration would protect and restore this shoreline habitat over the project life (50 years).

355. **IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES.** The no action alternative does not involve a commitment of resources. The proposed berm restoration 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 reestablish with cessation of sand placement activities.

356. **CUMULATIVE EFFECTS.** Cumulative impacts as defined by CEQ regulations are 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."

357. Berm restoration projects are becoming increasingly common in coastal areas of high development. Numerous beach nourishment projects have been conducted along the Atlantic Ocean and Delaware Bay coasts since the 1960's by local, state, and Federal agencies, as well as private interests. Depending on circumstances such as the methods 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 beachfill projects over structural alternatives. If properly planned, impacts are short-term resulting in minor ecological effects.

358. Since this project was designed to minimize adverse environmental effects of all types the project should not culminate in adverse cumulative impacts on ecological or socio-economic resources, and should result in the overall improvement of the ecosystem.

359. There are a number of other Corps' projects planned in the Delaware Bay that involve either shoreline protection or ecosystem restoration. The Delaware River Main Channel Deepening Project would restore approximately 135 acres of tidal wetlands at Egg Island Point, New Jersey, and 60 acres at Kelly Island, Delaware. In addition, approximately 2 miles of tidal marsh would be protected with geotextile tubes from erosion. The proposed projects at Reeds Beach to Pierces Point, New Jersey and Villas and Vicinity, New Jersey provide for restoration of approximately 50 acres of horseshoe crab and shorebird habitat and 82 acres of horseshoe crab and shorebird habitat respectively. Another environmental restoration was evaluated at Port Mahon, Delaware, where approximately 21.4 acres of tidal marsh would be restored, as well as 4,900 feet of beach restoration. All of these projects have been planned in coordination with the appropriate state and Federal resource agencies, and should be valuable to fish and wildlife resources, especially horseshoe crabs and shorebirds. The Maurice River, New Jersey project was terminated due to emergency action undertaken by the sponsor. On the Delaware side, a final report was completed in May 1997 for a beach restoration project at Roosevelt Inlet-Lewes Beach. The project entails a small beachfill plan using the inlet as the borrow source and reconstructing the south jetty. No opportunity for ecosystem restoration was identified. Impacts to the area are minimal since the inlet is regularly maintained for navigation purposes. For the Broadkill Beach project, the final report was completed in October in 1996. The proposed project provides for a beachfill plan using an offshore borrow area. Impacts to the borrow area are anticipated to be minimal.

360. **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 first avoids and then minimizes adverse impacts and last, compensates for unavoidable impacts.

361. 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. The selection of a previously disturbed area as a borrow site reduces the impacts to the benthic environment. In addition, construction will occur during times when impact to spawning or overwintering shortnose sturgeon and sea turtles will be minimized.

362. The majority of the unavoidable impacts are likely to be incurred by the benthic communities within the borrow area and deposition site. One measure to reduce impacts includes conducting operations during months of lowest biological activity.

363. Air quality and noise impacts can be reduced by utilizing heavy machinery fitted with approved muffling apparatus that reduces noise, vibration, and emissions.

364. **ENVIRONMENTAL JUSTICE.** The selected plan described in this study complies with Executive Order 12989-Environmental Justice in Minority Populations and Low-Income Populations, dated February 11, 1994; and no impacts are expected to occur. The project is not located in close proximity to a minority or low-income community area.

PROJECT COST ESTIMATE

365. **INITIAL CONSTRUCTION COSTS.** The estimated first cost for the selected plan is $3,314,000 (March 1998 price level) which includes real estate acquisition costs (including administrative costs), pre-construction engineering and design (PE&D), construction management (S&A) and associated contingencies. PE&D costs include preparation of plans and specifications; geotechnical testing; environmental, cultural and pre-construction monitoring; and the development and execution of the Project Cooperation Agreement (PCA). A summary of the first cost is shown in Table 41.

366. **PERIODIC NOURISHMENT COSTS.** Periodic nourishment is expected to occur at 8 year intervals subsequent to the completion of initial construction. Based on a volume of 32,000 cubic yards for each nourishment cycle, the total cost per operation (or cycle) is estimated to be $567,000 (March 1998 price level). A cyclical nourishment cost of $749,000 is expected every 8 years less $182,000 in savings associated with additional capacity at Artificial Island and elimination of dredging and transportation costs to Artificial Island.

367. **MAJOR RENOURISHMENT COSTS.** Major renourishment quantities were developed in accordance with ER 1110-2-1407 to identify additional erosional losses from the project due to higher intensity (low frequency) storm events. The periodic nourishment rates developed for the project alternatives already include losses due to more frequent storms. Major renourishment costs have been factored into future costs based on an event in project year 24 (approximately mid-life for the project) which would require major beach renourishment during periodic nourishment in year 24. Major renourishment costs are based on a quantity of 100,000 cubic yards which is approximately one-third of the initial construction quantity. The cost of major renourishment along with periodic nourishment in year 24 is estimated at $1,651,000.

TABLE 41
TOTAL FIRST COST SUMMARY
(MARCH 1998 PRICE LEVEL)

Description of Item	Quantity	Unit	Unit Price	Estimated Amount	Contingency	Total Amount
Lands and Damages (01.)						
Acquisitions (0102)	1	Job	LS	$173,400	$26,010	$199,410
Condemnations (0103)	1	Job	LS	$15,500	$2,325	$17,825
Appraisals (0105)	1	Job	LS	$12,000	$1,800	$13,800
Real Estate Payments (0115)	1	Job	LS	$20,800	$3,120	$23,920
Total Lands and Damages				**$221,700**	**$33,255**	**$254,955**
Relocations (02.)						
Mobilization, Demobilization, and Preparatory Work (02.03.01)	1	Job	LS	$6,169	$741	$6,910
Timber Pile Supports (02.03.18.02.03)	6	EA	$1,785	$10,710	$1,606	$12,316
30-Inch Diameter Ductile Iron Pipe (02.03.18.15.05)	25	LF	$208.52	$5,213	$782	$5,995
12-Inch Diameter Ductile Iron Pipe (02.03.18.15.06)	50	LF	$65.98	$3,299	$495	$3,794
Total Relocations				**$25,391**	**$3,624**	**$29,015**
Beach Replenishment (17.0)						
Mobilization, Demobilization and Preparatory Work (17.00.01)	1	Job	LS	$ 487,129	$58,455	$ 545,584
Sand Fill Placement (17.00.16.02.01)	332,000	CY	$4.63	$1,537,160	$230,574	$1,767,734
Total Beach Replenishment				**$2 ,024,289**	**$289,029**	**$2,313,318**
Preconstruction Engineering and Design (30.)						
Pre-construction Engineering and Design (PE&D) (30.)	1	Job	LS	$403,000	$60,450	$463,450
Construction Management (31.)						
Construction Management (S&A) (31.)	1	Job	LS	$220,000	$33,000	$253,000
Project Total						
Total Project First Cost				$2,894,380	$419,358	$3,313,738
Total Project First Cost (Rounded)				**$2,895,000**	**$419,000**	**$3,314,000**

368. **OPERATION, MAINTENANCE, REPAIR, REPLACEMENT, AND REHABILITATION (OMRR&R) COSTS.** The operation and maintenance of the project is the responsibility of NJDEP, the non-Federal sponsor. The annual operation and maintenance of the project includes annual surveys of four profile lines estimated at $4000 annually. Also included as part of the non-Federal sponsor's OMRR&R responsibilities will be an annual cost of $2000 to correct localized accumulation or depletion of the beach berm and foreshore. The annual cost for this maintenance is estimated to be $6,000 annually, and is based on operation and maintenance experience for similar beachfill projects within the Philadelphia District. The non-Federal sponsor bears the full financial responsibility for these OMRR&R activities.

369. **INTEREST DURING CONSTRUCTION.** Interest during construction is estimated at $88,000. It is assumed that the construction costs would be evenly distributed over the construction period. The duration of construction for the project is estimated at four months. The preconstruction engineering and design phase will begin two years prior to the start of construction. Therefore, in accordance with ER 1105-2-100, paragraph 6-153, interest during construction was based on 28 months.

ANNUALIZED COSTS

370. Initial costs and periodic nourishment costs were provided for the project life plan design. The first cost was estimated at approximately $3,314,000 for the proposed plan using a March 1998 price level and a 7.125% discount rate. A periodic nourishment cost of $749,000 is expected every 8 years less $182,000 in savings associated with additional capacity at Artificial Island and the elimination of dredging and transportation costs to Artificial Island. There are also approximately $9,000 in average annual costs, for monitoring, associated with the selected plan. Table 42 presents the annualization of these costs. Interest during construction included a 4 month construction period as well as a 2 year preconstruction engineering and design phase prior to the start of construction. Interest during construction is estimated at $88,000. Table 42 summarizes the total average annual cost for the proposed plan estimated at $336,000.

ECONOMICS OF THE SELECTED PLAN

371. The selected plan provides total average annual benefits of $648,000 at a total average annual project cost of $336,000. Interest during construction is estimated to be $88,000. Total average annual benefits and costs are displayed by category in Table 43. The result is a benefit-cost ratio of 1.9 with $312,000 in annualized net benefits.

COST APPORTIONMENT

372. The cost apportionment between the Federal and non-Federal total first cost of the selected plan under the Water Resources Development Act of 1986 is shown in Table 44. The selected plan has been shown to be economically justified on benefits associated with storm damage reduction and reduced Federal maintenance dredging benefits. There are no separable recreation features included with this project.

TABLE 42
PRESENT WORTH COST ANALYSIS
8 YEAR NOURISHMENT CYCLE
MARCH 1998 PRICE LEVEL & 7.125% DISCOUNT RATE
BASE YEAR 2002

TYPE	YEAR	COST	PW FACTOR	PW COST
First Costs-Includes PED and S&A	0	3,029,768	1.000000000	3,029,768
IDC	0	88,000	1.000000000	88,000
Real Estate	0	283,970	1.000000000	283,970
Monitoring (Beach Samples & Beach Analysis)	1	12,000	0.933488915	11,202
Monitoring	2	4,000	0.871401554	3,486
Monitoring	3	4,000	0.813443691	3,254
Monitoring (Beach Samples & Beach Analysis)	4	12,000	0.759340668	9,112
Monitoring	5	4,000	0.708836097	2,835
Monitoring	6	4,000	0.661690639	2,647
Monitoring (Beach Samples, Beach Analysis & Borrow Sediment Samples)	7	17,000	0.617680876	10,501
Monitoring	8	4,000	0.576598251	2,306
Periodic Nourishment	8	567,000	0.576598251	326,931
Monitoring (Beach Samples & Beach Analysis)	9	12,000	0.538248075	6,459
Monitoring	10	4,000	0.502448612	2,010
Monitoring	11	4,000	0.469030209	1,876
Monitoring (Beach Samples & Beach Analysis)	12	12,000	0.437834501	5,254
Monitoring	13	4,000	0.408713653	1,635
Monitoring	14	4,000	0.381529665	1,526
Monitoring (Beach Samples, Beach Analysis & Vibrocores)	15	62,000	0.356153713	22,082
Monitoring	16	4,000	0.332465543	1,330
Periodic Nourishment	16	567,000	0.332465543	188,508
Monitoring (Beach Samples & Beach Analysis)	17	12,000	0.310352899	3,724
Monitoring	18	4,000	0.289710991	1,159
Monitoring	19	4,000	0.270441998	1,082
Monitoring (Beach Samples & Beach Analysis)	20	12,000	0.252454608	3,029
Monitoring	21	4,000	0.235663578	943
Monitoring	22	4,000	0.219989337	880
Monitoring (Beach Samples, Beach Analysis & Borrow Sediment Samples)	23	17,000	0.205357608	3,491
Monitoring	24	4,000	0.191699050	767
Major Renourishment	24	1,651,000	0.191699050	316,495
Monitoring (Beach Samples & Beach Analysis)	25	12,000	0.178948939	2,147
Monitoring	26	4,000	0.167046850	668
Monitoring	27	4,000	0.155936383	624
Monitoring (Beach Samples & Beach Analysis)	28	12,000	0.145564885	1,747
Monitoring	29	4,000	0.135883207	544
Monitoring	30	4,000	0.126845467	507

Monitoring (Beach Samples, Beach Analysis & Vibrocores)	31	62,000	0.118408837	7,341
Monitoring	32	4,000	0.110533337	442
Periodic Nourishment	32	567,000	0.110533337	62,672
Monitoring (Beach Samples & Beach Analysis)	33	12,000	0.103181645	1,238
Monitoring	34	4,000	0.096318922	385
Monitoring	35	4,000	0.089912646	360
Monitoring (Beach Samples & Beach Analysis)	36	12,000	0.083932458	1,007
Monitoring	37	4,000	0.078350019	313
Monitoring	38	4000	0.073138874	293
Monitoring (Beach Samples, Beach Analysis & Borrow Sediment Samples)	39	17,000	0.068274329	1,161
Monitoring	40	4,000	0.063733329	255
Periodic Nourishment	40	567,000	0.063733329	36,137
Monitoring (Beach Samples & Beach Analysis)	41	12,000	0.059494356	714
Monitoring	42	4,000	0.055537322	222
Monitoring	43	4,000	0.051843474	207
Monitoring (Beach Samples & Beach Analysis)	44	12,000	0.048395309	581
Monitoring	45	4,000	0.045176484	181
Monitoring	46	4,000	0.042171747	169
Monitoring (Beach Samples, Beach Analysis & Vibrocores)	47	62,000	0.039366858	2,441
Monitoring	48	4,000	0.036748526	147
Periodic Nourishment	48	567,000	0.036748526	20,836
Monitoring (Beach Samples & Beach Analysis)	49	12,000	0.034304342	412
Monitoring	50	4,000	0.032022723	128
			TOTAL	4,480,432
CAPITAL RECOVERY FACTOR (50 YEARS @ 7.125%)				0.073607100
AVERAGE ANNUAL COSTS				329,792
O&M COSTS				6,000
TOTAL AVERAGE ANNUAL COSTS				335,792

Years 1-50 all include $2,000 for Aerials and $2,000 for H&H Hired Labor
Years 15, 31 & 47 include $50,000 for Vibrocores
Years 7,23 & 39 include $5,000 for Borrow Sediment Samples
Years 1,4,7,9,12,15,17,20,23,25,28,31,33,36,39,41,44,47, and 49 include $8,000 for Beach Samples and Analysis
Periodic Nourishment occurs on an 8 year cycle at $567,000

TABLE 43
BENEFIT-COST SUMMARY FOR THE SELECTED PLAN

Discount Rate	7.125%
Project Life	50 Years
Price Level	March 1998
Base Year	2002
Average Annual Benefits	
Storm Damage Reduction	$ 518,000
Reduced Federal Maintenance Dredging Costs	$130,000
Total AAB	**$648,000**
Total Project Costs	
Initial Construction	$3,030,000
Interest During Construction	$88,000
Real Estate/Relocations	$284,000
Periodic Nourishment (Annual) (includes major renourishment and project monitoring costs)	$79,000
Operation and Maintenance (Annual)	$6,000
Total AAC	**$336,000**
Benefit-Cost Ratio	1.9
Net Benefits	$312,000

TABLE 44
COST SHARING FOR THE SELECTED PLAN UNDER WRDA '86
(MARCH 1998 PRICE LEVEL)

ITEM				COST	
Initial Beach Replenishment				$3,030,000	
Lands, Easements, Rights-of-Way, Relocations, Disposal Areas (LERRD)				$284,000	
Periodic Nourishment (8 year cycle)				$567,000	
PROJECT FEATURE	**TOTAL COST**	**FEDERAL COST**	**%**	**NON-FEDERAL COST**	**%**
Initial Construction	$3,030,000				
LERRD	$284,000				
TOTAL INITIAL CONSTRUCTION	**$3,314,000**	**$2,154,000**	**65%**	**$1,160,000**	**35%**
LERRD Credit *		$0	0%	$262,000	100%
Cash Contribution		$2,154,000		$898,000	
Periodic Nourishment (50 years) (includes major renourishment and project monitoring costs)	$5,007,000	$3,255,000	65%	$1,752,000	35%
Ultimate Project Cost (50 years)	$8,321,000	$5,409,000	65%	2,912,000	35%

Note: Table does not include O&M costs throughout 50 year project life estimated at $300,000.
* Federal costs in the amount of $22,000 for review of the non-Federal sponsor's actions which are not creditable were deducted from the LERRD cost.

373. In accordance with Section 103 of the Water Resources Development Act of 1986 and appropriate Federal regulations, such as ER-1165-2-130, Federal participation in a project formulated for hurricane and storm damage reduction is 65 percent of the estimated total project first costs, including 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. Also included as part of LERRD are costs associated with the extensions of the outfall pipes for which the non-Federal sponsor will receive credit against the non-Federal cost share. The cost sharing for the Selected Plan is based on a total first cost of $3,314,000 and does not include interest during construction, which is used for economic justification purposes only. The total first cost is allocated $2,154,000 Federal and $1,160,000 non-Federal.

374. Under WRDA 1986 cost sharing, periodic nourishment would be cost shared in the same proportion as the initial construction. The total cost of this periodic nourishment (including major renourishment and project monitoring) is estimated at $5,007,000, allocated $3,255,000 Federal and $1,752,000 non-Federal, at March 1998 price levels. Based on a discount rate of 7.125% and a 50-year period of economic analysis, average annual initial construction costs are estimated at $250,000, while average annual costs for periodic nourishment (including major renourishment and project monitoring) are estimated at $79,000. The ultimate project cost, including initial construction and periodic nourishment (including major renourishment and project monitoring) is estimated at $8,321,000, allocated $5,409,000 Federal and $2,912,000 non-Federal.

375. 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 103 of WRDA of 1986, as amended. Under the Administration's proposed new cost sharing policy, periodic nourishment will generally be 35 percent Federal and 65 percent non-Federal. WRDA 1986 cost sharing rules pertaining to shore ownership and public use will continue to be applied (i.e. protection of private undeveloped lands will continue to be 100 percent non-Federal). Under the Administration's proposed cost sharing policy, the cost sharing for the initial construction would remain unchanged, and would be cost shared as $2,154,000 Federal and $1,160,000 non-Federal. The cost of periodic nourishment (including major renourishment and project monitoring) would be allocated $1,752,000 Federal and $3,255,000 non-Federal. The ultimate project cost, including initial construction and periodic nourishment (including major renourishment and project monitoring) is estimated at $8,321,000, allocated $3,906,000 Federal and $4,415,000 non-Federal. Refer to Table 45 for cost sharing under the Administration's proposed cost sharing policy.

TABLE 45
COST SHARING FOR THE SELECTED PLAN
ADMINISTRATION'S PROPOSED COST SHARING POLICY
(MARCH 1998 PRICE LEVEL)

ITEM				COST	
Initial Beach Replenishment				$3,030,000	
Lands, Easements, Rights-of-Way, Relocations, Disposal Areas (LERRD)				$284,000	
Periodic Nourishment (8 year cycle)				$567,000	
PROJECT FEATURE	**TOTAL COST**	**FEDERAL COST**	**%**	**NON-FEDERAL COST**	**%**
Initial Construction	$3,030,000				
LERRD	$284,000				
TOTAL INITIAL CONSTRUCTION	**$3,314,000**	**$2,154,000**	**65%**	**$1,160,000**	**35%**
LERRD Credit *		$0	0%	$262,000	100%
Cash Contribution		$2,154,000		$898,000	
Periodic Nourishment (50 years) (includes major replacement and project monitoring costs)	$5,007,000	$1,752,000	35%	$3,255,000	65%
Ultimate Project Cost (50 Years)	$8,321,000	$3,906,000	47%	$4,415,000	53%

Note: Table does not include O&M costs throughout 50 year project life estimated at $300,000.

* Federal costs in the amount of $22,000 for review of the non-Federal sponsor's actions which are not creditable were deducted from the LERRD cost.

376. It should be noted that the Country Club of Salem located in Reach 4 of the project is a private facility. The parcel of land owned by the Country Club of Salem is developed. The land contains a clubhouse and golf course. The beach in front of the clubhouse is not private, it is open to the public. The selected plan includes Reach 4. As such the costs assigned to prevention of damage to privately-owned developed lands, where use of the shore meets criteria for public use, are 35% non-Federal. Design of a shore protection project is first based on its technical performance and adequacy. It is technically inappropriate to design short beachfills based on the net benefits of individual reaches. This would leave gaps in the line of protection and expose members of the same community having the same contiguous shoreline to potential storm damage.

CONSTRUCTION AND FUNDING SCHEDULE

377. The selected plan will be constructed over a period of four months. A schedule for design and construction of the project is included in Appendix B, Section 17.

LOCAL COOPERATION

378. In accordance with Section 105 (a)(1) of WRDA 1986, the Oakwood Beach interim feasibility study was cost shared 50%-50% between the Federal Government and the State of New Jersey. The contributed funds of the local sponsor, the New Jersey Department of Environmental Protection (NJDEP) demonstrates their intent to support a project at Oakwood Beach, New Jersey.

379. **COORDINATION.** In an effort to keep the non-Federal sponsor involved and the local government informed, meetings were held throughout the feasibility phase. Coordination efforts will continue, including coordination of this report with other State and Federal agencies.

380. **PROJECT COOPERATION AGREEMENT.** A fully coordinated Project Cooperation Agreement (PCA) package (to include the Sponsor's financing plan) will be prepared subsequent to the approval of the feasibility phase and will reflect the recommendations of this interim feasibility study. NJDEP, the non-Federal sponsor, has indicated support of the recommendations presented in this feasibility report and the desire to execute a PCA for the recommended plan. Other non-Federal interests, such as the Township of Elsinboro, have indicated their support of the project.

