US Army Corps
of Engineers
Philadelphia District

DELAWARE BAY COASTLINE -
DELAWARE AND NEW JERSEY

Broadkill Beach, DE
Interim Feasibility Study

FINAL
APPENDICES B THROUGH G

September 1996

APPENDIX B

ECONOMIC ANALYSIS

DELAWARE BAY COASTLINE FEASIBILITY STUDY
BROADKILL BEACH
WITHOUT PROJECT CONDITION ECONOMIC ANALYSIS

Description Of The Study Area

Population and Land Use

Broadkill Beach is a small bay-side community consisting of 3 miles of beaches along the Delaware Bay and a permanent population slightly under 500. Due to the relatively small size of Broadkill Beach the community has remained unincorporated and is governed under the jurisdiction of Sussex County.

Sussex County is the largest of the three counties in Delaware, encompassing 950 square miles of the state's 1982 square miles. It is the second most populated county with approximately 17% of the state's permanent population. In 1990 Sussex County had a population of 113,229 residents, almost 1/4 of New Castle County's population, and an increase of 9.5% since 1985.

Unlike the majority of shoreline communities in Delaware, Broadkill Beach has remained a small residential community with very little tourism. There are approximately 430 single family homes and only 1 commercial lot within the town's boundaries, the Broadkill Store. The store is located at the corner of Route 16 and Bayshore Drive, the only marked intersection within Broadkill Beach.

Bayshore Drive is the primary road in Broadkill Beach and Route 16 is the only access road which leads into the community. Because Route 16 is the only evacuation route it is very important that the road remains accessible. In attempts to prevent flooding, the road was slightly raised almost 20 years ago. However, despite this effort the road still remains vulnerable to overflow in major storms. When the road becomes inundated with flood waters, access to Broadkill becomes virtually impossible.

Within the town itself there is only one main road, Bayshore Drive, which runs parallel with the bay. There are also a few roads which run perpendicular to Bayshore Drive, but most are small dirt roads with limited access. Even Bayshore Drive becomes a dirt road at the southern end of the community. Very few homes are built on these side roads. Instead, most homes line the bay-side of Bayshore Drive, with less than 1/4 of the homes on the west side of the road.

Development within Broadkill Beach is limited to the southern end of town due to the nature of the land. To the west of Broadkill Beach is the 635 acre Primehook National Wildlife Refuge. And to the far south, lies the state owned Beach Plum Island.

Due to these obstacles, most new construction is occurring on the southern end of Bayshore Drive. These homes are newer and more expensive than the cottages which are located in the center of town. Construction is expected to continue due to the abundance of

vacant lots as well as the existence of water hookups already pre-installed.

In 1990 the median value of a single family home in Sussex County was $79,800, almost 20% less than the State's median value. Less than half of the homes in Sussex County are owner occupied with 12.6% renter occupied and 41.2% vacant. Median rent for single family homes in Sussex County is approximately $278, more than 65% of Delaware State's median rent. Unlike Sussex County, however, residents of Broadkill Beach permanently occupy about 25% of the homes year round and the majority of homes are owner occupied rather than renter occupied.

Table 1
Housing Unit Occupancy

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

Source: Upclose U.S. Data Book 1993

Because of the expected continual development in both Broadkill and Sussex County, the U.S. Census Bureau, has projected that both the State of Delaware and Sussex County's population will continue to increase over the next twenty years, but at a decreasing rate of growth. Table 2 contains estimates of population by the Delaware Population Consortium, University of Delaware, College of Urban Affairs and Public Policy for the next fifteen years.

Table 2
Year Round Population

	1985	*1990*	*1995*	*2000*	*2005*	*2010*
Delaware	625,950	682,700	738,150	784,850	820,500	845,000
Sussex County	107,450	113,229	132,400	142,700	151,700	162,350

Economic Development

In 1990 Sussex County's labor force was projected to be 62,750, with an unemployment rate of 4.2%, just above the state's unemployment rate of 4.0%. The study area is similar to the rest of Sussex County and Delaware in its reliance on the agriculture and manufacturing/processing industry. In Sussex County, 1/3 of the workforce is employed in retail or services, while another 1/3 are in manufacturing.