381. Toward satisfying its responsibilities of local cooperation, the non-Federal sponsor will:

a. **Non-Federal Costs.** Provide non-Federal costs assigned to hurricane and storm damage reduction and as further specified below:

(1) **PED Cost Sharing Agreement.** Enter into an agreement which provides, prior to construction, 25 percent of preconstruction engineering and design (PED) costs;

(2) **PED Reimbursement.** Provide, during construction, any additional funds needed to cover the non-Federal share of PED costs;

(3) **Lands, Easements, Rights-of-Way, Relocations, and Disposal.** 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;

(4) **Initial Construction Cost Share.** Provide, during construction, any additional amounts as are necessary to make its total contribution equal to 35 percent of initial project costs assigned to hurricane and storm damage reduction;

(5) **Periodic Nourishment Cost Share.** Provide during construction of each periodic nourishment 65 percent of periodic nourishment costs assigned to hurricane and storm damage reduction;

(6) **Retaining Works and Disposal Areas.** 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, wasteweirs, bulkheads, embankments, monitoring features, stilling basins, and dewatering pumps and pipes.

b. **Operation and Maintenance.** 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.

c. **Government Access.** Give the Federal Government a right to enter, at reasonable times and in a 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.

d. **Hold and Save Clause.** Hold and save the United States free from 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.

e. **Documentation.** Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 Code of Federal Regulations (CFR) Section 33.20.

f. **Investigation of Hazardous Substances.** 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.

g. **Cleanup of Hazardous Substances.** 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.

h. **Liability for Hazardous Substances.** 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.

i. **Federal Real Estate Regulations.** 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 1987 (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 materials, and dredged or excavated material disposal, and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act.

j. **Federal and State Regulations.** 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".

k. **Cultural Mitigation.** Provide 35 percent of that portion of total historic preservation mitigation and data recovery costs assigned to initial construction of hurricane and storm damage reduction and 65 percent of those costs assigned to periodic nourishment that are in excess of one percent of the total amount authorized to be appropriated for the project;

l. **Compliance with Floodplain Programs.** Participate in and comply with applicable Federal flood plain management and flood insurance programs in accordance with Section 402 of the Water Resources Development Act of 1986, as amended (33 U.S.C. 701b-12), requiring non-Federal preparation and implementation of floodplain management plans;

m. **Floodplain Management Plan.** Within one year after the date of signing a project cooperation agreement, prepare a floodplain management plan designed to reduce the impact of future flood events in the project area. The plan shall be prepared in accordance with guidelines developed by the Federal Government and must be implemented not later than one year after completion of construction of the project.

n. **Assurance of Project Integrity.** 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 and maintenance of the project.

o. **Inform Interests of Extent of Project Protection.** Not less than once each year inform affected interests of the extent of protection afforded by the project.

p. **Floodplain Information.** 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.

q. **Public Ownership.** 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.

r. **Public Access.** Provide and maintain necessary access roads, parking areas, and other public use facilities, open and available to all on equal terms.

s. **Local Cooperation Agreement.** Recognize and support the requirements of Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended, and Section 103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended, which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof until the non-Federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element; and

t. **Project Surveillance.** At least twice annually and after storm events, perform surveillance of the beach to determine losses of nourishment material from the project design section and advance nourishment section and provide the results of such surveillance to the Federal Government.

382. **LOCAL SUPPORT/SPONSOR FINANCING.** The New Jersey Department of Environmental Protection has expressed support for a potential project. Their cooperation indicates a strong willingness to proceed with a potential solution to the storm damage problems identified at Oakwood Beach. The State of New Jersey has a stable source of funding for shore protection projects and has incorporated this project into its forecast of expenditures.

383. A fully coordinated Project Cooperation Agreement (PCA) package, including the Sponsor's financing plan and reflecting the recommendations of this feasibility study, will be prepared subsequent to the approval of the feasibility phase. The study sponsor, NJDEP, has provided funds to the District to cost share studies and projects for many years. NJDEP has a stable source of funding which provides at least $15 million annually for shoreline related projects. These funds will be used to cost share the Oakwood Beach project. Legislative efforts are underway to raise this limit to $25 million. The non-Federal sponsor has indicated their support for the proposed project, most recently in a letter dated March 2, 1999 (see Appendix A, Section 1).

CONCLUSIONS

PRECONSTRUCTION ENGINEERING AND DESIGN

384. As a requirement in completing the feasibility study, a public notice was 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 typical Design Documentation Report would not be required before the initiation of construction. The only technical work remaining consists of borrow area sampling and final environmental coordination and documentation, which can be accomplished concurrent with preparation of plans and specifications for construction. In the event that this study leads to construction, the costs for these activities shall be reimbursed by the non-Federal sponsor as a cost-shared item.

SELECTED PLAN

385. The selected plan generally extends 9500 feet along the community of Oakwood Beach and consists of the following:

- A 50-foot wide berm with a top elevation of +6.0 feet NAVD over a total project length of 9500 feet. The beachfill extends from the southernmost structure at Oakwood Beach (southern end of Salem-Ft. Elfsborg Road) to the northernmost structure (northern end of Slape Avenue) for a distance of approximately 9000 feet. The plan also includes two 250-foot tapers at each project terminus to tie into the existing beach. The total project length including tapers is 9500 feet. The slope of the beachfill is 1 vertical foot to 10 horizontal feet from the edge of the berm to the depth of closure. The plan also provides for the extension of two existing outfalls.

- A total initial volume of 332,000 cubic yards of sand fill will be placed along the project area. This fill volume includes initial design fill requirements and advanced nourishment.

- Periodic nourishment of 32,000 cubic yards of sand dredged from the Delaware River main channel will be placed at Oakwood Beach every 8 years. Periodic nourishment will be accomplished through dredged material from maintenance of the Delaware River main channel. This would be accomplished on approximately an 8 year cycle coincidental with normal maintenance activities.

- To properly assess the functioning of the proposed plan, monitoring of the placed beachfill, borrow area, and shoreline is included with the plan.

PROJECT COST SHARING

386. If this project goes to construction, the Federal Government shall contribute 65% of the first cost of the selected plan, which is currently estimated to be $2,154,000. The Federal Government shall contribute 35% of the periodic nourishment of the selected plan under the Administration's proposed cost sharing policy.

RECOMMENDATIONS

OVERALL ASSESSMENT

387. In making the following recommendations, the Philadelphia District has 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. I have evaluated several alternative plans for the purpose of hurricane and storm damage reduction. A project has been identified that is technically sound, economically cost effective over the life of the project, socially and environmentally acceptable, and has local support. Therefore, it is recommended that Federal participation be continued in the planning, design, and construction of a hurricane and storm damage reduction project for Oakwood Beach, New Jersey.

MODIFICATIONS

388. The recommendations contained herein 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 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.

26 April 99
Date

Debra M. Lewis
Debra M. Lewis
Lieutenant Colonel, Corps of Engineers
District Engineer

25 MAY 99

CENAD-DE (CENAP/July 98) (1105-2-10c) 1st End Mr. Pippens/8725
SUBJECT: Delaware Bay Coastline Delaware and New Jersey, Oakwood, Beach New Jersey, Final Feasibility Report and Integrated Environmental Assessment

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 design and construction of this hurricane and storm damage reduction project is recommended.

George C. Clarke COL, EN
FOR JERRY L. SINN
Major General, USA
Commanding

Acting Division Commander

LIST OF PREPARERS

389. The following individuals were primarily responsible for the preparation of this Draft Feasibility Report and Integrated Environmental Assessment.

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PUBLIC INVOLVEMENT AND AGENCY COORDINATION

390. A copy of the Draft Feasibility Report and Integrated Environmental Assessment was provided to the following agencies/individuals for review:

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EVALUATION OF 404(b)(1) GUIDELINES

I. Project Description

A. Location

The proposed project site includes the community of Oakwood Beach, Salem County, New Jersey. The project will use the Delaware River main navigation channel as a sand borrow area.

B. General Description

The purpose of the proposed project is to prevent damages due to storms and persistent shoreline erosion. The selected plan includes the construction of a 50-foot wide berm with a top elevation of +6.0 feet NAVD over a total project length of 9500 feet. The beachfill extends from the southern most structure at Oakwood Beach (southern end of Salem-Ft. Elfsborg Road) to the northernmost structure (northern end of Slape Avenue) for a distance of approximately 9000 feet. The plan also includes two 250-foot tapers at each project terminus to tie into the existing beach. The slope of the beachfill is 1 vertical foot to 10 horizontal feet from the edge of the berm to the depth of closure. The plan also provides for the extension of two existing outfalls.

C. Authority and Purpose

Authorization to undertake this study was established by a resolution adopted by the Committee on Public Works and Transportation, United States House of Representatives, on October 1, 1986. The resolution states:

"RESOLVED BY THE COMMITTEE ON PUBLIC WORKS AND TRANSPORTATION OF THE UNITED STATES HOUSE OF REPRESENTATIVES, that the Board of Engineers for Rivers and Harbors is hereby requested to make a comprehensive review of the existing reports on communities within the tidal portion of the Delaware Bay and its tributaries with a view to developing and updating a physical and engineering data base as the basis for actions and programs to provide shoreline protection or to provide up-to-date information for state and local management of this coastal area and to determine whether any modifications of the conclusions and recommendations contained in the previous reports of the Chief of Engineers that pertain to the Delaware Bay Coasts of Delaware and New Jersey are advisable at the present time. Such modifications to previous conclusions and recommendations shall be cognizant of, and incorporate where feasible, the findings of the final report of the Chief of Engineers on the Shoreline Erosion Control Demonstration Program, Section 54, of Public Law 93-251."

The purpose of the project is to reduce erosion and storm damages to the beach and bayfront structures at Oakwood Beach, Salem County, New Jersey.

D. General Description of Dredged or Fill Material

1. The proposed dredged material is classified as a poorly graded medium to coarse sand with some gravel.

2. The quantity required is estimated to be approximately 332,000 cubic yards initially, with approximately 32,000 cubic yards every 8 years comprising periodic nourishment over a 50-year project life.

3. One borrow area was proposed as a source of sand material for this project. This borrow site is in the main navigation channel of the Delaware River - Reedy Island range. It is proposed that all material needed for the initial berm restoration and future nourishment will be obtained from this borrow area (see Figure 8).

E. Description of Proposed Discharge Site

1. The proposed location is depicted in Figure 2 of this report.

2. The proposed discharge site is comprised of an eroding berm and various shoreline protection structures, with a minimum design width of 50 feet along Oakwood Beach's Delaware River shoreline.

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

4. The type of habitat present at the proposed location is an oligohaline intertidal and nearshore habitat.

5. The berm restoration will be accomplished by the placement of 332,000 cubic yards of sand for initial berm placement, with 32,000 cubic yards for periodic nourishment every 8 years over a 50 year project life. The berm restoration extends from the southern most structure at Oakwood Beach (southern end of Salem-Ft. Elfsborg Road) to the northernmost structure (northern end of Slape Avenue) for a distance of approximately 9000 feet. The plan also includes two 250-foot tapers at each project terminus to tie into the existing beach. The proposed berm restoration plan includes the construction of a 50-foot wide berm with a top elevation of +6.0 feet NAVD over a total project length of 9500 feet. The slope of the beachfill is 1 vertical foot to 10 horizontal feet from the edge of the berm to the depth of closure.

F. Description of Disposal Method

A hydraulic dredge or hopper dredge would be used to excavate the borrow material from the navigation channel. The material would be transported using a pipeline delivery system to

the berm restoration site. Subsequently, final grading would be accomplished using standard construction equipment.

II. Factual Determination

A. Physical Substrate Determinations

1. The final proposed elevation of the beach substrate after fill placement would be +6.0 feet NAVD at the top of the berm. The proposed profile would be 10H:1V from the edge of the berm to the depth of closure.

2. The sediment type involved would be sand.

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 at the placement site.

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

Actions that will be taken to minimize impacts include selection of fill material that is similar in nature to the pre-existing substrate.

B. Water Circulation, Fluctuation and Salinity Determinations

1. Water. Consider effects on:

a. Salinity - No effect.
b. Water Chemistry - No significant effect.
c. Clarity - Minor short-term increase in turbidity during construction.
d. Color - No effect.
e. Odor - No effect.
f. Taste - No effect.
g. Dissolved gas levels - No significant effect.
h. Nutrients - Minor short-term effect.
i. Eutrophication - No effect.
j. Others as appropriate – None.

2. Current patterns and circulation

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

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

c. Stratification - Thermal stratification occurs beyond the mixing region created by the surf zone. There is a potential for both winter and summer stratification. Stratification does not occur in the placement area due to turbulence. The normal pattern should continue post construction of the proposed project.

d. Hydrologic regime - The regime is oligohaline and estuarine. 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 5.5 feet and a spring tide range of 6.0 feet in the Delaware River. 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; utilization of clean sand and its excavation with a hydraulic dredge would also minimize water chemistry impacts.

C. Suspended Particulate/Turbidity Determinations

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

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

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

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

c. Toxic metals and organics - Because the borrow material is essentially all medium to coarse sand, high levels of toxic metals or organics are not anticipated. Table 40 shows metals detected in the borrow area. Acetone was the only organic detected.

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

e. Aesthetics - Construction activities associated with the fill site results in a minor, short-term degradation of aesthetics.

3. Effects on Biota

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

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

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

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

D. Contaminant Determinations

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

E. Aquatic Ecosystem and Organism Determinations

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

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

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

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

5. Effects on Special Aquatic Sites - No special aquatic sites are to be significantly impacted.

6. Threatened and Endangered Species - Several species of threatened and endangered sea turtles may be migrating through the sand borrow area depending on time of year. Sea turtles have been known to become entrained and subsequently destroyed by suction hopper dredges. Both the Atlantic and shortnose sturgeon are known to inhabit the Delaware River. Use of a hopper dredge during a time of high likely presence in the area could potentially entrain and destroy a sea turtle or sturgeon.

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

8. Actions to minimize impacts - Impacts to benthic resources can be minimized at the borrow area by dredging in a manner as to avoid the creation of deep pits, using one borrow area as the primary source of initial fill and nourishment activities, and choosing of an already disturbed area as a borrow site. 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 and sturgeon can be minimized by employing NMFS approved monitors, hardened dragarm deflectors and trawling in association with hopper dredges. The choice of when and what equipment to use will also reduce the chance of impacts occurring.

F. Proposed Placement Site Determinations

1. Mixing zone determination

a. Depth of water - 0 to 5 feet mean low water
b. Current velocity - generally under 3 feet per second mid channel
c. Degree of turbulence –Low to 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 - poorly graded medium-coarse sand with some gravel
h. Number of discharge actions per unit time - Continuous over the construction period

2. Determination of compliance with applicable water quality standards - Section 401 Water Quality Certifications and consistency concurrence with approved State Coastal Zone Management Programs have been obtained from the States of New Jersey and Delaware.

3. Potential effects on human use characteristics

a. Municipal and private water supply - No effect
b. Recreational and commercial fisheries - Short-term effects during construction.
c. Water related recreation - Short-term effect during construction.
d. Aesthetics - Short-term effect during construction.
e. Parks, national and historic monuments, national seashores, wilderness area, etc. - no effect

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

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

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

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

B. The alternative measures considered for accomplishing the project are detailed in the Plan Formulation Section of this document.

C. Water quality certification has been obtained from the states of New Jersey and Delaware.

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

E. The proposed berm restoration will comply with the Endangered Species Act of 1973. Additional informal coordination will occur prior to construction.

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

G. The proposed berm restoration 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 life stages of aquatic life and other wildlife dependent on the aquatic ecosystem; aquatic ecosystem diversity, productivity, and stability, and recreational, aesthetic, and economic values 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 placement site for the dredged material is specified as complying with the requirements of these guidelines, with the inclusion of appropriate and practical conditions to minimize pollution or adverse effects on the aquatic ecosystem.

FINDING OF NO SIGNIFICANT IMPACT

DELAWARE BAY COASTLINE, DE & NJ
OAKWOOD BEACH, NEW JERSEY
FEASIBILITY STUDY

OVERVIEW

The U.S. Army Corps of Engineers proposes to construct a berm along the Delaware Bay shoreline at Oakwood Beach, Salem County, New Jersey. The project will use the Delaware River main navigation channel as the borrow area for sand.

PURPOSE

The purpose of the proposed project is to prevent damages at Oakwood Beach due to storms and persistent shoreline erosion.

SPECIFICATIONS

The selected plan includes the construction of a 50-foot wide berm with a top elevation of +6.0 feet NAVD over a total project length of 9500 feet. The beachfill extends from the southern most structure at Oakwood Beach (southern end of Salem-Ft. Elfsborg Road) to the northernmost structure (northern end of Slape Avenue) for a distance of approximately 9000 feet. The plan also includes two 250-foot tapers at each project terminus to tie into the existing beach. The slope of the beachfill is 1 vertical foot to 10 horizontal feet from the edge of the berm to the depth of closure. The plan also provides for the extension of two existing outfalls. A total initial volume of 332,000 cubic yards of sand fill will be placed along the project area. Approximately 23.7 acres will be covered, of these approximately 3.3 acres will be intertidal and 20.4 acres will be below mean low water.

COORDINATION

The Final Feasibility Report and Integrated Environmental Assessment for the project has been coordinated with the U.S. Fish and Wildlife Service, the U.S. Environmental Protection Agency, the National Marine Fisheries Service, the New Jersey Department of Environmental Protection (NJDEP), the Delaware Department of Natural Resources and Environmental Control (DNREC), and all other known interested parties.

CRITICAL HABITAT IMPACT

The Final Feasibility Report and Integrated Environmental Assessment has determined that the proposed activity is not likely to jeopardize the continued existence of any species or the critical habitat of any fish, wildlife, or plant species which is designated as endangered or threatened pursuant to the Endangered Species Act of 1973 as amended by P.L. 96-159.

WATER QUALITY/COASTAL ZONE COMPLIANCE

The Environmental Assessment has concluded that the project can be conducted in a manner which should not violate New Jersey's or Delaware's Surface Water Quality Standards. Pursuant to Section 401 of the Clean Water Act, a 401 Water Quality Certificate has been received from the New Jersey Department of Environmental Protection and a letter was received from the Delaware Department of Natural Resources and Environmental Control indicating the Department's intent to issue a Water Quality Certificate upon review of the final project plans. Based on the information developed during preparation of the Environmental Assessment, and the application of appropriate measures to minimize project impacts, it was determined in accordance with Section 307 (c) of the Coastal Zone Management Act of 1972 that the plan complies with and can be conducted in a manner that is consistent with the approved Coastal Zone Management Programs of New Jersey and Delaware. Federal consistency determinations have been obtained from the NJDEP and DNREC.

CULTURAL IMPACTS

There are no known properties listed on, or eligible for listing on, the National Register of Historic Places that would be affected by the proposed activity. The proposed project will avoid archaeologically sensitive areas and is therefore not expected to impact any cultural resources.

RECOMMENDATION

Because the Final Environmental Assessment concludes that the proposed project is not a major Federal action significantly affecting the human environment, I have determined that an Environmental Impact Statement is not required.

15 April 99

Date

Debra M. Lewis

Debra M. Lewis
Lieutenant Colonel, Corps of Engineers
District Engineer

CLEAN AIR ACT STATEMENT OF CONFORMITY

CLEAN AIR ACT
STATEMENT OF CONFORMITY
DELAWARE BAY COASTLINE, DE & NJ
OAKWOOD BEACH, NEW JERSEY FEASIBILITY STUDY
SALEM COUNTY, NEW JERSEY

Based on the air quality 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. The proposed project would comply with Section 176 (c) (1) of the Clean Air Act Amendments of 1990.

26 April 99
Date

Debra M. Lewis
Debra M. Lewis
Lieutenant Colonel, Corps of Engineers
District Engineer

REFERENCES

Cox, J. Lee, Jr. 1986. Sensitivity Level Investigation of Cultural Resources in the Vicinity of the Main Navigational Channel, Delaware River, Wilmington to the Sea, and a Proposed Deepwater Port. Prepared for the U.S. Army Corps of Engineers, Philadelphia District.

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APPENDIX A

PERTINENT CORRESPONDENCE

Section 1 (General Correspondence)

Section 2 (USFWS Planning Aid Report)

Section 3 (Public Review Comments and Responses)

APPENDIX A

PERTINENT CORRESPONDENCE

Section 1 (General Correspondence)

APPENDIX A

Pertinent Correspondence

Section 1 (General Correspondence)

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55 S. Locust Avenue
Salem, NJ 08079

March 16, 1995

U.S. Army Corps of Engineers
Wanamaker's Building
100 Penn Square East
Philadelphia, PA

Dear Sir:

Enclosed please find a petition that has been signed by most of the river front property owners in Elsinboro Township, Salem County, NJ. I would request you review same and either respond or forward these documents to whoever can possibly offer some desperately needed help in this area.

I am, by copy of this letter, forwarding copies of the petition to our legislatures, township committee and Mayor. Mr. Faulls of your office has been very helpful in our trying to deal with this matter. Apparently, other members of the community are in contact with the EPA and the Port Authority in regard to our plight.

Your anticipated prompt attention to this matter will be greatly appreciated. Our river front property owners cannot endure another winter, harsh or otherwise. Our homes are in jeopardy and without the much needed help from agencies such as the Corps, we stand a chance of losing them. Most cannot afford the exorbitant costs of steel bulkheads and many have already replaced existing walls with new concrete walls that are severely undermined. This is an obvious situation that requires immediate action.

I will await hearing from you. Thanking you, I am,

Very truly yours,

Deborah W. Buechler

DEBORAH W. BUECHLER

Encs.
cc: Senator Raymond J. Zane
Assemblymen Collins and Stuhtrager
Senators Bradley and Launtenberg
Mayor Jack Elk
Township Committee Members
Congressman LoBiondo
Governor Christine Whitman

55 S. Locust Avenue
Salem, NJ 08079

March 1, 1996

U. S. Army Corps of Engineers
Wannamaker's Building
100 Penn Square East
Philadelphia, PA

Dear Sirs:

Please be advised that we, the undersigned, residents of the Township of Elsinboro, specifically, river front property owners, County of Salem, NJ, would like to make our problem known. As a result of the dredging and deepening of the Salem River and Delaware River, we have lost substantial amounts of beach resulting in destruction of bulk heads and total undermining of recently constructed sea walls. In the past eight to ten years, six feet of beach has disappeared.

No doubt, the problem is two-fold. First, nature has taken its toll on our beaches, however, secondly, and more importantly, dredging is an obvious and direct influence in this area. As you are aware, during the dredging the spoils have been pumped elsewhere. We have attempted to have these spoils pumped to our beaches to replenish some of what has been taken. This suggestion apparently has fallen on deaf ears and is, of course, still being offered as a possible and partial solution to this situation.

Your attention to the above matter will be greatly appreciated.

Sincerely,

Deborah W Beckler
Linda Ferguson
Bettie DeMaris
Naomi Swinson
Milton P. Smith
John Collis
Lee H Bacon
Howard C Nunn
Marjorie L. Sperry
Bonnie N Chappuis
Mary Lou McCambridge
Steven Nelson
Wm L. Richmond
Tammy Robinson
Leon Verkhaser
Margaret L. Copeland
John Wood Jr
William E. Brown
Roberta V. Pierson
James A. Ryan
Lynn B. Smith
Howard R. Davis Jr.
Virginia R. Davis
Virginia L. Lane

55 S. Locust Avenue
Salem, NJ 08079

March 1, 1996

U. S. Army Corps of Engineers
Wannamaker's Building
100 Penn Square East
Philadelphia, PA

Dear Sirs:

Please be advised that we, the undersigned, residents of the Township of Elsinboro, specifically, river front property owners, County of Salem, NJ, would like to make our problem known. As a result of the dredging and deepening of the Salem River and Delaware River, we have lost substantial amounts of beach resulting in destruction of bulk heads and total undermining of recently constructed sea walls. In the past eight to ten years, six feet of beach has disappeared.

No doubt, the problem is two-fold. First, nature has taken its toll on our beaches, however, secondly, and more importantly, dredging is an obvious and direct influence in this area. As you are aware, during the dredging the spoils have been pumped elsewhere. We have attempted to have these spoils pumped to our beaches to replenish some of what has been taken. This suggestion apparently has fallen on deaf ears and is, of course, still being offered as a possible and partial solution to this situation.

Your attention to the above matter will be greatly appreciated.

Sincerely,

John M. Gaumer
Marilyn C. Plasket
Ruth E. Bacon
Diane Hart
Don Hart
Jack R. Plasket
Ben Ferguson
Maureen Scull
Thomas Wyman
Chester Myers
James C. Hoffman
Dennis T. Kimble
Jacob L. Bullock
D. Willingham
Maris L. Heckel
Barbara Gulock
Bruce E. Hulsey
Virginia L. McCarthy
Thomas McCarthy
Louisa A. Johnson
David L. Johnson
Barbara A. Campbell
Susan C. Harris
John C. Harris

55 S. Locust Avenue
Salem, NJ 08079

March 1, 1996

U. S. Army Corps of Engineers
Wannamaker's Building
100 Penn Square East
Philadelphia, PA

Dear Sirs:

Please be advised that we, the undersigned, residents of the Township of Elsinboro, specifically, river front property owners, County of Salem, NJ, would like to make our problem known. As a result of the dredging and deepening of the Salem River and Delaware River, we have lost substantial amounts of beach resulting in destruction of bulk heads and total undermining of recently constructed sea walls. In the past eight to ten years, six feet of beach has disappeared.

No doubt, the problem is two-fold. First, nature has taken its toll on our beaches, however, secondly, and more importantly, dredging is an obvious and direct influence in this area. As you are aware, during the dredging the spoils have been pumped elsewhere. We have attempted to have these spoils pumped to our beaches to replenish some of what has been taken. This suggestion apparently has fallen on deaf ears and is, of course, still being offered as a possible and partial solution to this situation.

Your attention to the above matter will be greatly appreciated.

Sincerely,

Bertice D. Rupp
Donald C. Bedrick
Linda S. Bedrick
Peter J. Lentz, III
Peggy Lesberg
Cheryl Lyell
Ruth K. Neal
Mary K. Fridey
Raymond Henry
Phyllis Henry
Alexy Leech
Walter C. Williams

Walter I. Bacon
James C. Singleton
Sidney L. Riley
Celia G. Riley
Pamela Bright
Carol Redford
Edward J. Wuesser
Leon Weinheimer
Jerry Ryan

State of New Jersey

Christine Todd Whitman
Governor

Department of Environmental Protection

Robert C. Shinn, Jr.
Commissioner

Natural and Historic Resources
Division of Engineering and Construction

April 3, 1996

Ms. Sheila Fretz
59 South Locust Ave.
Oakwood Beach, NJ 08079

Dear Ms. Fretz:

Reference is made to your letter of March 12, 1996 to Governor Christine Todd Whitman regarding the beach erosion at Oakwood Beach. Also, reference is made to our visit with you and members of the Township of Elsinboro on Friday, March 29, 1996.

As we discussed at our meeting, the State and Army Corps of Engineers will be looking at some interim resolution in order that minimum protection can be provided to the homeowners. At the same time, we will begin to look at long term solutions for this problem. Within the next week or so, the Army Corps of Engineers and this office will be back in contact with your officials to further discuss some of the solutions that we are looking at.

If you talk to other members of the community, please tell them that in order for public funds, both federal and state, to be used in any work along the beachfront, public access to that beach area must be obtained.

If you have any concerns, please feel free to contact me at Division of Engineering and Construction, 1510 Hooper Avenue, Toms River, New Jersey, 08753, 908-255-0770.

Sincerely,

Bernard J. Moore
Administrator

mm
c Senator Raymond Zane
Lee Weir, Phila. Dist. Corps of Engrs. ✓

Phone
(908) 255-0770

1510 Hooper Avenue, Toms River, NJ 08753

Fax
(908) 255-0774

New Jersey is an Equal Opportunity Employer

April 11, 1996

Lee Weir
Philadelphia District Corps of Engineers
Wanamaker's Building
100 Penn Square East
Philadelphia, PA 19107-3390

Dear Mr. Weir:

All Oakwood Beach residents appreciate the concern your Department and the NJ DEP have shown about our severe beach erosion problem.

The following is an update of what the Mayor and I have been doing on our end so that everyone concerned will be well informed when the time comes to discuss solutions.

Thank you again for your help. Please get in touch with me if there is anything you feel I can do to help bring this situation to a positive solution.

Sincerely,

Sheila Fretz

Sheila H. Fretz
59 South Locust Avenue
Salem, NJ 08079
(609) 935-1851 Ext. 115 - Fax (609) 935-7955

FAXED 4-11-96

Fax Message
Fax No: (908) 255-0774 Page 1 of 3

April 11, 1996

Mr. Bernard J. Moore
Administrator
New Jersey Department of Environmental Protection
15109 Hooper Avenue
Toms River, NJ 08753

Re: Oakwood Beach Planning

Dear Mr. Moore:

I was very pleased to receive your letter of April 3, 1996 informing us that your Department and the Corps were beginning to look at interim and long term solutions to our erosion problem. We are all most appreciative of the speed and concern with our problem. Daily these conditions worsen and I have had to take steps to repair my property just to prevent further structural damage.

The purpose of this letter is to bring you up to date on what I am doing as far as getting the necessary information to the property owners. I shared your letter with our Mayor, Jack Elk and together with him, have been putting together a plan to inform the property owners of where we stand at this point, to address some of their questions and to begin to form a solid knowledgeable group to work with your people.

I met with about 8 people from different areas along the affected area last night. In keeping the group small, we were able to go over some general information, be brought up to date of where things stand now and also begin to develop key leaders in the different areas who can talk to the other property owners without scattering forces. The meeting went very well with everyone willing to listen to your proposals and most appreciative of the fact that the two key groups, your Department and the Corps, have been so responsive. I will be meeting with Jack Elk today to bring him up to date on our discussions at the meeting.

Our aim is to work closely with you to solve this very serious problem. We hope to work the entire group into a close unit with a few key key people passing on the concerns and questions of the entire group to you. This will keep the discussions moving quickly and save you time. Let me stress here that everyone I have spoken with is most positive about the outcome and most willing to cooperate with you. It has been a pleasure to work with groups who have a common purpose and are all moving in the same direction.

April 11, 1996

Mr. Bernard J. Moore
Administrator
New Jersey Department of Environmental Protection
15109 Hooper Avenue
Toms River, NJ 08753

Re: Oakwood Beach Planning

We will be most anxious to hear from you so we can begin the next step. While we are waiting for your plans, I will continue to pass information on to the property owners. I feel the better we are all informed, the better we will be able to work effectively with you.

I have included in this fax Jack Elk's memo to the residents concerning our progress.

Again, my thanks and those of the property owners for your timely help. I truly feel this project can end positively for all concerned.

Sincerely,

Sheila H. Fretz
59 South Locust Avenue
Salem, NJ 08079

Phone: (609) 935-1851 Ex. 115 - Fax: (609) 935-7955

cc: The Honorable Raymond Zane
Senator, 3rd. District
State of New Jersey

Lee Weir
Philadelphia District Corps of Engineers
Wanamaker's Building
100 Penn Square East
Philadelphia, PA 19107-3390

Jack Elk - Mayor - Elsinboro Township

Pg 3 of 3

ELSINBORO TOWNSHIP

April 8, 1996

Memorandum

To: Riverfront Property Owners

From: Jack Elk, Mayor Jack Elk

Re: POSSIBLE RIVERFRONT IMPROVEMENTS

With the accelerated beach erosion we have seen in the last year coupled with the severe weather we've had, it is more important than ever for all of us to take a close look at the potential for severe problems as well as ways of handling them to minimize property losses and how we could handle emergency situations should they develop along the river.

As most of you know, Carl Gaskill, Township Engineer and I, along with several of the Riverfront Property Owners have been in contact with the Army Corps of Engineers and the New Jersey Department of Environmental Protection. We had representatives from both Departments who did an actual site inspection on March 29. This site inspection brought home to them the fact that we all knew - we have a severe problem that will only get worse unless some uniform measures are taken to stop the erosion. In many places as much as a foot of solid ground as well as all the beach sand has been lost. The sand will possibly return but the solid ground will not. It is just a matter of time before all properties will be effected.

I have asked that they give us some recommendations to stop this problem and they have agreed to do so. They seem very willing to work with us. They will be working with me within the next few weeks in order to give us some options as well as what they will be able to do for us at a State Level.

Since we all have a stake in this issue, I will keep all of you informed of any and all discussions and possible solutions. At the point when these studies can be summed up into just what needs to be done and the methods of accomplishing it, I would like all of you to be a part of a meeting of all concerned parties, (property owners, Township Officials and any State and Federal Department Representatives. This meeting will give everyone involved a clear picture of what can be done and will give everyone input into our next step.

I'd appreciate any help any of you can give us in this decision making process. We all need to meet with these people to see what they are able to offer.

COPY

APR 2 5 1996

Operations Division

Honorable Bill Bradley
United States Senator
One Newark Center, 16th Floor
Newark, New Jersey 07102-5297

Dear Senator Bradley:

In the temporary absence of the District Engineer, I would like to response to your letter of April 4, 1996. I am enclosing correspondence from Sheila H. Fretz in regards to property in Elsinboro, New Jersey and dredging of the Salem River.

Model studies performed in conjunction with an environmental assessment in the Salem Cove area substantiate the Coriolis Theory in the Delaware Estuary, showing that during flood tides the strongest current action takes place on the New Jersey side. Consequently, this current action, and not the channel dredging, results in the extreme erosion of unprotected landforms like those seen from Elsinboro Point to the Salem River.

The erosion of the shoreline along the Elsinboro riverfront at Oakwood Beach has also been addressed in the Delaware Bay Coastline, Delaware and New Jersey Reconnaissance Study. This report identified that a shoreline protection project for the Oakwood Beach vicinity may be economically justified. However, Federal regulations prohibit involvement in shore protection projects along private shorelines where public use and access are not provided on a permanent basis. Currently, public access and use of Oakwood Beach has been denied by the local residents.

Bottom samples of the channel were taken in accordance with the environmental assessment of this project. These samples indicate the dredge material is primarily made up of clay, organic material, silt and very fine sand and is not of sufficient grain size to provide adequate protection to the shoreline. Therefore, we do not endorse such a course of action. If the State of New Jersey would entertain the idea of utilizing the dredge material for this purpose we would reevaluate this option of disposal.

If you have any further questions or desire additional information regarding this matter, please do not hesitate to contact me.

Sincerely,

David C. Schlessman
Major, Corps of Engineers
Acting District Engineer

Copy Furnished:

Honorable William Bradley
United States Senate
Washington, DC 20515

CENAD-CO-OP (2)
CENAP-OP (Nietta)
CENAP-PA
CENAP-DE
CENAP-EX (Giovinco)
Chip DePrefontaine

BILL BRADLEY
NEW JERSEY

COMMITTEES:
FINANCE
ENERGY AND
NATURAL RESOURCES
SPECIAL COMMITTEE ON
AGING

United States Senate

WASHINGTON, DC 20510-3001

April 4, 1996

TO:

Robert P. Magnifico
District Engineer
United States Army Corps of Engineers
Philadelphia District
Wannamaker Building, 100 Penn Square East
Philadelphia, PA 19107

RE: Property in Elsinboro, New Jersey

I forward the attached for your consideration and would appreciate receiving information in regard to this inquiry as soon as possible. Please direct your correspondence to Laurel Mackin of my staff. She can now be reached in my Newark office at One Newark Center, 16th Floor. The zip code is 07102-5297.

Thank you very much for your time and assistance in this matter, and I look forward to your prompt reply.

Sincerely,

Bill Bradley

Bill Bradley
United States Senator

BB/lmm

March 12, 1996

96 MAR 13 AM 6:01

The Honorable Bill Bradley
United States Senator
United States Senate
Washington, DC 20510 3001

Dear Senator Bradley:

Re: DRASTIC BEACH EROSION-DELAWARE RIVER SEORE
OAKWOOD BEACH, SALEM COUNTY, NEW JERSEY

I just read with interest your excellent article on preserving our New Jersey beaches in one of our local papers. I want to call a crisis situation to your attention concerning the beaches or lack thereof, along the Delaware River, especially an area known as Oakwood Beach in Salem County, South Jersey. I am writing to you on behalf of all the property owners along the Delaware River Shore in the area known as Oakwood Beach in Salem County. WE NEED IMMEDIATE HELP. Our ongoing erosion problems have now reached a CRISIS STATE. We no longer have time to debate what can be done, what should have been done or who should have done it. Your record speaks for itself in that you are willing to step forward and address problems of New Jersey residents and to step forward quickly. There are houses which at one time were located 10 feet from the water line that are now in eminent danger of being undermined by the river. This situation is made worse each time the tide moves.

We know that we are technically dealing with the State of Delaware as well as New Jersey and possibly more departments we don't even know about and we just do not know how to get results. What we do know is that time is of the essence. We need someone on the Federal level to take note of this local problem. I have always felt that being small did not mean that one can't be heard in our Country and this is certainly a time when our community must be heard. Time has run out and we can no longer wait for anyone to realize the problem. We have to come to the powers that be who can open doors and assist us. We are not here to debate why this erosion has escalated in the last months but we feel strongly that the dredging by the Corps of Engineers performed last summer to deepen the channel created a situation that, coupled with the storms of last year and the severe weather conditions of this winter caused the sand forming our beach and protection of our seawalls from the water to shift farther out into the channel. Our waterfront area has now eroded to the point where clay earth is exposed and our seawalls have either tumbled or have been undermined some 6 to 8 inches. For whatever reason, we need assistance immediately to protect what is left of our barriers from the water as well as help with finding a long term solution that we all can live with. We do not have the funds, the manpower or the expertise to correct this problem.

Senator Bill Bradley
New Jersey

Re: DRASTIC BEACH EROSION-DELAWARE RIVER SHORE
OAKWOOD BEACH, SALEM COUNTY, NEW JERSEY

Our hands are tied. Many of us have repaired seawalls within the last two or three years at the cost of thousands of dollars only to have them destroyed this year and this is before the heavy spring rains we will certainly experience shortly. WE MUST ASK THAT SOMEONE ON A STATE LEVEL STEP IN WITH SOME TYPE OF RELIEF AND A PLAN TO SECURE THIS AREA BEFORE HOUSES BEGIN TO TOPPLE INTO THE RIVER. THIS IS JUST TOO BIG A PROJECT FOR INDIVIDUALS. THE DAYS OF TAKING CARE OF THIS PROBLEM WITH A "FINGER IN THE DYKE" IS OVER.
March 12, 1996

This is just as much a catastrophe as a tornado or forest fire and I feel our Government here in New Jersey can see that this area is desperately in need of assistance. All of us pay our taxes, support our lawmakers, strive for a good solid community and do our part in the State. We now must ask for practical immediate help and expertise to solve this problem.

I must rely on your office to steer us in the right direction. May I expect a call from someone who can offer a solution?

We are ready to cooperate in any way possible to help assess the situation. Ideally, I would like to see someone on the State level meet with our Group and make an on-site inspection. I know after such an inspection, there would be no question of the need. We have done all we are able. Surely, the State of New Jersey will not stand by while a portion of its shore relocates to Delaware.

We have some of the finest wildlife areas and natural resources in the State and as property owners, we have a great concern for their preservation. We also have a great concern for our preservation as well. Knowing your interest in this area, we are appealing to you for help and direction.

Thank you for your immediate response to this letter.

Sincerely,

Sheila H. Fretz

Sheila H. Fretz
59 South Locust Ave.
Oakwood Beach
New Jersey
(609) 935-1851 Ex. 115

JUN 17 1996

Planning Division

Honorable Jack Elk
Mayor, Elsinboro Township
619 Salem - Ft. Elfsborg Road
Salem, New Jersey 08079

Dear Mayor Elk:

This is in follow up to the March 29, 1996 field visit by representatives of the Philadelphia District and subsequent coordination regarding the erosion problem at Oakwood Beach in Elsinboro.

We have considered several options and discussed the situation further with Mr. Bernard Moore of the New Jersey Department of Environmental Protection. The attached sheets summarize our conclusions on options which could be pursued in the short term. There are several actions including vinyl sheetpile and geobag/geotube protection which could be implemented locally as a stop-gap measure. We provided Carl Gaskill with brochures on these and other low cost measures for consideration as local projects, since Federal participation in these measures would not be possible in the short term.

Federal involvement may be possible in advance of the ongoing beach erosion study through beneficial use of sandy material dredged from the Delaware River channel under the authority of Section 933 of the Water Resources Development Act of 1986. However, studies would be required which would preclude this from occurring this year. Typically, the required studies might cost $100,000 and take six months and would require that we budget for them in advance. I've enclosed some guidelines for your reference on this authority.

Other options were considered to discharge material unconfined near the beach. The material in the Salem Cove disposal area is a mixture of sand and fine grained materials which is not of good quality for beachfill and would create turbidity problems if pumped unconfined on to Oakwood Beach. Significant study would be needed of material migration and impacts which may not be possible in the short-term. We also considered dredging sand from the Delaware River (see Map, Attachment 3) and discharging it into open water in the vicinity of Elsinboro Point, but cannot be placed close enough to have it nourish and protect the shoreline due to the limitations of available Government pipeline and equipment.

This may be viable as a long-term solution using dredging contractors which have the capability and equipment to perform the work.

It may be feasible for the town to haul dry, sandy material by truck from the Corps' Artificial Island or Killcohok disposal areas for placement along the beach, however this would require that the township bid competitively on advertised material along with any interested contractors. Purchase costs might be in the range of $.20 to $.40 per cubic yard in addition to the costs for excavation, hauling, and placement incurred by the township.

Whatever actions are undertaken would require regulatory compliance and any necessary studies to obtain it. A simplified procedure may be possible which avoids the need for a Corps permit if the actions qualify under the rules for maintenance, bank stabilization, minor discharges, and/or temporary construction access under existing Nationwide permit authority. These conditions are explained in the attachment on Nationwide Permits. Otherwise a normal Corps and state regulatory process would apply. Additional information on the process for applying jointly for these permits can be obtained from Mr. Jim Boyer of our Regulatory Branch at (215)656-6728.

I hope this information is satisfactory for your needs. We would be willing to meet and discuss this further at your convenience.

Sincerely,

Robert L. Callegari
Chief, Planning Division

Attachments:
1. Option Evaluations
2. Map
3. Section 933 Guidance
4. Regulatory Table

Option 1:

Install vinyl sheet pile such as Shore Guard, grout to tie into seawalls, backfill eroded property.

Local Responsibility:

100% for acquisition and installation of sheetpile, grouting, and backfill.

Considerations (Pro/Con):

May be a viable short-term measure. May be installed by jetting or pounding in sheets in short lengths. Could be installed by individual property owners or by contractors. The cost might be in the range of $40/linear foot of shoreline (installed) plus the cost of grouting. For a 5,000 foot length it might cost $200,000.

Regulatory Concerns:

Likely covered by the Corps nationwide permit, would require consideration for New Jersey Water Quality Certification and Coastal Zone Consistency.

Potential Federal Involvement:

None

Comments:

Low cost, could be constructed by individual property owners. Alleviates loss of material from behind seawalls. Brochure provided to Carl Gaskill on 20 May.

Option 2:

Geotubes or geobags along shoreline/base of revetment. Backfill eroded areas behind seawalls. Clean fill or soil-crete using contaminated material could be considered for fill.

Local Responsibility:

100% for placement, hauling material, and acquisition of borrow material. Real estate requirements would be a local responsibility.