The estimated per capita income in 1990 for Sussex County was $12,723, slightly lower than the state of Delaware which had a per capita income of $15,584. Although the study area is similar in nature to the county as a whole, it differs greatly from most coastal areas. Since most coastal communities have come to rely heavily on tourism, they are not affected by economically hard times caused by poor agricultural crops or a recession in the manufacturing industry. However, because Broadkill has a strictly agricultural and manufacturing industry, the economy tends to fluctuate greatly from year to year.

Table 3
Income For 1990

	Per Capita Income	*Median Household Income*	*Median Family Income*
Delaware	15,854	34,875	40,252
Sussex County	12,723	26,904	31,112

Source: The Upclose U.S. Data Book 1993

Economic Analysis

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 Coastline in Broadkill, Delaware.

Conditions

An October 1995 price level, 50 year project life, and a base year of 2000 were used in the economic analysis. Damages were converted to an annual equivalent time basis using a 7.75% discount rate as applicable to public works projects. The final table for the selected plan applied the FY 96 discount rate of 7.625%.

Methodology and Assumptions

Without project conditions damages were calculated for seven frequency storm events (5, 10, 20, 50, 100, 200 and 500 year events) for erosion, wave and inundation damages to structures, infrastructures and improved property. Values for infrastructures and property were estimated using standard engineering criteria. The assumption was made that all infrastructures damaged in Broadkill would be replaced in-kind. Once damage was calculated for all infrastructures they were placed into EAD to calculate the Expected Annual Damages.

Damage calculations for 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 and an ASCII "Structure" file. An excerpt from the structure file is located in Table 4.

Historical records show little damage to Broadkill over recent years, due in part to the local's effort to maintain the historical footprint of the shore line. When storms eroded the beaches of Broadkill the local sponsors helped finance beachfills to protect bayfront real estate. These beachfills were purely on an as needed basis and were not performed on a routine schedule.

A structure inventory survey was undertaken to gather data pertaining to the structural characteristics of all residential, commercial and public 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, etc. An example of the input is listed in Table 5. The average associated content value of each structure is estimated to be 35% 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.

Once the information was placed in COSTDAM, the program was able to calculate damages. COSTDAM initially examined a structure for damages caused by wave attack, based on the relationship between a structure's first floor elevation and the total water elevation that sustains a wave. COSTDAM then determined if the structure had undergone any erosion damage. If the water elevation was higher than the first floor elevation (based on FIA depth-damage curves adjusted by increased salt water damagibility) the program calculated damages caused by inundation. Examples of these curves are in Table 7. To avoid double counting, if damage occurs by more than one mechanism, COSTDAM took the maximum damage of any given mechanism (wave, erosion, inundation) and eliminated the remaining damages from the structure's total damages. Average annual damages were then calculated and aggregated for each reach.

Table 4
Excerpt of Structure File
for Existing and Future Development

1	1001	50.0	25.0	11.5	5.0	84	29S01S02	1-1
1	1002	80.0	500.0	11.5	9.0	158	55S07S08	1-1
2	2001	300.0	320.0	10.9	8.5	190	67S07S08	3-1
2	2002	300.0	325.0	11.2	7.5	101	35S05S06	3-1
3	3103	550.0	570.0	6.4	2.0	69	24S01S02	1-1 31

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.
Columns 73-75 contain the year the existing lot becomes developed from the base year.

Table 5

Marshall & Swift Estimator Program Input Data

Address: 3001
City, State ZIP: Broadkill, DE 19958

Floor Area: 2,238 square feet
Quality: Very Good
Condition: Very Good

Style: One 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 New	2,328	89.53	208,432

Erosion Damages

This analysis evaluated the expected storm erosion losses within each reach and the subsequent damage caused by a range of storm events. In order to estimate the extent of erosion damage produced by a certain horizontal retreat of the shoreline, the position of each structure in relation to the shoreline had to be determined. The erosion points were calculated by measuring the distance between the reference (profile) line and the front and back walls of each structure in AutoCAD, using the georeferenced MIPS mapping of the study area. Based on engineering input, it was determined 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. The total damage for was calculated by COSTDAM and entered directly into an Excel file to annualize all damages accrued.