Considerations (Pro/Con):

May be viable in the short-term. Geobags might be more expensive and difficult to use in this area. Lack of readily available fill material would require transport from offsite. Granular fill is available at Corps of Engineers Artificial Island or Killcohook disposal areas at a cost of about $.20 to $.40 per cubic yard on a competitive basis or at other local sources. Hauling costs may run $20 per cubic yard. Potential to use soil-crete (contaminated) mixture rather than clean material. Access for equipment is difficult from landside and ramps/construction roads might be needed to install bags along the beach, working around tidal conditions. In addition, specialized equipment may be needed to fill and place the bags. Heavy traffic on local roadways may cause damage while hauling material. Geotubes may be easier to install, possibly using a small dredge to pump the sand/silt mixture from the Salem Cove disposal area. This might require about 10,000 cy of material for a 5,000' length of shoreline. We estimate that there maybe about 25,000 cy of sand in the cove site and a total of about 60,000 cy of mixed quality material. With costs estimated as $75 to $150 per linear foot, the geotube option may cost $375,000 to $750,000.

Regulatory Concerns:

May be covered by the Corps nationwide permit, would require consideration for New Jersey Water Quality Certification and Coastal Zone Consistency. Any use of contaminated soil-crete would raise regulatory concerns over potential release of contaminants in an aquatic environment.

Potential Federal Involvement:

None

Comments:

Similar measures are described in the Low Cost Shore Protection Brochures provided to Carl Gaskill on 20 May. Additional copies are available from Philadelphia District.

Option 3:

Place Delaware River dredged material (sandy) at Oakwood Beach as a new open water disposal area.

Local Responsibility:

Any incremental cost increase in comparison to normal upland placement practices. This may involve difference in travel time for the dredge ($60,000/day), costs to move the mooring barge ($7,000/day), pipeline costs, and monitoring/inspection costs. Any grading or redistribution of material would have to be at local expense. Real estate requirements would be a local responsibility.

Considerations (Pro/Con):

This summer the Corps hopper dredge McFarland will be dredging sandy material in the Liston Range adjacent to and south of Artificial Island. Typically the McFarland would pump the 1200 to 1500 cy of sand it dredges per load into the northern end of Artificial Island or into Killcohook by way of a mooring barge hook-up. The dredge operates 24 hours a day and is expected to work about 25 days in that area. Typically, it might dredge and dispose of 3 or 4 loads of material in a 24 hour period. The dredge requires a water depth up to 28 feet, which means it could get no closer than about 2000 feet from the southern end of the shoreline at Elsinboro Point. It would be feasible to move the mooring barge and pump from there to portions of Oakwood Beach as on open water disposal area except that the Philadelphia District has no vessels or equipment capable of laying pipe in such shallow water, nor does the District have sufficient length of submersible pipe to get material close to the shoreline. Landside access for support equipment would also be difficult. Consideration was also given to creating a sand stockpile which could be redredged onto the beach or possibly nourish the beach naturally. However, it is doubtful that natural forces would move the material onto the beach. Dispersal into other areas and Federal channels would be a concern and would require study.

Regulatory Concerns:

Water quality certification may be relatively simplified for sandy material placed near the beach, although a stockpile would likely cause more concern. Application would be made by the Township of Elsinboro for the stabilization of the shoreline and pre-application discussions could be held at joint processing meetings. It is assumed that New Jersey would have a lead role for permitting actions. Joint meetings are held in Trenton monthly with State and Federal regulatory agencies and Corps representatives. Jim Boyer of the District's Regulatory Branch at (215) 656-6728 is the contact regarding the schedule of New Jersey joint

processing meetings. Coordination would also be required with Delaware which holds meetings the third Thursday of the month, (contact is William Moyer of DNREC at (302) 739-4691).

Potential Federal Involvement:

Federal participation would be limited to the cost of normal practices.

Comments:

The concepts are not feasible in the short-term due to the inability of the Government to install pipeline close to shoreline, potential for dispersal of a stockpile, and analyses required to evaluate environmental effects. May be viable for a dredging contract in the future.

Option 4:

Government dredging of material from the Corps' Salem Cove disposal area, placing it at Oakwood Beach, to renew capacity at the Salem Cove site.

Local Responsibility:

Grading and redistributing dredged material onto beach. Real estate requirements would be a local responsibility.

Considerations (Pro/Con):

This might be advantageous to the Federal government and save costs in comparison to placing material at more costly, distant sites. However, sampling of the sand mounds during the Salem River study showed them to be a mixture of sand and finer grain material with a sand veneer on the surface. Due to the large percentage of fine materials turbidity would be a problem for unconfined placement. Material could also migrate into the channel.

Regulatory Concerns:

The Town of Elsinboro would be the applicant for joint processing with New Jersey, Delaware and Federal agencies. Environmental agencies would likely object to removal of the mounds due to their value as bird habitat.

Potential Federal Involvement:

Unlikely. It would need to be studied in a dredged material management plan to assess it's viability.

Comments:

Federal interest, could possibly be established due to the potential economy of renewing Salem Cove disposal capacity. However, the fine nature of material makes this unattractive and infeasible as a short-term solution due to the necessary studies.

Option 5:

Place Delaware River dredged material (sandy) at Oakwood Beach as a Section 933 beneficial use project.

Local Responsibility:

Incremental costs beyond normal dredged material disposal practices (varies from 50% to 100%). Real estate requirements would be a local responsibility.

Considerations (Pro/Con):

Section 933 of the Water Resources Development Act provides for beneficial use of dredged material from navigation project construction or maintenance. A reconnaissance type report is required to demonstrate that beach restoration is economical based on its incremental costs in comparison to the erosion it prevents. Due to the study requirements this could not be coordinated in time for dredging this season. This authority requires public access and is subject to Corps policy certification. It has the advantage that all work including beach construction could be contracted or performed by the Federal government. Recent guidance and Section 933 authority are attached for reference.

Regulatory Concerns:

The section 933 reevaluation report addresses environmental concerns and all necessary permits would be obtained by the Federal government during preparation of plans and specifications.

Potential Federal Involvement:

Dependent on resolution of public access issues and cost-sharing requirements. Federal participation can vary from 0 to 50% of incremental costs.

Comments:

Report preparation time is about 6 months, might cost $100,000, and would have to be budgeted in advance. Analyses could be accomplished to a degree as part of the ongoing feasibility study as an option for long-term project implementation.

Federally Listed Threatened and Endangered Species

Except for 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 project area. Therefore, the Service has determined that the proposed project is not likely to adversely affect federally listed threatened or endangered species under Service jurisdiction or their critical habitats. No further consultation pursuant to Section 7(a)(2) of the Endangered Species Act is required by the Service. If project plans change, this determination may be reconsidered.

Principal responsibility for federally listed marine species, including whales and marine turtles, is vested with the National Marine Fisheries Service (NMFS). Therefore, the NMFS must be contacted to fulfill consultation requirements pursuant to Section 7(a)(2) of the Endangered Species Act. You may contact the NMFS at the following address:

National Marine Fisheries Service
Habitat and Protected Resources Division
Sandy Hook Laboratory
Highlands, New Jersey 07732
(908) 872-3023

Species of Special Concern

According to Service records, the diamondback terrapin (*Malaclemys terrapin terrapin*), a species of special concern, occurs within the vicinity of the study area. Species of special concern are species under consideration by the Service for possible inclusion on the List of Endangered and Threatened Wildlife and Plants. Although these species receive no substantive or procedural protection under the Endangered Species Act, the Service encourages federal agencies and other planners to consider species of special concern in project planning.

The New Jersey Natural Heritage Program (NHP) provides the most up-to-date information for candidate species in New Jersey, as well as maintaining information on State-listed species. The NHP may be contacted at the following address:

Mr. Thomas Breden
Natural Heritage Program
Division of Parks and Forestry
CN 404
Trenton, New Jersey 08625
(609) 984-0097

Further information on New Jersey's State-listed wildlife species may be obtained from the following office:

Mr. Larry Niles
Endangered and Nongame Species Program
Division of Fish, Game and Wildlife
CN 400
Trenton, New Jersey 08625
(609) 292-9400

Other Resources of Concern

In the Service's 1991 planning aid report we addressed fish and wildlife resources within the proposed study area, specifically migratory waterfowl, migratory shorebirds, finfish, and shellfish. The Service recommends that the Corps refer to this planning aid report for information on fish and wildlife resources within the study area. Please contact this office if you have any questions or concerns regarding information presented in the report.

The wetlands within the proposed project site are designated as priority wetlands by the Department of the Interior under the Emergency Wetlands Resources Act of 1986 (100 Stat. 3582) because of the national ecological significance of these wetlands. The proposed project is also within a focus area as defined by the Atlantic Coast Venture of the North American Waterfowl Management Plan. Focus areas contain critical waterfowl wintering, migratory, or breeding habitat, particularly for black ducks (*Anas rubripes*).

Supawna Meadows National Wildlife Refuge

The Supawna Meadows National Wildlife Refuge is within 0.5 mile of the proposed project area and may be directly or indirectly affected by the project activities. The refuge manager should be contacted at the following address in order to assist you in identifying any concerns that the Service may have regarding proposed projects adjacent to the Refuge.

Refuge Manager
Supawna Meadows National Wildlife Refuge
U.S. Fish and Wildlife Service
229 Lighthouse Road
Salem, New Jersey 08709
(609) 935-1487

Information contained in this letter and additional information obtained from the aforementioned sources represents the public interest for fish and wildlife resources and should warrant full consideration in project planning. The Service requests that no part of this letter be taken out of context and if reproduced, the letter should appear in its entirety.

Please contact John Staples or Eric Schrading of my staff if you have any questions or required further assistance regarding project-related fish and wildlife concerns.

Sincerely,

for Clifford G. Day
Supervisor

Literature Cited

U.S. Fish and Wildlife Service. 1991. Planning Aid Report on Delaware Bay, Delaware and New Jersey Reconnaissance Study. U.S. Department of the Interior, Fish and Wildlife Service, Pleasantville, New Jersey.

State of New Jersey

Christine Todd Whitman
Governor

Department of Environmental Protection

Robert C. Shinn, Jr.
Commissioner

August 23, 1996

Robert L. Callegari
Chief, Planning Division
Department of the Army
Philadelphia District, Corps of Engineers
Wanamaker Building
100 Penn Square East
Philadelphia, PA 19107-3390

RE: Delaware Bay, Oakwood Beach, New Jersey Interim Feasibility Study

Dear Mr. Callegari:

In response to your recent request for information and input from the New Jersey Department of Environmental Protection for the above referenced project, please find attached the following documents:

- a memorandum dated August 6, 1996 from Robert McDowell, Director, Division of Fish, Game and Wildlife;

- New Jersey Natural Heritage Program Data request Form.

The U.S. Army Corps of Engineers should continue to coordinate the further development and review of this project with the Department through the Office of Program Coordination. If you have any questions, please contact me at (609) 292-2662.

Sincerely,

Lawrence Schmidt
Director
Office of Program Coordination

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State of New Jersey

Christine Todd Whitman
Governor

Department of Environmental Protection
Division of Fish, Game and Wildlife
CN 400
Trenton, N.J. 08625-0400

Robert C. Shinn, Jr.
Commissioner

MEMORANDUM

To: Lawrence Schmidt, Director
DEP, Office of Program Coordination

From: Robert McDowell, Director
Division of Fish, Game and Wildlife

Date: August 6, 1996

Subject: Delaware Bay, Oakwood Beach, New Jersey Interim Feasibility Study

This serves to inform you of the Division of Fish, Game and Wildlife's comments and concerns relative to the Philadelphia District Army Corps of Engineers' *Delaware Bay, Oakwood Beach, New Jersey Interim Feasibility Study*. The purpose of the study is to evaluate the locations and optimum design for shore protection measures along Oakwood Beach, Elsinboro Township, Salem County, New Jersey. The study area consists of two miles of developed shoreline with the mean low water line at Oakwood Beach being the boundary between the states of New Jersey and Delaware.

Due to the developed nature of the site, it is not expected that wildlife or endangered / threatened species will be impacted, however, this is dependent upon the type of project the ACOE is planning to implement. Wildlife known to utilize the immediate project area include river otter, muskrat, Canada goose and an assortment of waterfowl during migration and winter [September thru March]. Their use of the area is considered transient; no special habitat is known to occur at the study site.

In regard to fish / shellfish resources, however, the Bureau of Marine Fisheries emphasizes that the Oakwood Beach location is a nursery area for many fish species, including: striped bass; bluefish; silverside; anchovy; spot and menhaden. Oakwood Beach is also an established juvenile striped bass survey site; surveys continue to be undertaken each summer and fall [since 1980] and the location is considered a principal seining site. A list summarizing species found at the site per year is attached for your information; additional fisheries information can be obtained from regional fisheries biologist, Russ Allen [609-748-2020]. In addition, the area is also known to be important to juvenile / adult blue crab; there is a sizable commercial fishery for blue crabs in the Oakwood Beach area. Therefore, the Division of Fish, Game and Wildlife conludes that paramount concerns for consideration in the *Interim Feasibility Study* would be the protection of prime nursery habitat in the study area and the selection of project alternatives that provide shore protection without compromising that habitat.

We hope this information is of service to you; please pass this information on to the ACOE in its entirety.

c. R.Itchmoney, A.Didun, R.Allen, J.Dobarro, L.Widjeskog, K.Clark

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N.J. DIVISION OF FISH, GAME & WILDLIFE DELAWARE RIVER STRIPED BASS JUVENILE SURVEY: 1980-1995 OAKWOOD BEACH

COMMON NAME	YEARS COLLECTED
ALEWIFE	82, 86, 90, 93, 94
AMERICAN EEL	83, 86, 88, 93, 95
AMERICAN SHAD	85-87, 89-91, 94, 95
ATLANTIC CROAKER	85, 89, 91-93, 95 Micropogonias undulatus
ATLANTIC MENHADEN	80, 82-95
ATLANTIC NEEDLEFISH 502	85 Strongylura marina
ATLANTIC SILVERSIDE	80-95
BANDED KILLIFISH	82
BAY ANCHOVY	80, 82-95
BLACK DRUM 622	90, 91, 93-95 Pogonias cromis
BLUEBACK HERRING	82, 84-87, 89-95
BLUEFISH ~~551~~ 590	80, 82-95 Pomatomus saltatrix
BLUEGILL SUNFISH 555	88 Lepomis macrochirus
BROWN BULLHEAD	85
CARP	83-85, 87, 90, 92, 93
CHANNEL CATFISH	84, 87, 88, 94
CREVALLE JACK 594	81-85, 87-90, 92, 93, 95 Caranx hippos
GIZZARD SHAD 383	80, 84, 85, 87-90, 92, 95 Dorosoma cepedianum
HARVESTFISH 698	91 Peprilus alepidotus
HOGCHOKER	81, 83-94
INLAND SILVERSIDE 521	88 Menidia beryllina
INSHORE LIZARDFISH 405	93 Synodus foetens
MUMMICHOG	95
NORTHERN KINGFISH 621	95 Menticirrhus saxatilis
NORTHERN PIPEFISH 530	80-82, 84, 86-88, 90, 93 Syngnathus fuscus
ROUGH SILVERSIDE 521	82, 85, 87-95 Membras martinica
SPANISH MACKEREL 688	89, 90 Scomberomorus maculatus
SPOT	81-86, 88-91, 93, 94
SPOTTAIL SHINER	85
STRIPED ANCHOVY 385	87, 88, 90-92, 95 Anchoa hepsetus
STRIPED BASS	82, 87-95
SUMMER FLOUNDER	84, 86, 91, 92, 94
WEAKFISH	85, 86, 89, 91, 92, 95
WHITE PERCH	80, 84-90, 92-95

CENAP-PL-PB 29 September 1997

MEMORANDUM FOR FILES

SUBJECT: MEETING WITH ELSINBORO TWP OFFICIALS, SALEM COUNTY, AND NJDEP ON 26 SEPTEMBER 1997

1. Meeting Purpose and Attendees: To discuss potential financial sources for funding a project as well as to address NJDEP and COE public access requirements for a potential project. Those in attendance included the following:

Lee Ware, CENAP-PL-PB
Jane Jablonski, CENAP-PL-PB
Bernie Moore, NJDEP
Jack Elk, Elsinboro Twp Mayor
Lee Bacon, Elsinboro Twp Plng Commission
Patricia Dimatteo Knobloch, County of Salem, Dept of Economic Development
Rita Shade Simpson, County of Salem, Dept of Economic Development

2. Summary of Discussions:

J. Jablonski briefly described ongoing feasibility study activities and explained that revetment and beachfill plans were being evaluated as long-term solutions for the area. It was noted that beneficial use of dredged material from maintenance dredging of the existing 40 ft Delaware River main channel was also being evaluated. It was noted that beneficial use material is likely to come from the Liston range of the main channel. This is the most likely range that has the potential to provide a suitable quantity and type of material for placement at Oakwood Beach. Typically the material dredged from this range is placed at either Buoy 10, Artificial Island, or Killcohook Federal disposal areas depending on where in the range the material is removed. The length of the range is very long and extends toward the transition from the Delaware River to the Delaware Bay. Following identification of the location of suitable material within the Liston range an incremental cost over normal dredging disposal practice will be determined. Development of the incremental cost is likely to take 2 months. Cost-sharing is 50% Federal/50% non-Federal for the incremental cost beyond normal operations, as long as all conditions are met (economical, public access, etc.).

B. Moore noted that the state is willing to provide 75% of the non-Federal share. Locals would be responsible for the remaining 25% of the non-Federal share. Salem County identified DCA grants, Blue Acres, and Green Acres as potential funding sources.

With regard to state public access requirements, B. Moore noted that a parking lot would not be required and provided there are no restrictions on street parking, street parking should be sufficient. He also noted that restrictions on swimming after dusk were allowable. He is to obtain copies of town ordinances along the shore to cite examples of

this. B. Moore did not think that riparian rights existed in the area. He will check with the state riparian and tidelands people. He will also obtain a legal opinion. L. Bacon noted that he thought the residents owned that the land to the high water mark and that the State of New Jersey owned the land from the high water mark to the low water mark and the State of Delaware owned the land from the low water mark bayward. Deeds need to be researched to determine ownership. B. Moore noted that a perpetual easement for the public to obtain access to the beach would be required. L. Bacon and J. Elk plan to target areas where access may be easiest to obtain and may start planning to buy easements. R. Simpson indicated that she was willing to discuss tax advantages with property owners. J. Jablonski distributed copies of COE regulations concerning COE public use and access requirements (Attachment 1.).

R. Simpson noted that potential sources of funding for a project include DCA grants, Green Acres, and Blue Acres. Green Acres funding requires acquisition of land. Blue Acres funding might be suitable for easement purchases. B. Moore noted that if the state were to buy beach property it might cost $1/square foot. He also noted that an appraised value might be $2.50-$3.00/square foot. L. Bacon noted that the existing beach width ranges from 0 feet at the southern end of the beach to about 50 feet in the central portion. L. Bacon noted that about 5 properties/year invest in some type of shore protection. This has been going on for the last 6-8 years. It was noted that one property at the southern end just recently invested $10,000 to place additional footers on their shore protection structures. L. Bacon thought that the primary causes of damage (in descending order) in the area were the result of erosion; ice causing cracks in the bulkheads; and waves from ships and winds/storms.

R. Simpson noted that DCA grants were available for the residents to do bulkhead repairs. L. Bacon noted that about 20 years ago following a major storm loans were granted to the residents for repairs. He noted that the loans were paid back for some time until repayment was no longer required.

B. Moore noted that the NJ Division of Fish & Game purchases land. He noted that Moores Landing and East Point were recently purchased by the NJ Fish & Game. It was also noted that land purchased by Green Acres is managed by the NJ Fish & Game.

Beneficial use of dredged material was also discussed. Ware noted that the timing and cost of a beneficial use project is uncertain since it would depend on the quantity and location of material to be dredged. A COE policy guidance letter concerning requirements of a beneficial use study was distributed (Attachment 2). It was noted that beneficial use would consist of a one-time fill with no periodic nourishment requirements. B. Moore will send a letter to COE requesting a beneficial use study. Salem County will further evaluate potential sources of funding. It was noted that NJDEP and Salem County should contact Adam Oestreich at the COE Baltimore Real Estate Division with regard to real estate issues and tax maps. Vacant areas for public access are being evaluated. It was noted that the average price of a home at Oakwood

Beach is approximately $100,000. It was thought that a 10 ft wide easement should be sufficient for public access.

Attachments (handouts)

Jane L. Jablonski, P.E.
Project Engineer

State of New Jersey

Christine Todd Whitman
Governor

Department of Environmental Protection
Division of Engineering and Construction

Robert C. Shinn, Jr.
Commissioner

March 2, 1999

Mr. Robert Callegari, Chief
Planning Division
U.S. Army Corps of Engineers
Philadelphia District
Wanamaker Building
100 Penn Square East
Philadelphia, Pennsylvania 19107-3390

Subject: Oakwood Beach, NJ Feasibility Study

Dear Mr. Callegari:

I am writing this letter in support of the Oakwood Beach, NJ Feasibility Study. This study indicates that a shore protection project is economically justified, technically feasible, and environmentally sound. The plan provides for a 50-foot wide berm over a project length of 9,500 feet. The plan also provides for periodic nourishment over the 50-year life of the project. We are in agreement with the proposed project and as the non-Federal sponsor support going forward with a favorable recommendation for Congressional authorization. We understand that consideration is being given to revised cost-sharing for periodic nourishment of shore protection projects and are willing to support cost-sharing acceptable to the Administration as enacted by Congress in law.

The State of New Jersey is financially prepared to continue with cost-sharing of the subsequent pre-construction engineering and design study and have programmed funds from the New Jersey Shore Protection Fund for this purpose. We are, as well, prepared to finance this project through its construction. We look forward to participating with you in the plans and specifications and subsequent construction phases of this project.

Sincerely,

Bernard J. Moore
Administrator

BM:swb

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CENAP-PL-PB 01 April 1999

MEMORANDUM FOR FILES

Subject: Delaware Bay Coastline, DE & NJ; Oakwood Beach, NJ: Summary of Public Workshop held on 31 March 1999 at Elsinboro Township, NJ

1. A public workshop was held on 31 March 1999 at 7:00 pm in Elsinboro Township to discuss the results of the Oakwood Beach study with local residents. Those in attendance included the following:

Lee Ware CENAP-PL-PB	Jack Elk, Mayor of Elsinboro Township
Jane Jablonski CENAP-PL-PB	Lee Bacon, Plng Commission, Elsinboro Township
Tony DePasquale CENAP-EN-DC	Bernie Moore, NJDEP
Jeff Gebert CENAP-EN-H	David Faulhaber, Elsinboro Township

2. Mayor Elk called the meeting to order. Lee Ware then introduced Corps personnel and provided some brief opening remarks. Lee Ware noted that public access is a requirement for State and Federal involvement in a project and that the feasibility report was currently being finalized and would then be processed in Washington as a basis for Congressional authorization. He also noted that the necessary environmental permits had been obtained from the State of New Jersey for the project and similar permits from the State of Delaware would be forthcoming. Jane Jablonski then presented information on the background of the study and details on the proposed shore protection for Oakwood Beach. The meeting was then opened to the audience for questions and comments.

3. Mr. Mulford expressed concern over several sluices that empty water into the bay and whether or not their extensions would be incorporated into the project. The Corps responded that these outfalls would be extended as part of LERRD and that they would remain functional as part of the beachfill plan.

4. One resident wanted to know the limits of the project and whether or not his house was in the project area. Lee Bacon addressed the limits of the project area.

5. Residents questioned the environmental quality of the beachfill material. Is it toxic or good quality beachfill? What percentage of the material is fines versus sand? If you place the sand from the southern end of the beach to the northern end, will the sand run out before the northern end of the project is completed? The Corps responded that the material is good quality coarse sand and gravel and will come from the Reedy Island range of the Delaware River, below the channel depth. The material is virgin material with up to 5% fines and has little organic matter. It is tan/gray sand which when pumped will look black, but will lighten up after waves winnow out the finer material. It is clean beachfill and there are over 2 million cubic yards of material available, more than enough for this project. Maintenance material may be somewhat finer sand, but is still good quality and might be used for nourishment.

6. Mr. Mulford wondered if an offshore berm was placed on the outside of the existing islands over a 9500 foot length would this eliminate or reduce the direct flow of the tide and forceful water which is directed at the southern portion of the beach. The Corps responded that a submerged offshore berm may have some beneficial effect by reducing the amount of wave energy that reaches the shoreline. In order to have much effect it would have to be built up significantly in order to impact winter storm waves, possibly during elevated tide conditions. An offshore berm was considered early on in the study however due to the environmentally sensitive cove area and the high cost this alternative was eliminated from further consideration. The most efficient and effective use of dredged sediment at Oakwood Beach would involve direct placement on the beach.

7. An individual associated with the Sierra Club in Delaware questioned the quality of the beachfill material being placed on Oakwood Beach. He stated that the material is not clean and that Delaware River sediments contain hot spots per independent reports. He noted that the river is particularly polluted in the sediments in the bends and shallow areas. He stated that the project (Delaware River 45 ft Project) is not justified and chemical analyses were inaccurate due to averaging of samples. He noted that DNREC has indicated that they are concerned about the quality of the sediment and its impact when disposed of and during dredging operations. The Corps responded that the Delaware River 45 ft Project is independent from the Oakwood Beach Project and will not be discussed at the meeting. It was noted that there are separate meetings being held on the Delaware River Deepening project. The Corps noted that the borrow area for the Oakwood Beach project is below that of the proposed Delaware River main channel 45 ft depth. The Corps also noted that DNREC is changing their analysis and it is the Corps understanding that they have no problem with the proposed Delaware River deepening project. Additional studies are being coordinated with WES to resolve issues on chemical testing. The tests for material at Reedy Island range showed slightly elevated readings for cadmium. The cadmium level is slightly above NJDEP's residential guideline but should not be of any concern. Metals do not bind to sand particles and will be washed away with the silt/clay particles in the sand. Acetone was also detected in the sediment however this was likely a result of lab contamination since it is a common laboratory solvent used in chemical testing procedures.

8. Residents questioned how much the project would cost Elsinboro Township and how the township would obtain the funds. NJDEP responded that the non-Federal share of construction is about $1.2 million and Elsinboro Township's share would be 25% of this or about $300,000. For each nourishment cycle the cost would be $567,000 and Elsinboro Township's share would be about $50,000 of the $200,000 local share. The ultimate project cost is $8.3 million over the 50 year project life, and Elsinboro Township's share would be 25% of the State's 35% share.

9. Residents questioned how many public access areas were needed and what areas are identified as public access areas. Lee Bacon stated that three or four access areas would be needed, depending on their location. Access points can not be any more than ½ mile apart. The PSE&G area is the only definite area so far.

10. One resident suggested that a vote on whether or not to proceed with the project be taken at the meeting. Lee Bacon reiterated that there would not be a vote at the meeting. He stated that the township was looking for informal feedback from the residents and that the township did not yet have all the answers on the plan or funding requirements and sources of funding.

11. One resident questioned whether the entire township would vote on the project or just the shorefront property owners. Lee Bacon responded that a vote was envisioned to be among beach front property owners who may be called upon to contribute to some extent. This vote will likely occur during PED when the plan is better defined.

12. Residents questioned what the elevation of the beachfill at particular locations would be and whether the beachfill would be higher than the existing bulkheads. They had a concern that the sand would wash into their yards or become airborne. The Corps responded that the material should be somewhat coarser than what is on the beach and therefore would have less tendency to erode or be carried elsewhere by waves or wind forces. The beachfill would not be higher than the yards or bulkheads and during design the beachfill elevation would be adjusted if necessary to prevent a "dune" effect. This is a flat berm, sloping toward the water after 50 feet and the elevation of +6.0 ft NAVD would be 3.5 feet above the current high tide level. It was noted that the material dredged will be of better quality than that dredged from Salem River and placed overboard at Gull Island.

13. Residents were concerned that if public access was given would the landowners need to worry about emergency services and who to contact during an emergency. They were also concerned about maintenance of the public access areas, debris, crime, etc. They also wanted to know if public access signs had to be posted. Local township officials noted that emergency access is currently obtained when needed for whichever state's forces arrive first. The Corps noted that the township will be responsible for maintenance costs, debris removal, and police monitoring. Regulations can be adopted locally to regulate hours of access and activities (fishing, vehicles, bond fires, etc.). Beach tags may be required to offset local costs. No advertising is needed, however small signs may be needed to identify beach access paths. Parking along the road should be sufficient. Significant visitation from outside the area is not anticipated but needs to be accommodated.

14. Residents questioned how the land ownership might change once the area was filled with sand and what the impact would be on taxes. The Corps and NJDEP responded that the underlying ownership, state boundaries, etc., would not change. The State of New Jersey would enter into an agreement with the State of Delaware regarding the Oakwood Beach project. Mayor Elk responded that he had coordinated with the tax assessor and was told that the beachfill would have no effect.

15. One resident questioned the feasibility of placing a jetty or sand dike in the Salem Cove to prevent erosion from waves resulting from vessels transiting the navigation channels. The Corps responded that numerical model studies were conducted to address

the causes of erosion and these concluded that the channel features do not contribute to any significant degree to the erosion problem at Oakwood Beach. A sand berm would have a less desirable effect in providing the shoreline with protection than sand placement on the beach. The Corps is prevented from considering vessel wakes by higher authorities to address channel related erosion. A jetty would be extremely costly (many millions of dollars for a 2 mile length) and would not be economically justified. In addition, the Salem Cove is very sensitive environmentally and the Corps was discouraged from impacting it any further.

17. Residents questioned whether an 8 year nourishment cycle was appropriate, noting that conditions can change as a result of hurricanes. The Corps responded that hurricanes were not considered but that the effects of one could be addressed with cost-shared emergency responses. The beachfill will be monitored and the need for nourishment determined, considering funding constraints, storm effects, etc. The 8-year cycle is an estimated average.

18. One resident questioned why the project was designed for only 50 years. The Corps responded that Congressional cost caps apply and specify maximum costs for a finite period. Restudy and reauthorization of another project would be needed for longer periods. The State has been involved with other projects that were designed to include 10 or 25 years of nourishment. The State considers 50 years of nourishment to be a long time.

19. One resident expressed concern over how the nature of the area might change as a result of the project. Privacy is a desirable feature of the area. The Corps responded that the township has to make a choice whether to go ahead with the project or not and that public access is a prerequisite for State and Federal involvement. The State had proposed an $800,000 bulkhead project at Oakwood Beach back in the 1970s which in today's dollars would cost much more. NJDEP noted that it was the same public access issue which stopped the bulkhead project.

20. One resident commented that tremendous maintenance costs are incurred by local landowners many of whom are elderly and can no longer afford to protect their property. He noted that many of the older residents have given up on trying to protect their property. He noted that the township could no longer afford to "do nothing".

21. The meeting was adjourned approximately 10:00 pm with some closing remarks.

Jane L. Jablonski

Jane L. Jablonski, P.E.
Project Engineer

DEPARTMENT OF THE ARMY
Philadelphia District, Corps of Engineers
Wanamaker Building
100 Penn Square East
Philadelphia, Pennsylvania 19107-3390

CEANP-EN-MC

02 APR 1999

MEMORANDUM FOR Commander, North Atlantic Division, ATTN: CENAD-ET-EM

SUBJECT: Delaware Bay Coastline, Delaware and New Jersey, Oakwood Beach, New Jersey Final Feasibility Study, April 1999

1. **References:**

   a. Subject Feasibility Report.
   b. CENAD-ET-P memo dated 9 October 1998 commenting on Reference 1a, copy enclosed.

2. **Recommendations**. As discussed in Reference 1a, the Philadelphia District recommends proceeding from the Feasibility Phase directly to the preparation of Plans and Specifications (P&S). The design of the recommended plan is not technically complex and is essentially complete. Therefore, the District has concluded that a typical Design Documentation Report (DDR, formerly referred to as Design Memorandum or DM) would not be required prior to construction of the proposed project. The District recommends proceeding directly from the Feasibility Phase to the preparation of P&S.

3. **Request**. Concurrence to waive the DDR requirement is requested. As indicated in comment (d) of Reference 1b, a copy of this request will be placed in the Pertinent Correspondence section of the Final version of Reference 1a.

FOR THE COMMANDER

Encl

L. J. LIPSKI, P.E.
Actg Chief, Engineering & Construction Division

CF:
CENAP-PL-PB

DEPARTMENT OF THE ARMY
NORTH ATLANTIC DIVISION, CORPS OF ENGINEERS
FORT HAMILTON MILITARY COMMUNITY
GENERAL LEE AVENUE, BLDG 301
BROOKLYN, NY 11252

REPLY TO
ATTENTION OF:

CENAD-ET-P (1105-2-10c) 9 October, 1998

MEMORANDUM FOR Commander, Philadelphia District, ATTN: CENAP-PL-P

SUBJECT: Delaware Bay Coastline, Oakwood Beach, NJ, Draft Feasibility Study, CENAD Quality Assurance (QA) Comments

1. The subject report is under concurrent review by HQUSACE and CENAD. The following CEAND Qualify Assurance (QA) comments are enclosed for your action.

2. These comments should either be addressed prior to release of the subject draft report to the public or incorporated into the Quality Control Report (QCR) as appropriate.

3. POC for this is study Mr. Cornell Pippens at (718) 491-8725.

Encl.

SAMUEL P. TOSI P. E.
Chief, Planning Division
Directorate of Engineering and Technical Services

DELAWARE BAY COASTLINE
DELAWARE AND NEW JERSEY
OAKWOOD BEACH, NEW JERAEY
DRAFT FEASIBILITY REPORT
CENAD QUALITY ASSURANCE COMMENTS

a. The Chief of Operations Division signed the Certification of Independent Technical Review, but there is no mention of the Operations Division as a study team member. There is no indication of the coordination efforts with the Operations Division as a team member of the district's QA process. The Operations Division should be mentioned as a technical review team element in the subject Quality Control Report (QCR).

b. It should be clearly stated in the Quality Control Report that supervisory chain, members' work efforts, (as Independent Technical Review Team Members), are separately and independently preformed from their subordinate work efforts.

c. The Draft Fish and Wildlife Service Coordination Act (2b) (FWCA) should be included into the draft report prior to public release. Additionally, the subject draft Main Report should contain a detailed point by point Corps response to all significant FWS concerns or project recommendations.

d. The memorandum to waiver Design Memorandum should be included in the Pertinent Correspondence section of the subject final feasibility report.

APPENDIX A

PERTINENT CORRESPONDENCE

Section 2 (USFWS Planning Aid Report)

PLANNING AID REPORT

DELAWARE BAY COASTLINE - OAKWOOD BEACH, NEW JERSEY INTERIM FEASIBILITY STUDY

FISH AND WILDLIFE RESOURCES

Prepared by:

U.S. Fish and Wildlife Service
Ecological Services, Region 5
New Jersey Field Office
Pleasantville, New Jersey 08232

September 1997

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-97/038

September 9, 1997

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:

Enclosed is the U.S. Fish and Wildlife Service (Service) planning aid report on the Philadelphia District Corps of Engineers (District) Delaware Bay Coastline - Oakwood Beach, New Jersey Interim Feasibility Study. The information presented in this planning aid report describes the fish and wildlife resources of the project area. This report has been prepared pursuant to a Fiscal Year-1997 interagency agreement between the District and the Service.

This planning aid report is provided as technical assistance and does not constitute the report of the Secretary of Interior pursuant to Section 2(b) of the Fish and Wildlife Coordination Act (48 Stat. 401; 16 U.S.C. 661 *et seq.*). Planning aid is valid only for the described conditions and must be revised if changes to the proposed project take place prior to initiation.

The information presented in this report is also provided pursuant to the Endangered Species Act of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*) to ensure the protection of endangered and threatened species. These comments do not preclude separate review and comments by the Service on any forthcoming environmental documents pursuant to the National Environmental Policy Act of 1969 as amended (83 Stat. 852; 42 U.S.C. 4321 *et seq.*).

FEDERALLY LISTED THREATENED AND ENDANGERED SPECIES

The bald eagle (*Haliaeetus leucocephalus*), a federally listed threatened species, has been documented to nest within 6 miles of Oakwood Beach. Additionally, bald eagles have been documented to periodically nest within different areas of the Salem River watershed. The bald eagle typically nests atop large trees within sight of water in areas with little human disturbance. Bald eagles are opportunistic feeders and will eat carrion or live prey, including fish, small mammals, and waterfowl. Following the nesting season, if food is readily available, migratory eagles may temporarily roost in an area for several weeks before moving on to a more permanent winter roosting site.

Bald eagles are often attracted to a waterbody, such as the Salem River adjacent to the subject property; therefore, eagles from the nearby nest site may occasionally forage or roost in the vicinity of Oakwood Beach. While it is unlikely that shoreline protection activities would adversely impact roosting or feeding bald eagles in the vicinity of the project area, the Service recommends that the Corps reinitiate consultation pursuant to Section 7(a)(2) of the Endangered Species Act prior to the start of any construction activities to ensure that proposed activities do not adversely affect the bald eagle.

Other than the bald eagle and an occasional transient peregrine falcon (*Falco peregrinus*), no other federally listed or proposed endangered or threatened flora or fauna under Service jurisdiction are known to occur within the project area. The National Marine Fisheries Service must be consulted concerning the presence of the federally listed (endangered) shortnose sturgeon (*Acipenser brevirostrum*), Atlantic Ridley turtle (*Lepidochelys kempii*), hawksbill turtle (*Eretmochelys imbricata*), and leatherback turtle (*Dermochelys coriacea*), and the federally listed (threatened) loggerhead turtle (*Caretta caretta*), and green turtle (*Chelonia mydas*) within the project area. Appendix A provides current summaries of the federally listed endangered and threatened and federal candidate species in New Jersey.

NATIONAL WILDLIFE REFUGE

The Supawna Meadows National Wildlife Refuge is within 0.5 mile of the proposed project site and may be directly or indirectly affected by project activities. The refuge manager should be contacted at the following address to assist you in identifying any concerns that the Service may have regarding proposed projects adjacent to the Refuge:

Refuge Manager
Supawna Meadows National Wildlife Refuge
U.S. Fish and Wildlife Service
R.D. 3, P.O. Box 540
Salem, New Jersey 08079
(609) 935-1487

Any questions regarding this report or federally listed endangered or threatened species should be directed to John Staples or Eric Schrading of my staff. The Service looks forward to continued cooperation with the District in the planning stages of the proposed project.

Sincerely,

Clifford G. Day
Supervisor

Enclosure

PLANNING AID REPORT

DELAWARE BAY COASTLINE - OAKWOOD BEACH, NEW JERSEY INTERIM FEASIBILITY STUDY

FISH AND WILDLIFE RESOURCES

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

Preparers: Eric P. Schrading and Mark D. Eberle
Assistant Project Leader: John C. Staples
Project Leader: Clifford G. Day

September 1997

EXECUTIVE SUMMARY

The U.S. Army Corps of Engineers, Philadelphia District's (District) Delaware Bay Coastline Feasibility Study is being conducted through a series of interim studies. These interim studies include the Delaware Bay Coastline in the vicinity of Oakwood Beach, New Jersey, which is the subject of this planning aid report. This planning aid report incorporates information compiled from the Service's New Jersey Field Office library and office files, site inspections, personal interviews, and other sources. The primary focus of the subject Feasibility Study is to investigate and identify potential methods of protecting areas experiencing coastal erosion due to hurricane and storm damage. In the Oakwood Beach area, the District is currently examining beach nourishment or revetments as the primary methods to minimize erosion and provide shoreline protection (Dayan, pers. comm., 1997). Other alternatives, including structural (e.g., bulkheads, seawalls, groins, geotubes) and non-structural systems, are also being considered by the District.

The Delaware Estuary provides important habitat for numerous fish and wildlife resources, including waterfowl, shorebirds, songbirds, raptors, and anadromous fish (Delaware River Basin Fish and Wildlife Management Cooperative, 1985). The Oakwood Beach area generally does not support significant wildlife habitat because the shoreline has been degraded. Substantial bulkheads, revetments, seawalls, and rip-rap provide the interface between uplands and shallow water areas, and residential development has encroached on the shoreline. However, since the nearshore area of Oakwood Beach is relatively shallow, it serves as an important nursery area for many fish species and supports significant recreational and commercial fisheries. In addition, islands and marshes adjacent to Oakwood Beach provide important habitat for waterfowl, wading birds, shorebirds, and other aquatic-dependent wildlife.

Despite temporary impacts on benthic invertebrates and finfish, beach nourishment would likely benefit fish and wildlife resources in the long term. Specifically, beach nourishment will provide potential forage and nesting areas for shorebirds and diamondback terrapins (*Malaclemys terrapin terrapin*). In addition, adverse impacts to offshore benthic communities, associated with obtaining borrow material for beach nourishment, would be minimized if the Delaware River Main Channel Deepening project is used as a source of sand. Unlike beach nourishment, revetments provide little to no habitat for fish and wildlife. Additionally, revetments may promote erosion of the foreshore, which may create a deep water zone in front of the structure, thereby lowering primary productivity in the immediate vicinity (Mulvihill *et al.*, 1980).

To summarize, of the alternatives examined, beach nourishment offers the best opportunity for enhancement of fish and wildlife habitat within the project area. The Service recommends the beach nourishment alternative since it would potentially create a wide, gently sloping beach and low dunes providing habitat for shorebirds and diamondback terrapins.

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APPENDIX A. Federally Listed Endangered and Threatened Species, Federal Candidate Species, and State-listed Endangered and Threatened Species in New Jersey

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
WANAMAKER BUILDING, 100 PENN SQUARE EAST
PHILADELPHIA, PENNSYLVANIA 19107-3391

DEC 5 1998

RECEIVED
DEC 8 1998
HISTORIC PRESERVATION C

Environmental Resources Branch

Ms. Dorothy P. Guzzo, Administrator
New Jersey Historic Preservation Office
New Jersey Department of Environmental Protection
CN 404
Trenton, New Jersey 08625

99-327
(97-929)

Dear Ms. Guzzo:

Enclosed for your review and comment is a Draft Feasibility Report and Integrated Environmental Assessment for a berm restoration project along Oakwood Beach, Salem County, New Jersey. The purpose of the project is to reduce shoreline erosion and provide storm damage protection to Oakwood Beach. The proposed discharge site is comprised of an eroding shoreline approximately 9500 feet long. The plan also provides for the extension of two existing outfalls. Approximately 23.7 acres of aquatic habitat will be covered, of this approximately 3.3 acres will be intertidal and 20.4 acres will be below mean low water. The quantity of sand required is estimated to be approximately 332,000 cubic yards initially, with 32,000 cubic yards every 8 years compromising periodic nourishment over a 50-year project life.

Several alternatives were examined including the no-action alternative. Plan formulation can be found on page 71 of the enclosed report. The no-action alternative would allow continued erosion along the bank resulting in increased susceptibility to storm damage. Berm restoration was considered to be the most cost-effective alternative for stabilizing the shoreline.

The New Jersey portion of the project is the 3.3 acre intertidal zone situated between the shoreline bulkhead and the mean low water line. The remaining project area lies beyond the low water line in Delaware waters. A preliminary assessment of the intertidal zone was conducted to determine the probability for intact cultural resources. A review of pertinent cultural resources reports, historical aerial photographs, and on site inspection indicated that the potential for cultural resources in this area was extremely minimal.

Based on this preliminary assessment, it is the Philadelphia District's opinion that the proposed project will have "No Effect" on significant cultural resources in the New Jersey portion of the project area. The likelihood for intact, undisturbed cultural resources along this area of deflated shoreline is extremely minimal and we believe that no further cultural resources

investigations are required. Please review the enclosed document and provide this office with your opinion regarding our "No Effect" finding by 07 January 1999. If you have any questions regarding this letter, please contact Michael Swanda of the Environmental Resources Branch at (215) 656-6556.

Sincerely,

Robert L. Callegari
Chief, Planning Division

Enclosure

Based on available information, it is my opinion that there are no historic properties within the project's area of potential effect. Consequently, pursuant to 36 CFR 800.4(d), no further Section 106 consultation is required, unless resources are discovered during project implementation pursuant to 36 CFR 800.11.