Loss of Improved Property and Infrastructures

Loss of improved property and infrastructure damage, due to erosion, was also calculated for each reach. EAD was used to calculate the damages to both land and infrastructures. The land value was determined by comparing market value of the developed land 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 100' x 50' 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 cell. The cost of fill and the replacement of roads was not a fixed value. It decreased with greater quantities eroded, therefore reflecting economies of scale.

Loss of Landscaping was calculated by estimating the value of landscaping for each cell. Houses were individually placed into two categories of landscaping fair and low. Once the individual structures were assigned a rating the cell received a general rating based on the overall ratio of homes 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.

Table 6

Residential Structures S03 (2 story, no basement, residential structure)
# of rows (free format) 13 Depth Damage (expressed as a decimal) (free format)

-2	0
-1	.01
0	.10
1	.24
2	.30
3	.36
4	.39
5	.42
6	.47
7	.49
8	.56
9	.64
10	.67

Residential Contents S04 (2 story, no basement)
# of Rows (free format) 13
Depth Damage (expressed as a decimal) (free format)

-2	0
-1	0
0	.22
1	.31
2	.40
3	.54
4	.61
5	.67
6	.76

7	.81
8	.88
9	.88
10	.96

Wave-Inundation Damages

Beachfront structures are subject to damage as a result of direct wave impact. However damage was not claimed for a structure from both wave attack and erosion for the same event to avoid double counting. Also, any structure sustaining total damage in the wave attack or erosion analysis at a particular event was not included in the inundation model for that event. A structure was considered to be damaged by a wave when there was sufficient force in the total water elevation to destroy a structure. Partial wave damages are not calculated; instead the structure was subjected to inundation damages.

The percentages of total replacement cost 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 (Federal Insurance Administration) curves. The distinguishing characteristics were construction type (frame, concrete block, or masonry), the number of stories in a structure as well as the presence of a basement.

Future Development

The structure file also includes future development. Table 7 displays the number of structures by decade. Available lots were determined through tax maps as well as field observation. Lots were assumed to be developed over the life of the project at approximately the same rate as historical development has occurred. These future structures are also assumed to be developed in similar locational patterns as previous development. Structures were developed with similar characteristics as existing adjacent homes. If the vacant lot is surrounded by two story homes on piles worth $150,000 then future development was expected to be a house around $150,000. However all houses were assumed to be built on piles with a first floor elevation at the 100 year storm level +1 foot, in accordance with FEMA regulations.

Once the structural characteristics were determined for future development, the data was then placed in COSTDAM and future damages incurred over the 50 year project life were calculated. To prevent over stating damages, each new structure was given a "vudo number" which told what year the lot was expected to be developed, after the base year of 2000. For example if the lot was to be developed in 2010 the vudo number would be 10. COSTDAM then began calculations for that structure in the year 2010 and disregarded any prior damages. The total expected annual damages for future development is $194,000 compared to $831,000 for existing development.

Table 7
Number of Structures by Decade

Year	1994	2000	2010	2020	2030	2040	2050
Total	426	473	552	623	668	668	668

Local Beach Nourishment Costs.

The State has been involved in maintaining the beach at its pre-storm state, and this involvement is expected to continue. Based on the erosion occurring in Broadkill, the amount of material required to maintain the beach is 43,890 cy/yr. This will cost the State approximately $620,000 annually. Without this expenditure by the State, the without project storm damages estimated in this report would have been significantly higher.

Without Project Conditions Summary

Table 8 displays annual damages for existing and future structures caused by erosion, wave and inundation for the seven storm frequencies. These figures are based on a total of 668 structures, 242 of which are vacant lots which are expected to be developed by the year 2050. Annual damages to present and future structures in Broadkill are $1,025,000

Table 8
Without Project Damages
October 1995 Price Level Discount Rate 7.75%
Damages are in $000s

Structures	1,025
Improved Property	262
Infrastructure	38
Local Costs Foregone	573
Total Average Annual Damages	*1,898*

BROADKILL WITH PROJECT CONDITIONS

Storm Damage Reduction

Damages for 5 with project alternatives were calculated using the same methodologies and database previously detailed in the without project conditions. The benefits for any given project are the difference between without project damages and with project damages. The storm damage reduction benefits are shown for all 5 alternatives in Table 9.