Dorothy P. Guzzo 1/6/99
Deputy State Historic Preservation Officer Date

US ARMY CORPS OF ENGINEERS COMMENT RESPONSE

Letter Date: 05 December 1998

Response:

- No Response Needed

December 10,1998

Mr.Robert L. Callegari
Attn: Environmental Resources Branch
U.S. Army Corps of Engineers,
Wannamaker Building,100 Penn Square East,
Philadelphia,Pa. 19107-3390

Re: Oakwood Beach, NJ Feasibility Study,
Draft Feasibility Report and Integrated Environmental Assessment

Dear Sir:

I have lived in my present location for fifty-seven years. We live at 105 Locust Ave. We are the first house on the south side of the Salem Country Club property.

For approximately 70 years I have been familiar with the level of the beach at the front of my home. We are very fortunate that our level of sand has remained constant while the southern end of the beach has not. I feel that those beach owners should be protected on a permanent basis.

A few years ago, the company which deepened the Salem river Channel had an electrical instrument to assist them in dredging placed on the high bank of Salem County Club property. Inasmuch as they used our electricity I became friendly with those gentlemen. At that time, I asked them about the quality of the material they were dredging, with regards to having it placed along Oakwood Beach. They could not have been more vocal-direct and totally against using this dredged material for this purpose. I won't go into all of the negative qualities of that material plus they said it would be several years before it would be stable enough on which to walk.

The above statements lead me to your words "suitable beachfill". This is the situation about which I am most concerned. No doubt, you have done the necessary research regarding the material from the Reedy Island range. If, after you start your
1 operation and I assume due to its close proximity to Reedy Island , you would start at the South end of our beach, you find that the dredged material is not as you forecast, what recourse or procedure do we, at the North end of the beach have?

I am confident that you are fully aware that Oakwood Beach is crescent shaped. I would estimate, without taking a house to house survey, that the northern half of these houses in this crescent have had NO erosion. Based on this, if the quality of
2 material you anticipate is not as expected, would you continue work to our end of the beach ? Must you do all of the beach? Why not do the southern end? I'm will aware of the economics of doing a portion.

I am not concerned about the open access to the river--we live at the dead-end of Locust Ave/. During the course of the summer we have several people walk either on our property or the Club's to fish in the river.

3 Several of us have gone through a number of requests and studies in the past with the Corp. and each result was the same.---" it is your responsibility" With this in mind and your words "periodic nourishment" and with a possible change in management in the Corp., what security and guaranty do we beach front residents have? Also, the funding priorities may change or possibly eliminate the funding altogether.

3 When this project starts, what will be the cost to Elsinboro Twp ? What will these costs be when you "replenish" the sand?

It is taken for granted that all of the Elsinboro taxpayers are not willing to pay for a waterfront protection project. It is we who have chosen to live along the river.

Perhaps when final engineering has been completed and the Corp is well aware that approximately four to seven sluices drain into this area. One drain pipe which runs directly through my PROPERTY drains the entire south side of the golf course. This must remain ~~open~~ OPEN or the water will back up into our entire area.

4 Needless to say, I'm not an engineer but I feel, on your figure #1 map (I drew on this), if a sizable permanent berm was placed on the outside of the existing islands, using your 9500 ft., this would eliminate or reduce the direct flow of the tide and forceful water which comes down from New Castle which is directed at the southern portion of our beach. This would redirect the flow from our southern beach---on down the river. Under the same conditions, if it washed out once-- it will wash out again. By building the outside permanent berm the renourshing expense would be eliminated in the future.

5 I feel our Township Committee will require several public hearings regarding this project. Everyone at the decision -making level should be in attendance. Has this project been fully funded? I hereby formally request a public hearing based on a request for answers to the above stated questions.

David A Mulford

David A. Mulford
105 Locust Ave., Salem,N.J. 08079
609-935-0200

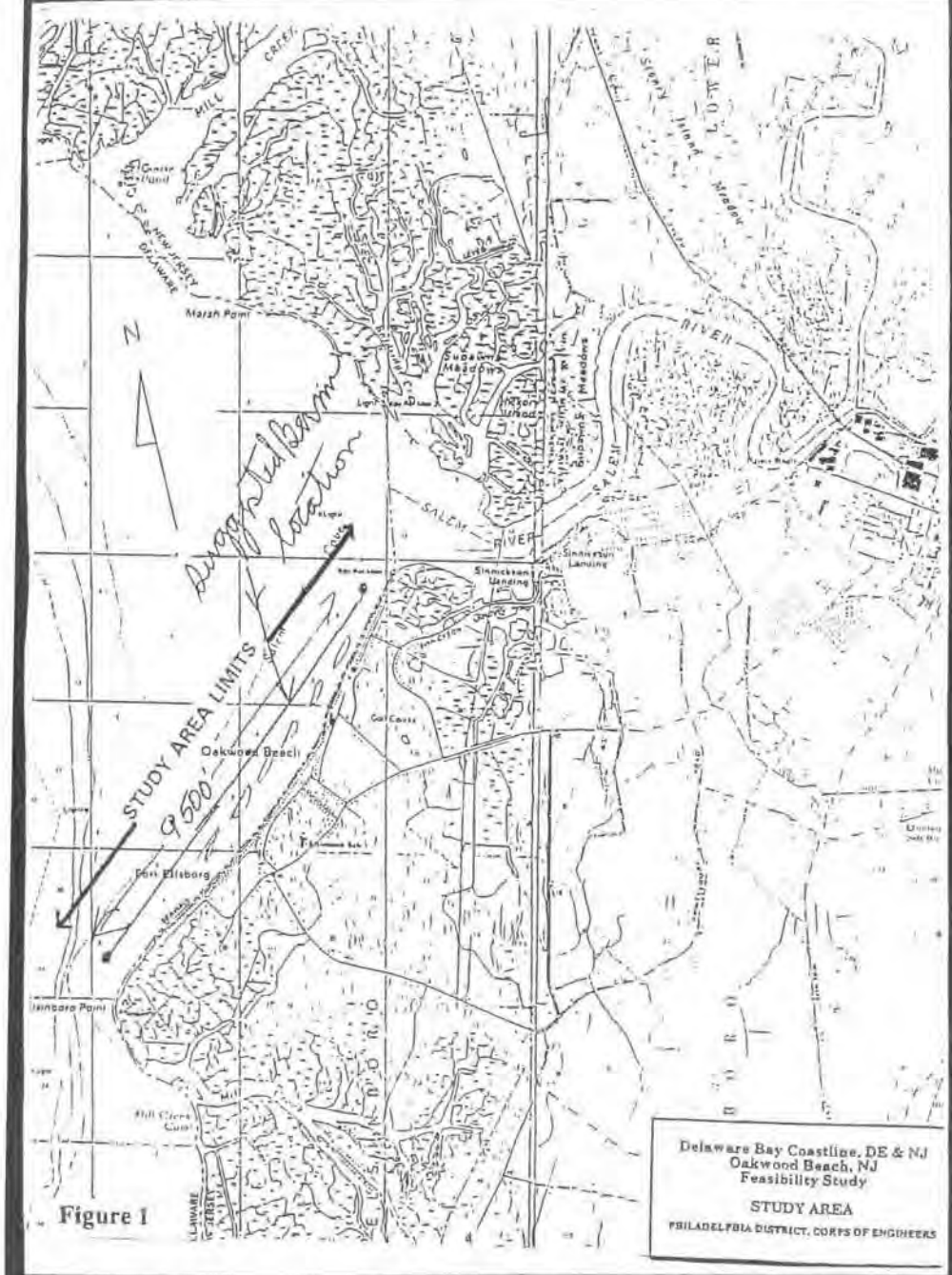

Figure 1

US ARMY CORPS OF ENGINEERS COMMENT RESPONSE

Letter Date: 10 December 1998

Response:

- (1) The granular material located in the proposed project borrow area may be classified as poorly graded medium to coarse sand with some gravel. The borrow material is coarser than the granular material currently located on Oakwood Beach, and is significantly coarser than any other source of borrow used by the Philadelphia District anywhere in its beachfill program. As such, it is expected that the borrow material will have a long residence time on the beach.

- (2) The progression of the beachfill would be established by the successful bidder at the time of construction. Based on the sediment sampling conducted we fully anticipate that suitable coarse sand would be available from within the borrow area as noted above.

- (3) The State of New Jersey, acting through the New Jersey Department of Environmental Protection (NJDEP), is the sole non-Federal sponsor and as such will cost share the initial construction of the project with the Corps at 65% Federal and 35% Non-Federal. NJDEP will also cost share in the periodic nourishment or continuing construction of the project according to cost sharing agreeable to the Administration as enacted by Congress in law. The non-Federal costs are outlined in the report as $1,160,000 for initial construction and $3,255,000 for periodic nourishment throughout the life of the project. Although the State of New Jersey is fully responsible for the non-Federal project costs; certain costs, operational responsibilities, and real estate requirements may be needed by the State from Elsinboro Township. These have not yet been fully enumerated. The non-Federal responsibilities include relocations, such as the extension of outfall pipes.

- (4) A submerged offshore berm may have some beneficial effect by reducing the amount of wave energy that reaches the shoreline. In order to have much effect it would have to be built up significantly in order to impact winter storm waves, possibly during elevated tide conditions. However, the cove area was found to be a sensitive environmental area and these types of solutions were considered and eliminated earlier in the study. The most efficient and effective use of dredged sediment at Oakwood Beach however, would involve direct placement on the beach.

- (5) The Feasibility phase has been fully funded. The next phase of study, which has not yet been funded, would be the Pre-construction Engineering and Design phase which would be cost shared with non-Federal sponsor at 75% Federal and 25% non-Federal. A public workshop was held on 31 March 1999 with the Corps, NJDEP, and the Elsinboro Township residents to discuss the concerns of the local township officials and residents.

Salem County Planning Board

94 MARKET STREET • SALEM, NEW JERSEY 08079

609-935-7510 Ext. 412
FAX: 609-935-3830

Widdifield, Chairman

December 31, 1998

Robert Callegari, Chief Planning Division
Environmental Resources Branch
US Army Corps of Engineers
Wanamaker Building
100 Penn Square East
Philadelphia, Pa. 19107-3390

RE: Oakwood Beach, N.J. Feasibility Study

Dear Mr. Callegari,

The Salem County Planning Department supports the selected plan for storm protection and storm damage reduction for the Oakwood Beach community. We are particularly supportive of recycling the dredged sands from the Delaware main channel to benefit this community, and that public access has been successfully negotiated.

Sincerely,

Rita Shade Simpson
Environmental Planner

cc: Elsinboro Township Committee

US ARMY CORPS OF ENGINEERS COMMENT RESPONSE

Letter Date: 31 December 1998

Response:

- No Response Needed

FISH AND WILDLIFE COORDINATION ACT
SECTION 2(b) REPORT

ASSESSMENT OF THE OAKWOOD BEACH INTERIM FEASIBILITY STUDY, SALEM COUNTY, NEW JERSEY

Prepared by:

U.S. Fish and Wildlife Service
Ecological Services, Region 5
New Jersey Field Office
Pleasantville, New Jersey 08232

January 1999

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-98/069

January 6, 1999

Lt. Colonel Debra M. Lewis
District Engineer, Philadelphia District
U.S. Army Corps of Engineers
Wanamaker Building
100 Penn Square East
Philadelphia, Pennsylvania 19107-3390

Dear Lt. Colonel Lewis:

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 Oakwood Beach Project. 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 report is provided in accordance with our Fiscal Year-1998 scope-of-work agreement and is based on plans and information provided in the Corps August 1998 Draft Oakwood Beach, New Jersey Feasibility Report and Integrated Environmental Assessment. The Service previously provided the Corps with a Planning Aid Report (PAR) entitled, "Delaware Bay Coastline - Oakwood Beach, New Jersey Interim Feasibility Study, Fish and Wildlife Resources" (September 1997). The 1997 PAR included information on fish and wildlife resources relevant to the Oakwood Beach Project.

The project purpose is to investigate and identify potential methods of protecting areas experiencing coastal erosion due to hurricane and storm damage. The Corps has identified that beachfill restoration is the selected method at Oakwood Beach to provide shoreline protection. Other alternatives that were considered include structural systems (e.g., bulkheads and stone revetments) and the no-action alternative. The selected plan involves the construction and maintenance of a 50-foot-wide berm immediately waterward of an existing residential community at Oakwood Beach. The Corps proposes to use beach nourishment material from the existing Delaware River main channel maintenance for initial fill and periodic renourishment of Oakwood Beach. This type of beneficial use of dredge material is typically encouraged by the Service.

Since the nearshore area of Oakwood Beach is relatively shallow, it serves as an important nursery area for many fish species and supports significant recreational and commercial fisheries. In addition, islands and marshes adjacent to Oakwood Beach provide important

habitat for waterfowl, wading birds, shorebirds, and other aquatic-dependent wildlife. With appropriate mitigative measures, adverse impacts from the proposed project on these fish and wildlife resources can be minimized.

The bald eagle (*Haliaeetus leucocephalus*), a federally listed (threatened) species, has been documented to nest within 6 miles of Oakwood Beach. Additionally, bald eagles have been documented to periodically nest within different areas of the Salem River watershed. While it is unlikely that shoreline protection activities would adversely impact roosting or feeding bald eagles in the vicinity of the project area, the Service recommends that the Corps re-initiate consultation pursuant to Section 7(a)(2) of the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*) prior to the start of any construction activities to ensure that proposed activities do not adversely affect the bald eagle. Other than the bald eagle and an occasional transient peregrine falcon (*Falco peregrinus*), no other federally listed or proposed endangered or threatened flora or fauna under Service jurisdiction are known to occur within the project area. If additional information on federally listed or proposed species becomes available, this determination may be reconsidered.

Additional information regarding this 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 OAKWOOD BEACH INTERIM FEASIBILITY STUDY, SALEM 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

January 1999

EXECUTIVE SUMMARY

The U.S. Army Corps of Engineers, Philadelphia District (Corps) initiated the Delaware Bay Coastline, Delaware and New Jersey Shore Protection Study, incorporating the Oakwood Beach 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 October 1986. The study area extends approximately 1.8 miles along the Delaware River from Elsinboro Point to the Salem River, Elsinboro Township, Salem County, New Jersey.

The Oakwood Beach Project (Project) is designed to protect a residential community from coastal erosion due to hurricane and storm damage. Oakwood Beach is a small community comprised of primary residences and a few summer homes. The existing shoreline protection structures (e.g., seawalls, bulkheads, and revetments) vary in condition between new and very degraded. The Project involves 1.8 miles (10.9 acres) of beach nourishment using a total of 332,000 cubic yards of sand along the Delaware Bay shorefront of Oakwood Beach. Borrow material would be generated from the Delaware River main channel and periodic renourishment would occur every 8 years (depending on need). Approximately 32,000 cubic yards of sand is anticipated for periodic nourishment and the material would also come from maintenance of the existing Delaware River main channel. This type of beneficial use of dredge material is encouraged by the Service.

The Delaware Estuary provides important habitat for numerous fish and wildlife resources, including waterfowl, shorebirds, songbirds, raptors, and anadromous fish. The Oakwood Beach area generally does not support significant wildlife habitat because the shoreline has been degraded. Substantial bulkheads, revetments, seawalls, and rip-rap provide the interface between uplands and shallow water areas, and residential development has encroached on the shoreline. However, since the nearshore area of Oakwood Beach is relatively shallow, it serves as an important nursery area for many fish species and supports significant recreational and commercial fisheries. In addition, islands and marshes adjacent to Oakwood Beach provide important habitat for waterfowl, wading birds, shorebirds, and other aquatic-dependent wildlife. With appropriate mitigative measures (e.g., seasonal restriction), adverse impacts on fish and wildlife resources can be minimized. Additionally, creation of a wide, gently sloping beach could potentially enhance fish and wildlife habitat within the project area by creating nesting areas for diamondback terrapin (*Malaclemys terrapin terrapin*) and providing a sand source to replenish offshore shoals used by finfish.

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Appendix B.	Federally Listed and State-listed Endangered and Threatened Species in New Jersey

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 Oakwood Beach Project (Project). This report is provided in accordance with a Fiscal Year-1998 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; provides recommendations to minimize adverse impacts; and identifies additional opportunities for habitat enhancement. The study area extends approximately 1.8 miles along the Delaware River from Elsinboro Point to the Salem River, Elsinboro Township, Salem County, New Jersey (Figure 1).

The Delaware Bay Coastline, Delaware and New Jersey Shore Protection Study, that incorporates the 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 October 1986. The authorization calls for defining coastal area problems associated with erosion and identifying: potential solutions; costs; environmental and social impacts of potential solutions; and an optimized National Economic Development Plan.

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 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 Oakwood Beach Interim 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. 15 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
Pleasantville, New Jersey 08232

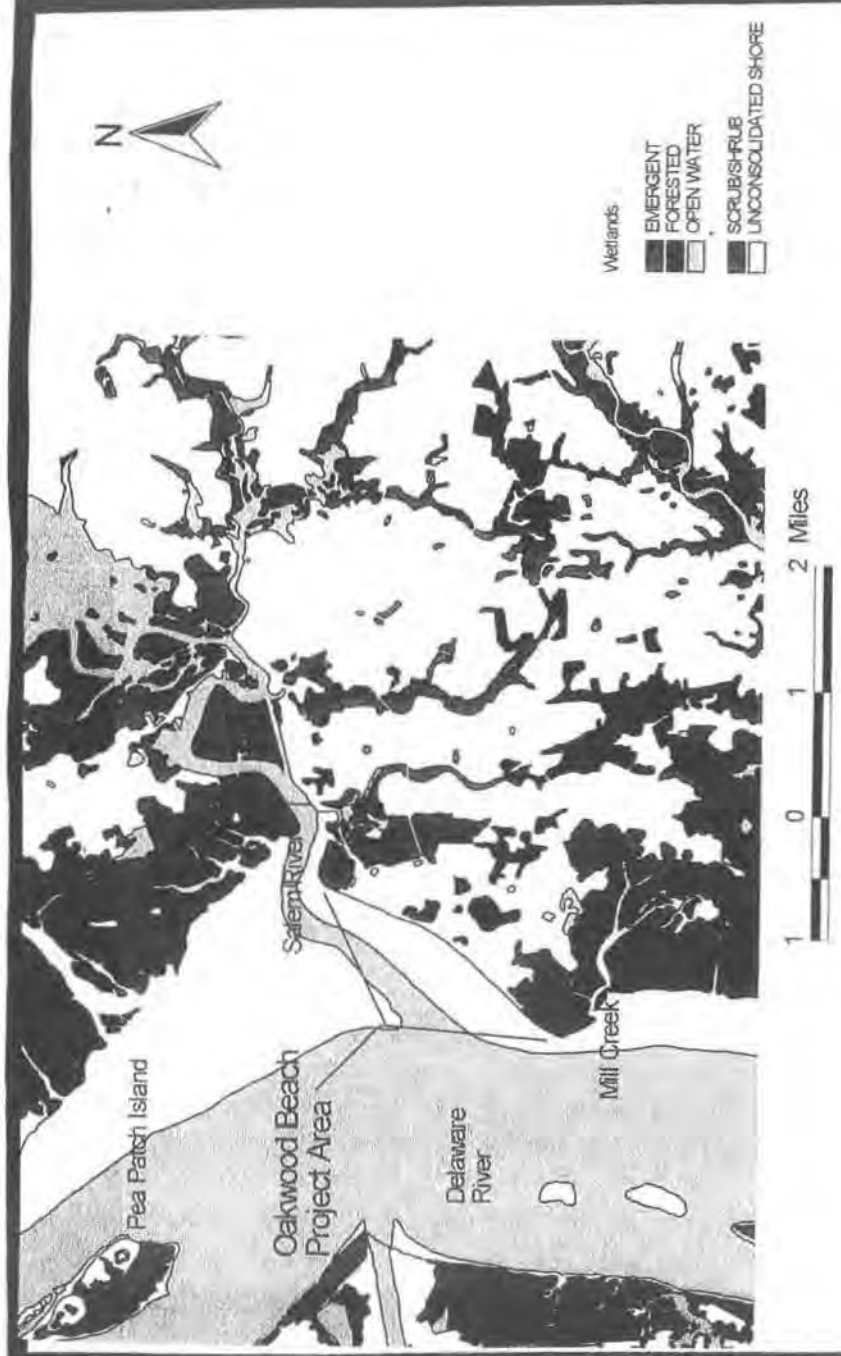

Figure 1. Oakwood Beach Project Area

II. PROJECT DESCRIPTION

The objectives of the Project are to take an integrated approach to the solution of erosion and inundation problems and storm vulnerability of the shoreline. Specifically, the objectives include the following:

1. Provide shore protection to reduce shoreline erosion and potential storm and inundation damages at Oakwood Beach.

2. Minimize degradation of the natural environment in areas impacted by planned shore protection measures and protect fish and wildlife resources. Where possible, the environmental character of the study area will be preserved and maintained.

The proposed project would involve beach nourishment along the Oakwood Beach Delaware Bay shore front. Specifically, the project would provide a beachfill with a berm width of 50 feet and a total length of 9,500 feet. The landwardmost berm elevation would be constructed at +6.0 feet based on the North American Vertical Datum of 1983 (U.S. Army Corps of Engineers, 1998). The beach nourishment would include two 250-foot tapers at each project terminus to tie into the existing beach. The slope of the beachfill is 1 vertical foot to 10 horizontal feet from the edge of the berm to the depth of closure. The Oakwood Beach Project would require approximately 332,000 cubic yards of material (i.e., sand) for initial fill. Subsequent maintenance would require 32,000 cubic yards of material and would be provided on an 8-year cycle coincidental with normal maintenance activities within the existing Delaware River main channel (U.S. Army Corps of Engineers, 1998). Two existing outfalls would be extended as part of the project. The proposed project life is 50 years.

The Corps identified that the maintenance of the existing Delaware River main channel would provide all of the borrow material (for initial fill and periodic renourishment) for the Oakwood Beach Project. Specifically, an area on the Delaware River main channel between river mile 54 and 57 would be used to generate borrow material for the Oakwood Beach project (Figure 2). The Corps proposes that material for initial fill would be obtained via hydraulic dredge; however, material for periodic renourishment would be obtained by hopper dredge. The borrow material from the Delaware River main channel is comprised of 94 to 99 percent sand with less than two percent total organic content (U.S. Army Corps of Engineers, 1998). Sand and gravel size of the borrow material varies between 0.075 mm to 38 mm. The majority of the borrow material is classified as medium to coarse grained sand varying in size between 0.4 and 0.6 mm (Dayan, pers. comm., 1998).

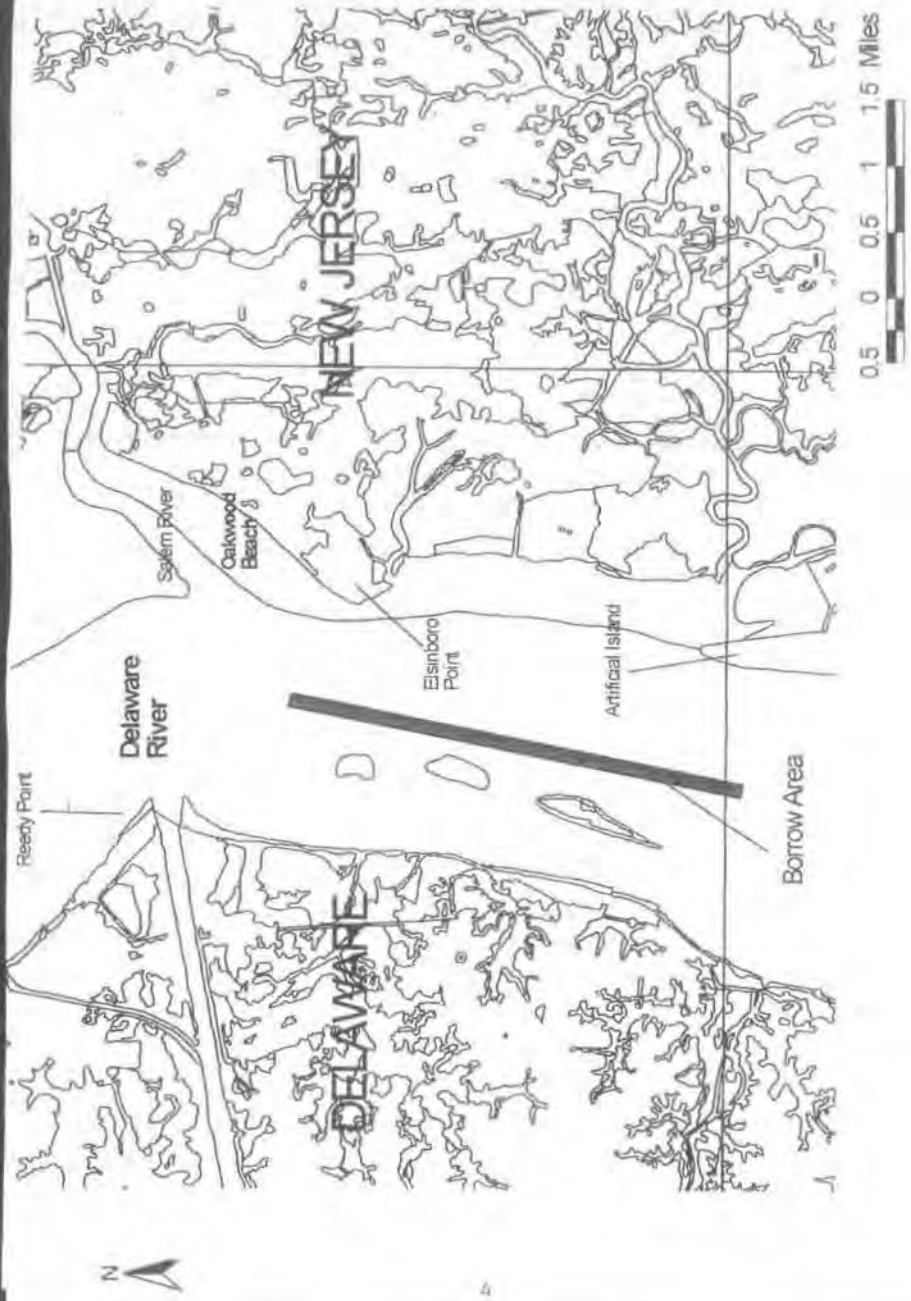

Figure 2. Oakwood Beach Borrow Area

III. METHODS AND PROCEDURES

The information and findings presented in this report are based on review of the August 1998 Oakwood Beach, New Jersey, Draft Feasibility Report and Integrated Environmental Assessment (U.S. Army Corps of Engineers, 1998) 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 New Jersey Division of Fish, Game and Wildlife's (NJDFGW) Bureau of Marine Fisheries, Bureau of Shellfisheries, and Endangered and Nongame Species Program; and a site visit conducted by Service biologists on July 15, 1997.

IV. PHYSICAL CHARACTERISTICS

The project area is 1.8 miles long and primarily includes residential development and shoreline protection structures (e.g., bulkhead, revetment, rip-rap). Oakwood Beach extends from Elsinboro Point north to the Salem River. The southern one-third of Oakwood Beach has almost no beach at high tide, and timber bulkheads and concrete seawalls protect individual homes. The center one-third of Oakwood Beach consists of a narrow beach (approximately 30 to 50 feet wide) with plastic and wood bulkheads placed immediately landward of the intertidal area. The northern one-third has little to no beach with seawalls and revetments protecting homes. The limited extent of project area beaches and shallow water areas are typically comprised of a veneer of sand overlaying a mud substrate that was likely former salt marsh. Extensive shallow water habitat extends from the waterward extent of the project area to the Delaware River Channel. The project area is bordered landward by residential development (mostly single-family houses) and comprises the entire upland portion of the shoreline. Approximately 114 residential structures occur within the project area and include primary residences and a few summer homes.

The existing shoreline protection structures (e.g., seawalls, bulkheads, and revetments) that separate the beach from residential development vary in condition between new and very degraded. Several of the existing structures are being undermined and are deteriorating. Shoreline protection structures appear to be constructed by individual property owners and are constructed from various materials (e.g., concrete, gabions, timber, and rip-rap from highway demolition).

Salt-water marsh areas border the northern and southern ends of the project area. Emergent wetlands in the vicinity of the project area are either dominated by *Spartina* spp. or *Phragmites australis*. Forested and scrub-shrub wetlands in the vicinity of the project area are typically dominated by red maple (*Acer rubrum*) with sweetgum (*Liquidambar styraciflua*), southern arrowwood (*Viburnum dentatum*), and highbush blueberry (*Vaccinium* spp.) as co-dominants. The Service considers the marsh habitat value for fish and wildlife resources as good to excellent.

Recorded shoreline erosion over the past 112 years has subjected shoreline properties to storm damage from waves and tidal inundations and resulted in substantial wetland losses (U.S. Army Corps of Engineers, 1991). National Oceanic and Atmospheric Administration maps

dating back to 1881 indicate long-term erosion of the shoreline at Oakwood Beach. However, the shoreline has remained relatively stable horizontally, but not vertically, since 1946 as a result of placement and maintenance of erosion control structures.

V. FISH AND WILDLIFE RESOURCES

The Service's "Delaware Bay Coastline - Oakwood Beach, New Jersey Interim Feasibility Study, Fish and Wildlife Resources" Planning Aid Report (Schrading, 1997) provides a detailed description of benthic organisms, finfish, shorebirds, wading birds, waterfowl, raptors, and other terrestrial wildlife that occur in the project area. The project area provides valuable open water habitat for a variety of finfish and benthic organisms. Adjacent intertidal and wetland areas also provide valuable habitat for migratory birds and other wildlife.

The U.S. Environmental Protection Agency (1994) characterized the benthos of the Salem River area, immediately north of the proposed project site, as degraded. Due to degradation of benthic habitats, there is no significant shellfish industry (i.e., clams, oysters) in the Oakwood Beach area (Dobarro, pers. comm., 1997). Additionally, due to the lack of beach above the mean high tide and the low salinity of the water, there appears to be no potential habitat for horseshoe crabs. Although shellfish and horseshoe crab habitats are lacking, the project area supports potential habitat for blue crabs (U.S. Environmental Protection Agency, 1996) and there is a sizable commercial fishery for blue crabs (*Callinectes sapidus*) in the Delaware Bay. Normant (pers. comm., 1998) identified that the Oakwood Beach area is used by commercial harvesters for blue crabs.

The nearshore area of Oakwood Beach is relatively shallow and acts as an important nursery area for many fish species including: striped bass (*Morone saxatilis*), bluefish (*Pomatomus saltatrix*), silverside (*Menidia* spp.), anchovy (*Anchoa* spp.), spot (*Leiostomus xanthurus*), and Atlantic menhaden (*Brevoortia tyrannus*) (Allen, pers. comm., 1997). Oakwood Beach is an important sampling station for the NJDFGW and surveys have been conducted there since 1980. The area supports significant recreational and commercial fisheries, primarily as a result of nutrient export from wetlands.

The Emergency Wetlands Resources Act of 1986 (P.L. 99-645) directs the Department of the Interior to identify the location and types of wetlands that should receive priority attention for acquisition by federal and State agencies using Land and Water Conservation Fund appropriations. The designated priority wetlands also include "focus areas" identified by the Atlantic Coast Joint Venture of the North American Waterfowl Management Plan (NAWMP) as containing critical waterfowl wintering, migratory, or breeding habitat, with an emphasis placed on black duck habitat. Wetlands adjacent to the project area on the northern and southern ends are classified as both Service priority wetlands and NAWMP "focus areas." As such, while the shoreline within the project area provides limited value for wildlife species, adjacent wetland areas provide habitat of high value for a variety of shorebirds, waterfowl, and raptors.

The project area also provides feeding and limited nesting habitat for the diamondback terrapin (*Malaclemys terrapin*). Local residents claim that these turtles historically have nested at Oakwood Beach. Beach renourishment of the Oakwood Beach area may restore some nesting habitat for northern diamondback terrapins, provided beach areas are constructed above the levels of normal high tides.

VI. ENDANGERED AND THREATENED SPECIES

The bald eagle (*Haliaeetus leucocephalus*), a federally listed (threatened) species, has been documented to nest within 6 miles of Oakwood Beach. Additionally, bald eagles have been documented to periodically nest within different areas of the Salem River watershed. The bald eagle typically nests atop large trees within sight of water in areas with little human disturbance. Bald eagles are opportunistic feeders and will eat carrion or live prey, including fish, small mammals, and waterfowl. Following the nesting season, if food is readily available, migratory eagles may temporarily roost in an area for several weeks before moving on to a more permanent winter roosting site.

Bald eagles are often attracted to a waterbody, such as the Salem River adjacent to the subject project area; therefore, eagles from the nearby nest site may occasionally forage or roost in the vicinity of Oakwood Beach. While it is unlikely that shoreline protection activities would adversely impact roosting or feeding bald eagles in the vicinity of the project area, the Service recommends that the Corps re-initiate consultation pursuant to Section 7(a)(2) of the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*) prior to the start of any construction activities to ensure that proposed activities do not adversely affect the bald eagle.

Other than the bald eagle and an occasional transient peregrine falcon, no other federally listed or proposed endangered or threatened flora or fauna under Service jurisdiction are known to occur within the project area.

Several federally listed marine species under the jurisdiction of the National Marine Fisheries Service (NMFS) may occur within the Oakwood Beach project area and within the proposed borrow area, including the federally listed (endangered) shortnose sturgeon (*Acipenser brevirostrum*), Atlantic Ridley turtle (*Lepidochelys kempti*), hawksbill turtle (*Eretmochelys imbricata*), and leatherback turtle (*Dermochelys coriacea*), and the federally listed (threatened) loggerhead turtle (*Caretta caretta*) and green turtle (*Chelonia mydas*). Coordination with NMFS regarding potential adverse impacts to these species is recommended. Seasonal restrictions on dredging of the Delaware River main channel and placement of nourishment material at Oakwood Beach may be necessary to avoid adverse impacts on these federally listed species.

A variety of State-listed endangered and threatened species inhabit the beaches and marshes of the Oakwood Beach area. The State-listed (endangered) pied-billed grebe (*Podilymbus podiceps*) is known to occur within the marshes adjacent to the Oakwood Beach project area. The State-listed (threatened) American bittern (*Botaurus lentiginosus*) may also occur within

marshes and riparian corridors adjacent to the Oakwood Beach project area (New Jersey Division of Fish, Game and Wildlife, 1997). Only breeding populations of the American bittern are State-listed as threatened. Andrews (1990) reports breeding populations of the State-listed (threatened) great blue heron (*Ardea herodias*) and little blue heron (*Egretta caerulea*) using Pea Patch Island. Additionally, a yellow-crowned night heron (*Nycticorax violaceus*), State-listed as threatened, was recorded at the mouth of the Salem River, which is immediately north of the proposed project site (New Jersey Audubon Society, 1990).

The osprey, State-listed as threatened, is a common resident in the Oakwood Beach area and the project area provides important habitat for this species (New Jersey Division of Fish, Game and Wildlife, 1997). Several other State-listed endangered and threatened raptors migrate or reside in marshes adjacent to Oakwood Beach, including the State-listed endangered short-eared owl (*Asio flammeus*), Cooper's hawk (*Accipiter cooperii*), and northern harrier (*Circus cyaneus*) and the State-listed threatened red-shouldered hawk (*Buteo lineatus*). Due to the limited habitat available within the Oakwood Beach Project area and the transient nature of many of the above-mentioned State-listed species, it is unlikely that the proposed project would adversely impact State-listed species.

VII. IDENTIFICATION OF BENEFICIAL AND ADVERSE IMPACTS, AND MITIGATIVE MEASURES

A. BENEFICIAL AND ADVERSE IMPACTS

Shoreline protection efforts that include extraction of materials from offshore borrow areas and related beach nourishment operations may result in a variety of adverse impacts to benthic organisms, finfish, and wildlife. Beach nourishment and renourishment activities also result in the loss of shallow water cover types.

1. Extraction from Borrow Areas

Dredging borrow areas results in the removal of sediment and organisms and adversely impacts water quality. Borrow material for beach nourishment at Oakwood Beach would be excavated from approximately 3 miles of the Delaware River main channel (i.e., 800-foot-wide channel). This proposed dredging would adversely impact approximately 291 acres of benthic habitat, resulting in mortality of benthic organisms. The Corps reports that benthic infauna, in terms of density (ranging from 1,486 to 3,744 individuals / m^2) and biomass (ranging from 1.1 and 18.1g/m^2), are similar between the navigational channel and adjacent shallow and deeper water areas (U.S. Army Corps of Engineers, 1998). 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 one year, with minor sedimentological changes, and a small decline in diversity and abundance within the benthic community. In addition, since borrow material

would regularly be removed from the navigational channel, the environmental impacts associated with dredging would occur with or without the proposed shoreline protection project. The Service generally supports beneficial use of dredge material for purposes such as shoreline protection.

The borrow material from the Delaware River main channel is comprised of 94 to 99 percent sand with less than two percent total organic content (U.S. Army Corps of Engineers, 1998). Sand and gravel size of the borrow material varies between 0.075 mm to 38 mm. The State of New Jersey does not require contaminant testing of dredged material if the material to be dredged is greater than 90 percent sand (grain size > 0.0625 mm) (New Jersey Department of Environmental Protection, 1997). However, the State of Delaware owns all subaqueous lands to the low water line in New Jersey in this portion of the Delaware Estuary and expressed concerns regarding potential presence of polychlorinated biphenyls (PCBs) in the borrow material. As part of the Delaware River Main Channel Deepening Project, sediment cores within the Delaware River main channel were tested to quantify the levels of metals, pesticides, PCBs, volatile organic compounds, semivolatile organic compounds, and total organic carbon (U.S. Army Corps of Engineers, 1991). Total organic carbon of the borrow material is low, and was measured as 0 percent in the top 3.5 feet of sediment. Of the heavy metals detected in the borrow area sediments, only cadmium (1.1 to 2.2 mg/kg) tested above the New Jersey Residential Criteria (1 mg/kg); however cadmium levels are lower than the New Jersey Non-Residential Criteria (100 mg/kg). No other chemical contaminants were detected within the proposed borrow area, including PCBs (U.S. Army Corps of Engineers, 1998).

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 by 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 to January), adverse impacts on fish and wildlife resources can be minimized.

2. Beach Nourishment

The proposed beach nourishment would bury infaunal organisms and result in mortality within the shallow nearshore (littoral) zone. Approximately 10.9 acres of subtidal area (below mean low water) would be impacted by beachfill placement. Most of the organisms inhabiting the dynamic nearshore and intertidal zones are highly mobile and adapt quickly to significant changes in abiotic factors. 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 between the original beach and sand provided for beach nourishment may also affect the rate of recolonization and community diversity. Based on the recorded grain sizes identified in the Delaware River main channel, some of the borrow material may have fairly large grain size (i.e., 10 mm to 38 mm). Placing beach nourishment material on Oakwood Beach with

significantly different grain size from the existing grain size on the beach may limit the rate of recolonization and use by fish and wildlife resources.

Beach nourishment, when finfish such as the striped bass are using the shallow water areas as nursery habitat, could adversely impact juvenile finfish (Allen, pers. comm., 1997). Turbidity and re-suspension of toxic materials such as cadmium can adversely affect juvenile finfish during a life stage that is sensitive to changes in environmental factors. Avoidance of beach nourishment activities during use of the area as nursery habitat would minimize adverse impacts on juvenile finfish.

Blue crabs spawn throughout the summer in the low salinity waters near the mouth of the Salem River. Larval stages develop in shallow water areas through October (Normant, pers. comm., 1998). Beach nourishment activities could impact spawning activities of blue crabs by increasing turbidity in the project area and re-suspending contaminated sediments. In addition, construction between May and October could result in burial of larval or juvenile blue crabs.

The Service expects that the likelihood of shorebirds to nest on beaches within the project area is currently low due to the limited extent and narrow width of the beach. In addition, extensive human disturbance and the presence of man-made shoreline protection structures further limits the value of the beach areas for shorebirds. However, the proposed beach nourishment may create suitable nesting and feeding habitat for shorebirds. Occurrence and nesting of federally listed or State-listed threatened or endangered species may require restrictions on some recreational activities and beach management activities to protect these species from adverse impacts. However, based on existing information, other than transient shorebird feeding, it is unlikely that the project area would support substantial shorebird feeding or shorebird nesting.

The proposed long-term maintenance (e.g., 50 years) of a beach could provide a sand source for off-shore shoals. Off-shore shoals are used by finfish and the re-supply of sand to such shoals could be important to maintaining the integrity of this finfish habitat.

B. MITIGATIVE MEASURES

1. Extraction from Borrow Areas

The Water Resources Development Act of 1996 (33 U.S.C. 2201 *et seq.*; 100 Stat. 4082) (WRDA) directs the Corps to place a greater emphasis on disposal 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. The Service commends the Philadelphia District Corps for using material from the Delaware River main channel maintenance for direct beneficial uses consistent with Section 207 of the WRDA of 1996.

The Corps proposes to use a hydraulic dredge with a pipeline delivery system to minimize turbidity and adverse impacts on adjacent shallow water for initial beach fill (U.S. Army Corps of Engineers, 1998). However, the Corps would use hopper dredging for subsequent periodic renourishment. Typically hydraulic-pipeline dredging is preferred over hopper dredging by the Service because hydraulic dredging minimizes turbidity. Additionally, hydraulic-pipeline dredging minimizes the potential entrainment of federally listed sea turtles (Greene, pers. comm., 1996). Therefore, the Service recommends the use of hydraulic-pipeline dredging over hopper dredging whenever feasible. As identified previously, the NMFS should be consulted regarding potential impacts on federally listed species (under its jurisdiction) as a result of the proposed project. The Service understands that the Corps has contacted the NMFS regarding this project. The Service also recommends dredging during the period of lowest biological activity (November to January) to minimize impacts on benthic organisms.

2. Beach Nourishment

Beach nourishment and subsequent renourishment would create approximately 10.9 acres of new beach area along Oakwood Beach. Much of the area created and the existing beach area would be considered upland. It is assumed that the Corps would obtain an easement for the project area for the project life (e.g., 50 years) in order to complete renourishment activities. However, it is unclear what type of easement would exist after the project is completed. In order to prevent residential or commercial development (including alternative shoreline protection structures such as bulkheads and revetments) within the project area or adjacent beach area, the Service recommended that the Corps obtain a perpetual deed restriction or conservation easement for the newly created beach and adjacent beach areas. The Corps identified that "temporary and permanent easements required for implementation of this project will be acquired prior to initiation of construction" (U.S. Army Corps of Engineers, 1998). The Service concurs; however, the type of easement and associated restrictions should be identified and provided to the Service for review and comment.

The Corps proposes to extend two existing outfall structures to ensure that stormwater is not being discharged directly on the beach. Stormwater outfall from adjacent residential areas and the Salem Country Club golf course can discharge contaminated material into the Delaware River including herbicides, pesticides, fertilizers, and petroleum products. Ensuring that all stormwater that flows through the extended outfall pipes is treated (e.g., collected in a stormwater treatment basin) prior to discharge is one opportunity to protect water quality within the proposed project area. Therefore, the Service recommended that the Corps investigate any such opportunities to protect or improve water quality in the proposed project area (e.g., water treatment basin). The Corps identified that "treatment of the stormwater prior to discharge is unrelated to the extension of the outfalls" and that "stormwater management is a local responsibility" (U.S. Army Corps of Engineers, 1998). The Service understands that stormwater management is a local responsibility. However, the Service presumes that the Corps has some discretion in project design to include environmental

improvements such as stormwater treatment basins. The Service only requests that opportunities to improve the water quality at Oakwood Beach be investigated as part of this project.