Table 9
Storm Damage Reduction by Alternative
October 1995 Price Level and Discount Rate 7.75%

Alt.	Berm	Dune	WO Project Storm Dam.	With Project Storm Dam.	Storm Dam. Reduction	Percent Reduced
1	100	14	1,897,830	380,190	1,517,640	80%
2	100	16	1,897,830	308,490	1,589,340	84%
3	150	14	1,897,830	271,020	1,626,810	86%
4	150	16	1,897,830	259,110	1,638,720	86%
5	150	18	1,897,830	243,090	1,654,740	87%

Optimization

Optimization of the alternatives is based on the priority benefit categories of storm damage reduction and reduced maintenance, indexed to an October 1995 price level. Initial and nourishment costs for the various with project alternatives are annualized for comparison to the average annual benefits for specific project alternatives. Initial construction and periodic nourishment are annualized over a 50 year project life at 7.75%. The average annual costs are subtracted from average annual benefits to calculate net benefits and select the optimal plan which maximizes net benefits. Included in Table 10 are the average annual benefits and costs, the net benefits and benefit-cost ratio for storm damage reduction. Plan 2 with a 100' berm and a dune at +16 NGVD is the optimal plan.

Table 10
Average Annual Benefit/Cost Matrix
October 1995 Price Level
Discount Rate 7.75%
(in $000s)

			100' BERM		150' BERM
			ALT 1		ALT 3
+14' DUNE	Average Annual Benefits Average Annual Costs Benefit-Cost Ratio Net Benefits		1,518 1,146 1.32 372		1,627 1,259 1.29 367
			ALT 2		ALT 4
+16' DUNE	Average Annual Benefits Average Annual Costs Benefit-Cost Ratio Net Benefits		1,589 1,173 1.35 416		1,639 1,285 1.28 354
					ALT 5
+ 18' DUNE	Average Annual Benefits Average Annual Costs Benefit-cost Ratio Net Benefits				1,655 1,312 1.26 343

BENEFITS

The benefits of any coast protection project result from the difference between the losses that will be experienced without the project compared to the same losses occurring at some time into the future with the project. The expected value of losses are then also calculated for the with project condition. The average annual benefit is then the area between the two curves. (If the event losses are then plotted against the reciprocal of the return period of these events, then the area under this curve is the expected value of the losses) Table 11 displays the with project (residual) damages for the proposed plan which equals $308,000 on an average annual basis.

Table 11
With Project Damages in ($000s)
October 1995 Price Level
Discount Rate 7.75%

Structures	284
Improved Property	13
Infrastructure	11
Total Average Annual Damages	308

The affect of coastal erosion can result in an economic loss of land and property. Buildings, including the land integral to the property, infrastructure, and non-built up land may all be lost to the sea. This raises two additional complexities in assessing the benefits of coastal protection arising from the frequent association between flood risk and coastal erosion. One affect of erosion is that the risk of flooding to areas further inland increases over time as the land recedes. The other is if erosion is unchecked, land that is now at risk of flooding will first become unusable because of the frequency with which it is flooded, and will eventually be lost through erosion. So for the first part of the time horizon the benefit of protecting a property arises from reduction or elimination of flood losses, and as erosion occurs, a one time capital loss. However, local intervention on a periodic basis will prevent the gradual (long term) erosion from claiming property. This expenditure will not be incurred under a with project condition. The estimate for local cost foregone for beach maintenance in Broadkill is estimated at $620,000 annually. Total average annual benefits equal to $1,741,000.

FINAL NED PLAN
Annualization of Costs & Benefit to Cost Ratio (BCR)

Initial costs, cyclical maintenance costs were provided for the project life plan design. The first cost was estimated at $8,409,000 for the proposed plan using an October 1995 price level and a 7.625% discount rate. A cyclical maintenance cost of $2,852,000 is expected every 5 years. There are also monitoring costs associated with the selected plan. Table 12 presents the annualization of these costs. Interest during construction was calculated for a 10 month construction period as displayed in Table 13, estimated at $279,000. Table 14 summarizes the total average annual cost for the proposed plan estimated at $1,303,000. The BCR for the proposed plan is 1.34 to 1 with net benefits of $438,000 per year.