The proposed beach nourishment could adversely impact juvenile finfish (e.g., striped bass) during the nursery period due to increased turbidity and re-suspension of contaminated sediments (e.g., cadmium). Spawning and juvenile production of blue crabs could also be adversely affected by construction of the proposed project. In order to minimize adverse impacts on juvenile finfish and spawning blue crabs, the Service recommended that the Corps avoid beach nourishment activities between April 1 and October 30. However, based on additional recommendations by the NJDFGW (Appendix A), the Service recommends extending this seasonal restriction from between March 1 and October 30 to avoid adverse impacts on in-river and shallow water aquatic resources, specifically American shad (*Alosa sapidissima*), blueback herring (*Alosa aestivalis*), and striped bass. The Corps has not committed to the recommended seasonal restriction and only identified that "full consideration will be given to implementing construction schedules that minimize adverse environmental impacts" (U.S. Army Corps of Engineers, 1998). The Service strongly recommends that the Corps adopt and implement the recommended seasonal restriction.

Northern diamondback terrapin nesting habitat is limited in the project area due, in part, to the lack of beach area above the high tide line. Beach renourishment of the Oakwood Beach area may restore nesting habitat for northern diamondback terrapins, especially if beach areas are constructed above the levels of normal high tides. The preferred window for renourishment is September to March to avoid impacts to eggs and juveniles (Jenkins, pers. comm., 1997). However, due to the limited availability of nesting habitat for diamondback terrapins within the project area, this seasonal restriction is not considered applicable.

The Corps proposes to re-nourish the proposed project area every 8 years coincidental with normal navigational channel maintenance activities. The Service concurs with the Corps proposal to maximize the timeframe between renourishment cycles. Renourishment on an 8-year cycle should allow for recolonization of the intertidal and subtidal substrate between renourishment cycles.

VIII. CONCLUSIONS AND RECOMMENDATIONS

The proposed project area is located in a developed region of New Jersey that currently supports limited wildlife resources. However, the Oakwood Beach area does support valuable finfish nursery habitat and blue crab spawning habitat. Overall, implementation of the Oakwood Beach project could enhance some fish and wildlife habitat within the project area. The proposed project could create additional nesting areas for diamondback terrapin, create feeding areas for shorebirds, and provide sand material to maintain off-shore shoals used by finfish. The Service supports the Corps proposal to use dredge material for beneficial use at Oakwood Beach provided certain measures are implemented to minimize adverse impacts on

fish and wildlife resources. Potential project-related adverse impacts to fish and wildlife could be minimized by incorporating the following recommendations into the final project design.

1. Re-initiate informal consultation with the Service pursuant to Section 7 of the Endangered Species Act prior to initiating any construction activities to ensure that project activities do not adversely affect the bald eagle.

2. Continue to coordinate with the National Marine Fisheries Service regarding potential impacts on federally listed threatened or endangered species under its jurisdiction.

3. Use a hydraulic-pipeline dredging method whenever feasible for periodic renourishment.

4. Schedule dredging during the period of lowest biological activity (November to January) to minimize impacts on benthic organisms.

5. Identify the type of conservation easement and associated restrictions for the newly created beach and adjacent beach areas and provide the Service with an opportunity to review the easement.

6. Investigate opportunities to improve water quality in the proposed project, such as ensuring that all stormwater that flows through the extended outfall pipes is treated (e.g., collected in a stormwater treatment basin).

7. Adopt and implement a seasonal restriction for beach nourishment activities between March 1 and October 30 to minimize adverse impacts on juvenile finfish and spawning blue crabs.

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B. PERSONAL COMMUNICATIONS

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APPENDICES

APPENDIX A

Coordination with the
New Jersey Division of Fish, Game and Wildlife

State of New Jersey

e Todd Whitman
or

Department of Environmental Protection

Robert C. Shinn
Commissio

Division of Fish, Game and Wildlife
Robert McDowell, Director
P.O. Box 400
Trenton, NJ 08625-0400

September 14, 1998

Clifford G. Day, Supervisor
US Fish and Wildlife Service
927 N. Main St. (Bldg. D1)
Pleasantville, NJ 08232

Dear Mr. Day:

This serves to inform you that the Division of Fish, Game and Wildlife [DFGW] concurs with the USFWS 2(b) Draft Coordination Act Report entitled, *Assessment of the Oakwood Beach Interim Feasibility Study, Salem County, New Jersey, September 1998*. 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' [ACOE] plan to protect against coastal erosion by constructing a 50-foot wide berm immediately waterward of the Oakwood Beach residential community for a length of approximately 9,500 LF.

While we concur with the report as a whole, we are concerned about the time restriction of April 1 through October 30 for the protection of near-shore aquatic resources [i.e. recommendation # 7 in the report]. Because of the early presence of American shad, river herring and striped bass in this reach of the river or channel [i.e. the source of the beachfill], we recommend that the time restriction be expanded to include March 1 through October 30. This would avoid any conflict in protecting both in-river and shallow water aquatic resources if the recommended dredging period of November through January needs to be expanded or changed because of bad weather or other delays.

Lastly, we note that the State of Delaware may need to be consulted on this project. The boundary between Delaware and New Jersey is the mean low water line at Oakwood Beach. Since the proposed beachfill would be placed over that area, it could move the mean low water line and impact resources under Delaware's jurisdiction. Therefore, Delaware's approval of the project should also be sought.

We hope this information is of service to you.

Sincerely,

Robert McDowell, Director
Division of Fish, Game and Wildlife

c. A. Didun

APPENDIX B

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

Revised 2/98

	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*	T
	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

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 erythrocephalu*
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 threatene
**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

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*

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

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.
(908) 735-5450.

ENDANGERED AND NONGAME SPECIES PROGRAM
GO WILD FOR WILDLIFE
CHECK-OFF N.J. Income Tax Conservation Fund
N.J. Division Fish-Game-Wildlife

ENDANGERED AND NONGAME SPECIES PROGRAM

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION AND ENERGY
DIVISION OF FISH, GAME AND WILDLIFE

US ARMY CORPS OF ENGINEERS COMMENT RESPONSE

Responses to recommendations in Section VIII (page 12) of the US Fish and Wildlife Service Final Section 2(b) report for Oakwood Beach, Salem County, New Jersey.

- (1) The U.S. Army Corps of Engineers will continue coordination and consultation with the U.S. Fish and Wildlife Service pursuant to Section 7 of the Endangered Species Act prior to and during any construction activities.

- (2) An initiation letter was sent to National Marine Fisheries Service in July of 1996. A draft copy of the Feasibility Report and Integrated Environmental Assessment was sent to them for review. They feel that the biological opinion issued by them for dredging in Philadelphia District covers this project. A final copy of the Feasibility Report and Integrated Environmental Assessment will be provided to them.

- (3) Periodic nourishment at Oakwood Beach will be done coincidentally with normal navigational channel maintenance activities. A hopper dredge is typically used for Delaware River navigational channel maintenance activities. It is therefore more cost effective to use a hopper dredge for periodic nourishment at Oakwood Beach. If a hydraulic pipeline dredge is working in the area it will be considered for periodic nourishment. A hydraulic pipeline dredge is more economical for initial construction due to larger quantity of material required. Initial construction will be done independently of Delaware River maintenance dredging activities.

- (4) Full consideration will be given to implementing construction schedules that minimize adverse environmental impacts. Construction periods will be coordinated with the U.S. Fish and Wildlife Service to insure that adverse effects are avoided. The construction schedule has been revised to include 07 November 2001 through 28 February 2002.

- (5) Temporary and permanent easements required for implementation of this project will be acquired prior to initiation of construction.

- (6) Treatment of the stormwater prior to discharge is unrelated to the extension of the outfalls. Stormwater management is a local responsibility.

- (7) Full consideration will be given to implementing construction schedules that minimize adverse environmental impacts. Construction periods will be coordinated with the U.S. Fish and Wildlife Service to insure that adverse effects are avoided.

State of New Jersey
Department of Environmental Protection

Office of Program Coordination
PO Box 418
Trenton, NJ 08625-0418
Phone 609-292-2662
Fax 609-777-0942
lschmidt@dep.state.nj.us

January 11, 1999

Mr. Robert L. Callegari
Chief, Planning Division
Philadelphia District, Corps of Engineers
Wanamaker Building, 100 Penn Square East
Philadelphia, PA 19107-3391

RE: Draft EA Comments
Oakwood Beach, Salem County

Dear Mr. Callegari:

The Office of Program Coordination of the New Jersey Department of Environmental Protection has completed its review of the Draft Environmental Assessment (EA) for the berm restoration project along Oakwood Beach (Elsinboro Township, Salem County). We offer the following comments on the Draft EA for your consideration regarding potential impacts to natural resources, concurrence on your finding of "No Effect" on significant cultural resources, land use permitting, and public access.

NATURAL RESOURCES

The Department's Division of Fish, Game and Wildlife (DFGW) review of the Draft EA has concluded that they do not have any outstanding objections to the selected plan provided the recommendations expressed in the Draft 2(b) Coordination Act Report of the US Fish and Wildlife Service (USFWS) entitled **Assessment of the Oakwood Beach Interim Feasibility Study, 1998** (Appendix A: page 12, Section VIII, Conclusions and Recommendations) are incorporated into the project scope. The DFGW concurs with that report with one modification, that is, the extension of the time restriction in recommendation #7 (April 1 through October 30) to include the month of March. This would avoid any conflict in protecting both in-river and shallow water aquatic resources if the recommended dredging period of November through January (recommendation #4) needs to be expanded or changed because of bad weather or other delays. The additional month is needed to protect the early presence of anadromous fish (American shad, river herring, and striped bass) in the lower Delaware River. As a result of the uncommitted Army Corps of Engineers (ACOE) responses to the most crucial recommendation in the USFWS report (see Appendix A), the DFGW believes it is necessary to get a commitment from the ACOE to comply with the recommended time restrictions for the benefit of the natural resources of the area.

CULTURAL RESOURCES

Based on available information, it is the opinion of the Department's Historic Preservation Office (HPO) that there are no historic properties within the area of potential effect of the project. Thus, pursuant to 36 CFR 800.4(d), no further Section 106 consultation is required, unless resources are discovered during project implementation pursuant to 36 CFR 800.11.

LAND USE PERMITTING

The Draft EA notes that the proposed project will require a Water Quality Certificate and a concurrence of federal consistency with the Coastal Zone Management program of New Jersey. The Department's Land Use Regulation Program, as part of the certification and concurrence process, will identify any other land use permits required for the implementation of the proposed project.

PUBLIC ACCESS

The Selected Plan will includes pedestrian access to the beach approximately every one-half mile. The Department endorses the increase of public access for recreational opportunities.

Thank you for giving the New Jersey Department of Environmental Protection the chance to comment on the Draft Environmental Assessment for the project.

Sincerely,

Lawrence Schmidt
Director
Office of Program Coordination

C: Bernard Moore
Robert McDowell
Ruth Ehinger
Dorothy Guzzo
Thomas Hampton

US ARMY CORPS OF ENGINEERS COMMENT RESPONSE

Letter Date: 11 January 1999

Response:

- **Natural Resources-** Full consideration will be given to implementing construction schedules that minimize adverse environmental impacts. Construction periods will be coordinated with the US Fish and Wildlife Service to ensure that adverse effects are avoided. The construction schedule has been revised and is expected to occur 07 November 2001 through 28 February 2002. All comments associated with the Final U.S. Fish and Wildlife 2(b) Coordination Act Report recommendations are located at the end of the 2(b) report appendices.

- **Cultural Resources-** Comment noted.

- **Land Use Permitting-** Water quality certificates and concurrence of Federal consistency with the New Jersey and Delaware coastal zone management programs have been obtained.

- **Public Access-** Oakwood Beach is currently not a tourist destination nor is it anticipated to be following project construction. Recreational benefits are not being claimed for the project. The primary project purpose is hurricane and storm damage reduction. Changes in the visitation volume from the existing condition as a result of the project are anticipated to be minimal. Nearby townships that have small beaches along the Delaware River do not attract visitors from outside the immediate area. Nearby street parking is unrestricted and is expected to accommodate all anticipated public use. Non-residents that use the area now are primarily boaters that use the Salem River and Cove. Public pedestrian access to the beach will be provided approximately every one-half mile.

STATE OF DELAWARE
DEPARTMENT OF NATURAL RESOURCES &
ENVIRONMENTAL CONTROL
DIVISION OF WATER RESOURCES
89 KINGS HIGHWAY
DOVER, DELAWARE 19901

Department of the Army
Philadelphia District,
Corp of Engineers
Wanamaker Building
100 Penn Square East
Philadelphia, PA 19107-3391

January 12, 1999

Dear Mr. Dayan:

This letter pertains to the Draft Feasibility Report for the berm restoration project at Oakwood Beach, Salem County, NJ.

The NPDES Storm Water Program, created under the Clean Water Act, does not directly address beach restoration. However, under the Municipal Segment of the Program land use, erosion and sediment control are addressed. Thus, beach restoration and stabilization are indirectly addressed.

I offer the following recommendations:

a. Comply with the Wetland and Subaqueous Land Section (WSLS) program regulations;

b. Utilize the guidance, advise and expertise from WSLS for shoreline stabilization; and

c. Utilize the guidance, advise and expertise from the DNREC, Division of Soil and Water Conservation for shoreline restoration and stabilization.

If you have any questions, please call me at (302) 739-5731.

Sincerely,

Chuck Schadel

Chuck Schadel
Environmental Engineer
Surface Water Discharges Section

US ARMY CORPS OF ENGINEERS COMMENT RESPONSE

Letter Date: 12 January 1999

Response:

- Recommendations a-c have been noted
- Where applicable, coordination has been initiated with the Delaware Department of Natural Resources & Environmental Control, Division of Soil and Water Conservation and the Division of Water Resources. A water quality certificate and coastal zone management consistency statement has been requested from both the States of Delaware and New Jersey. All certificates and approvals will be obtained prior to construction.

STATE OF DELAWARE
DEPARTMENT OF STATE
DIVISION OF HISTORICAL AND CULTURAL AFFAIRS
HISTORIC PRESERVATION OFFICE
15 THE GREEN
DOVER • DE • 19901-3611

January 15, 1999

Mr. Robert L. Callegari, Chief
Planning Division
Philadelphia District, Corps of Engineers
100 Penn Square East
Philadelphia, PA 19107-3391

ATTN. Mike Swanda, Environmental Resources Branch

Dear Mr. Callegari:

This letter is pursuant to my review and comment on a draft report entitled *Oakwood Beach, New Jersey: Draft Feasibility Report and Integrated Environmental Assessment*. Based on this review, it is our opinion no significant historic and/or archaeological resources are located in the area of proposed fill below mean low water or at the proposed Reedy Island Range borrow source, which are within the jurisdiction of the State of Delaware. Thus, pursuant to the Advisory Council on Historic Preservation's regulations (36 CFR 800), we can concur with a No Resources/No Effect determination for that portion of this project which is located within the State of Delaware.

If you have any questions or require any additional information, please do not hesitate to contact me at your convenience. Thank you.

Sincerely,

Faye L. Stocum
Archaeologist

US ARMY CORPS OF ENGINEERS COMMENT RESPONSE

Letter Date: 15 January 1999

Response:

- No Response Needed

STATE OF DELAWARE
DEPARTMENT OF NATURAL RESOURCES & ENVIRONMENTAL CONTROL
DIVISION OF SOIL AND WATER CONSERVATION
89 KINGS HIGHWAY
DOVER, DELAWARE, 19901

Mr. Robert Callegari
U.S. Army Corps of Engineers
Philadelphia District
100 Penn Square East
Philadelphia, Pennsylvania 19107-3390

12 February 1999

RE: Consistency Certification
Oakwood Beach, NJ, Draft Feasibility Report and Integrated Environmental Assessment

Dear Mr. Callegari:

The Delaware Coastal Management Program (DCMP) has received and reviewed your consistency determination for the above referenced project. Based upon our review and pursuant to National Oceanic & Atmospheric Administration regulations (15 CFR 930), the DCMP concurs with your consistency determination for the Oakwood Beach, NJ, Draft Feasibility Report and Integrated Environmental Assessment.

However, we do have two specific comments regarding information contained in this document. First, it appears that the benefit-cost summary is based upon the assumption that the Delaware River 45-foot deepening project will be completed in the year 2000, yielding benefits from reduced maintenance dredging that total $181,000 (p96) or $149,000 (p119). It is important to note that the Main Channel Deepening project has not yet been fully approved, and there are still remaining issues to be negotiated. The benefit-cost ratio for Oakwood Beach may be altered if calculations are repeated and assumptions regarding the Main Channel project are omitted.

Additionally, if for any reason the borrow site should change from the currently identified Reedy Island range of the Delaware River main navigation channel, we would need to evaluate the suitability of the new identified site. We are currently in the process of examining the ultimate plans for disposal of material removed from the bend widening for the Main Channel Deepening project.

Our concurrence is based upon the restrictions and/or conditions placed on any and all permits issues to you for this project.

If you have any questions regarding this determination, please do not hesitate to contact me at (302) 739-3451.

Sincerely,

Sarah W. Cooksey
Delaware Coastal Management Program

SWC/jmr

cc: File 98.027

US ARMY CORPS OF ENGINEERS COMMENT RESPONSE

Letter Date: 12 February 1999

Response:

- Concurrence with the Federal consistency determination based upon the restrictions and/or conditions placed on all permits issued for this project is noted.
- Page C-23 of Appendix C (Economic Analysis) of the main report includes a benefit-cost analysis should the deepening of the main channel not occur. Reduced Federal maintenance dredging benefits would still accrue to a lesser degree under existing conditions. The proposed shore protection project would still be justified without deepening of the main channel.
- Coordination will be re-initiated with appropriate resource agencies in the event a new borrow site is identified for the Oakwood Beach project.

Phone Conversation

Between:	Nathan S. Dayan USACE NSD 215-656-6562	and	Anita Riportella NMFS 732-872-3116

Topic: Oakwood Beach, New Jersey Draft Feasibility Study and Integrated Environmental Assessment

Comment: National Marine Fisheries Service will not be responding in writing to the Environmental Assessment. They feel all their issues are covered in the report. They also feel the Biological Opinion issued by them for dredging projects in Philadelphia District covers this project.

US ARMY CORPS OF ENGINEERS COMMENT RESPONSE

Phone Conversation Log

Response:

- No Response Needed

Phone Conversation

Between:	Nathan S. Dayan USACE 215-656-6562	and	Loren La Monica USEPA 212-637-3496

Topic: Oakwood Beach, New Jersey Draft Feasibility Study and Integrated Environmental Assessment

Comment: U.S. Environmental Protection Agency will not be responding in writing to the Environmental Assessment. They feel all their issues are covered in the report. They also feel that the beneficial use of dredge material from the main channel will reduce the impact to the environment. They had further questions on historic erosion and were placed in contact with Jeff Gebert.

US ARMY CORPS OF ENGINEERS COMMENT RESPONSE

Phone Conversation Log

Response:

- No Response Needed

State of New Jersey
Department of Environmental Protection

Mr. Nathan Dayan
Wanamaker Building
Environmental Resources Branch
100 Penn Square East
Philadelphia, PA 19107-3390

MAR 12 1999

RE: Federal Consistency Determination
Water Quality Certificate
Oakwood Beach; Salem County, New Jersey
File #1703-98-0003.1

Dear Mr. Dayan:

The New Jersey Department of Environmental Protection, Land Use Regulation Program, acting under Section 307 of the Federal Coastal Zone Management Act, as amended, has determined that the creation of 9,500 linear feet of 50 foot wide berm, at Oakwood Beach; Salem County is consistent with the Rules on Coastal Zone Management as amended to December 7, 1998.

The source of the material along with the proposed construction techniques is detailed in a report entitled "Draft Feasibility Report and Integrated Environmental Assessment" prepared by the Army Corps of Engineers and dated August 1998.

Issuance of this Federal Consistency Determination also includes the Department's authorization of a Water Quality Certificate to conduct a regulated activity in tidal waters.

Should you have any questions concerning this determination or wish to discuss the project further, please contact Kevin Broderick of my staff directly at (609) 984-0288.

Sincerely,

Richard H. Kropp, P.E., Director
Land Use Regulation Program

US ARMY CORPS OF ENGINEERS COMMENT RESPONSE

Letter Date: 12 March 1999

Response:

- No Response Needed

STATE OF DELAWARE
DEPARTMENT OF NATURAL RESOURCES &
ENVIRONMENTAL CONTROL
DIVISION OF WATER RESOURCES
89 KINGS HIGHWAY
DOVER, DELAWARE 19901

WETLANDS & SUBAQUEOUS
LANDS SECTION

TELEPHONE (302)739-4691
FACSIMILE (302)739-6304

March 31, 1999

Robert L. Callegari
Chief, Planning Division
U.S. Army Corps of Engineers
CENAP-PL
100 Penn Square East
Philadelphia, PA. 19107-3390

RE: SP-377/98 - Oakwood Beach Feasibility Study

Dear Mr. Callegari:

The Wetlands and Subaqueous Land Section has reviewed the "Oakwood Beach, NJ Feasibility Study, Draft Feasibility Report and Integrated Environmental Analysis," dated August 1998 and received by this office on December 1, 1999. Based on our current understanding of the project, we anticipate that we will issue water quality certification for this project, after a review of the final project plans. Please be aware that this office can not make a final determination on water quality certification for the project until the final plans have been submitted and evaluated and public comments have been solicited and reviewed.

If you have any questions, please contact us at (302) 739-4691.

Sincerely,

Laura M. Herr
Program Manager I
Wetlands & Subaqueous
Lands Section

Sincerely,

William F. Moyer
Program Manager II
Wetlands and Subaqueous
Lands Section

US ARMY CORPS OF ENGINEERS COMMENT RESPONSE

Letter Date: 31 March 1999

Response:

- No Response Needed