Table 12
Present Worth Cost Analysis for 5 Year Nourishment Cycle
October 1995 Price Level & 7.625% Discount Rate
Base Year 2000
100' Berm 16' Dune

TYPE	YEAR	COST	PW FACTOR	PW COST
First Cost	0	833822	1.000000000	833827
Real Estate	0	70401	1.000000000	70401
IDC	0	279000	1.000000000	279000
Monitoring	0	82800	1.000000000	82800
O&M	1	41400	0.929152149	38467
O&M	2	52900	0.863323715	45670
O&M	3	41400	0.802159085	33209
O&M	4	2934470	0.745327838	2187142
O&M	5	41400	0.692522962	28670
O&M	6	52900	0.643459198	34039
O&M	7	41400	0.597871496	24752
O&M	8	82800	0.555513585	45997
O&M	9	2893070	0.516156641	1493277
O&M	10	52900	0.479588052	25370
O&M	11	41400	0.445610269	18448
O&M	12	82800	0.414039739	34282
O&M	13	41400	0.384705913	15927
O&M	14	2904570	0.357450326	1038239
O&M	15	41400	0.33125738	13750
O&M	16	82800	0.308595344	25552
O&M	17	41400	0.286732027	11871
O&M	18	52900	0.266417679	14093
O&M	19	2893070	0.247542558	716158

O&M	20	82800	0.230004700	19044
O&M	21	41400	0.213709361	8848
O&M	22	52900	0.198568512	10504
O&M	23	41400	0.184500360	7638
O&M	24	5726841	0.171428906	981746
O&M	25	41400	0.159283536	6594
O&M	26	52900	0.147998640	7829
O&M	27	41400	0.137513254	5693
O&M	28	82800	0.127770736	10579
O&M	29	2893070	0.118718454	343461
O&M	30	52900	0.110307506	5835
O&M	31	41400	0.102492456	4243
O&M	32	82800	0.095231086	7885
O&M	33	41400	0.088484168	3663
O&M	34	2904570	0.082215255	238800
O&M	35	41400	0.076390481	3163
O&M	36	82800	0.070978379	5877
O&M	37	41400	0.065949714	2730
O&M	38	52900	0.061277318	3242
O&M	39	2893070	0.056935952	164720
O&M	40	82800	0.052902162	4380
O&M	41	41400	0.049154158	2035
O&M	42	52900	0.045671691	2416
O&M	43	41400	0.042435950	1757
O&M	44	2934470	0.039429454	115705
O&M	45	41400	0.036635962	1517
O&M	46	52900	0.034040383	1801
O&M	47	41400	0.031628695	1309

O&M	48	82800	0.029387870	2433
O&M	49	0	0.027305802	0
			TOTAL	**16,590,791**

Capital Recovery Factor (50 YEARS @ 7.625%)	0.07823491724
AVERAGE ANNUAL COSTS	$1,297,979
Ann. Maintenance for Sand Fence & Dune Grass	$5,000
TOTAL AVERAGE ANNUAL COSTS	**$1,302,979**

Table 13
Interest During Construction
Discount Rate 7.625%
Price Level: October 1995

Month	First Cost	Future Value Factor	Investment Cost
1	$1,122,867	1.0631494	$1,193,776
2	$587,200	1.0566590	$620,470
3	$587,200	1.0502083	$616,682
4	$587,200	1.0437969	$612,917
5	$920,693	1.0374247	$955,150
6	$920,693	1.0310914	$949,319
7	$920,693	1.0247967	$943,524
8	$920,693	1.0185405	$937,764
9	$920,693	1.0123224	$932,039
10	$920,693	1.0061424	$926,349
	$8,408,627		$8,687,988

	Total Investment		$8,687,988
	Cost:		
	Minus First Cost:		$8,408,627

	INTEREST DURING CONSTRUCTION:		$279,361

Rounded:	**$279,000**

*Study will proceed directly from feasibility phase to the preparation of plans and specifications. The costs for these preconstruction efforts is included in the total initial construction cost. More detailed costs are shown in the Project Management Plan.

Table 14
Comparison of Benefits and Costs
October 1995 Price Level
Discount Rate 7.625%

Benefit Category:	
Structures	$794,000
Improved Property	$300,000
Infrastructure	$27,000
Local Costs Foregone	$620,000
Total Average Annual Benefits	**$1,741,000**
Costs:	
First Costs:	$8,409,000
Interest During Construction	$279,000
Monitoring in Base Year	$82,800
Total Average Annual Costs:	**$1,303,000**
Benefit-Cost Ratio:	1.34
Net Benefits:	**$438,000**

Risk and Uncertainty Analysis

In accordance with ER 11052-100, the parameters and variables considered critical were varied in a sensitivity analysis. The amount of variation is reasonable since the techniques and methodology used in the analysis were refined to an effort to reduce uncertainty. The sensitivity analysis increased the discount rate by 2.375 percentage points to 10%. The base year for the project is in 4 years. Review of the trend in discount rates shows that the rate has not increased by more than 1 percentage point in any 4 year period since 1974. Most recently, the discount rate has actually decreased every year since 1990. Plan sensitivity to depth-damage and replacement cost values was less critical.

INTEREST RATE

Project benefits and costs were annualized at a higher discount rate of 10%. The results are displayed below.

DISCOUNT RATE 10%

Average Annual Benefits:	
Storm Damage Reduction	$630,000
Improved Property	$249,000
Infrastructures	$25,000
Local Costs Foregone	$573,000
Total Average Annual Benefits	**$1,477,000**
Total Average Annual Costs	**$1,341,000**
BCR:	1.1
Net Benefits:	$136,000

REPLACEMENT COST VALUES

The NED plan was also rerun changing the structures and content replacement values +/- 10%. The results are displayed below.

REPLACEMENT COSTS +10%

Average Annual Benefits:	
Storm Damage Reduction	$821,000
Improved Property	$249,000
Infrastructures	$25,000
Local Costs Foregone	$573,000
Total Average Annual Benefits:	**$1,668,000**
Total Average Annual Costs:	**$1,180,000**
BCR	1.41
Net Benefits:	$488,000

REPLACEMENT COSTS -10%

Average Annual Benefits:	
Storm Damage Reduction	$672,000
Improved Property	$249,000
Infrastructures	$25,000
Local Costs Foregone	$573,000
Total Average Annual Benefits:	**$1,519,000**
Total Average Annual Costs:	**$1,180,000**
BCR:	1.29
Net Benefits:	$339,000

DEPTH-DAMAGE CURVES

The NED plan was rerun changing the inundation depth-damage +/- 10%. The results are displayed below.

DEPTH-DAMAGE CURVES +10%

Average Annual Benefits:	
Storm Damage Reduction	$786,000
Improved Property	$249,000
Infrastructures	$25,000
Local Costs Foregone	$573,000
Total Average Annual Benefits:	**$1,633,000**
Total Average Annual Costs:	**$1,180,000**
BCR:	1.38
Net Benefits:	$453,000

DEPTH-DAMAGE CURVES -10%

Average Annual Benefits:	
Storm Damage Reduction	$724,000
Improved Property	$249,000
Infrastructures	$25,000
Local Costs Foregone	$573,000
Total Average Annual Benefits:	**$1,571,000**
Total Average Annual Costs:	**$1,180,000**
BCR:	1.33
Net Benefits:	$391,000

APPENDIX C

UNITED STATES
FISH AND WILDLIFE SERVICE
COORDINATION

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Chesapeake Bay Field Office
177 Admiral Cochrane Drive
Annapolis, MD 21401
December 5, 1994

Lt. Colonel Robert P. Magnifico
District Engineer
U.S. Army Corps of Engineers
100 Penn Square East
Philadelphia, PA 19107-3390

Attn: Barbara Conlin

Re: Broadkill Beach Interim
Feasibility Study

Dear Colonel Magnifico:

Enclosed is a Planning Aid Report for the subject study. In accordance with the Scope of Work, it contains information on the baseline biological conditions, potential environmental impacts of the project, and preliminary mitigation measures. While beach replenishment is not expected to result in any major adverse effects, a restriction on construction during May and early June is recommended to lessen impacts to spawning horseshoe crabs and staging shorebirds. If there are any questions, please contact George Ruddy at (410) 573-4528.

Sincerely,

John P. Wolflin
Supervisor
Chesapeake Bay Field Office

cc: Delaware Estuary Program
DE DNREC, Div. of Fish and Wildlife
NMFS, Oxford

Delaware Bay Coastline-Broadkill Beach
Interim Feasibility Study

Planning Aid Report:

Baseline Biological Conditions and Potential Impacts of Beach Replenishment

Prepared for:
U.S. Army Corps of Engineers
Philadelphia District

Prepared by:
George Ruddy
Fish and Wildlife Biologist

Under Supervision of :
John P. Wolflin, Supervisor
Chesapeake Bay Field Office
U.S. Fish and Wildlife Service

December 1994

ABSTRACT

Delaware Bay Coastline-Broadkill Beach
Interim Feasibility Study

Baseline Biological Conditions and Potential
Impacts of Beach Replenishment

December 1994

This report provides planning aid information to assist the Philadelphia District, Army Corps of Engineers, in their feasibility study of potential storm protection measures for Broadkill Beach, Sussex County, Delaware. The report describes the biological conditions along the shoreline and at two proposed sand borrow sites located approximately two nautical miles offshore. It also contains information on potential environmental effects of beach replenishment and mitigation measures. The information is derived from existing data sources, field inspection, and consultation with Federal and State resource agencies. The project is not expected to result in any major adverse biological impacts, although a restriction on project construction during May and early June is recommended as a way to mitigate potential impacts to spawning horseshoe crabs and staging shorebirds. Coordination with the National Marine Fisheries Service is recommended to address potential conflicts with sea turtles at the borrow site.

Key words: beach replenishment, Broadkill Beach

INTRODUCTION

The Philadelphia District, Army Corps of Engineers is conducting the Delaware Bay Coastline-Broadkill Beach, Delaware Feasibility Study. The study is investigating shore protection measures for the community of Broadkill Beach. A primary alternative is beach replenishment using sand from an offshore borrow source. The possible use of structures such as breakwaters and groins is also being examined. However, as yet no specific alternative plans have been developed. This report provides information on the baseline biological conditions, potential environmental effects of the general beach replenishment alternative, and mitigation measures. It is submitted in accordance with provisions of the Fish and Wildlife Coordination Act (29 Stat. 401, as amended; 16 U.S.C. 661 et seq.) and Section 7 of the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.).

BASELINE BIOLOGICAL CONDITIONS

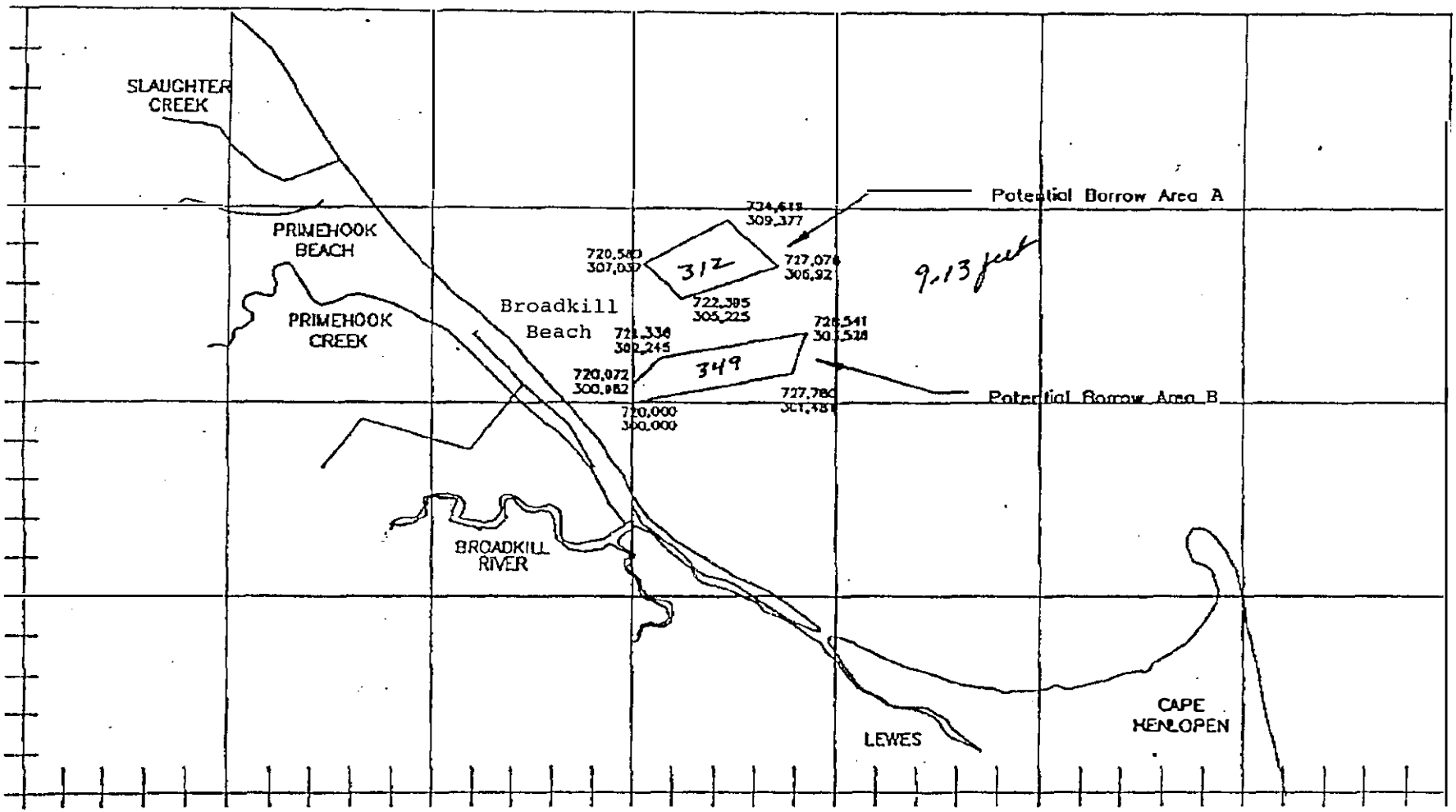
The project area includes the Broadkill Beach shoreline, adjacent estuarine waters, and proposed borrow sites located approximately two nautical miles offshore (Figure 1). This area is located in the lower portion of Delaware Bay where the salinity is typically between 26 and 30 ppt (Sharp 1988). The mean tidal range, based on the calculation for Roosevelt Inlet, is 4.4 feet (U.S. Department of Commerce 1990).

Broadkill Beach Shoreline

A Service biologist inspected the Broadkill Beach shoreline on November 11, 1994, just after a beach replenishment effort by the State of Delaware. The existing beach is exposed to a fetch of 12 miles or more across Delaware Bay. The Broadkill Beach community is linearly distributed in a narrow zone between the beach and an extensive saltmarsh. There is only a very narrow low vegetated dune zone between the back of the beach and the community. The vegetation is primarily beach grass (*Ammophila breviligulata*). In some areas the beach grass had obviously been propagated by planting.

Most of the benthic biological activity along the shoreline occurs within or seaward of the intertidal zone. Site specific benthos information for Broadkill Beach is limited. Watling and Maurer (1973) reported that the beach-flea (*Talorchestia megalophthalma*) and the sea cucumber (*Thyone briareus*) were dominant species. A two-year study by Maurer and April (1979) of the benthic assemblages at a intertidal sand flat approximately 6 miles southward at the mouth of Delaware Bay provides some relevant information. Although this site has less exposure to wave energy and a broader intertidal zone, many of the organisms recorded during this study should also occur at Broadkill Beach. These include: polychaete worms (*Scoloplos fragilis, Scolelepis squamata, Heteromastus filiformis*), bivalves (*Gemma gemma, Tellina agilis, Nucula proxima*), crustaceans (*Neohaustorius biarticulatus, Chiridotea caeca, Sphaeroma quadridendatum, Ovalipes occellatus*), and the horseshoe crab (*Limulus polyphemus*). The study noted the occurrence of significant predation of the benthos by fish, crabs, and birds. These benthic assemblages were also found to be resilient to seasonal periods of sediment movement.

Figure 1. Location of the Broadkill Beach study area. Approximate scale is 1 inch=1.5 mile.



While the open beach above the intertidal zone is a relatively barren environment, there is some biological activity. The beach wrack which collects near the highest reach of the tide may contain carrion, plant parts, and other organic material which attracts various foraging birds (eg. gulls, shorebirds, fish crows, and grackles) and mammals (eg. raccoons and red foxes). The most striking biological activity at Broadkill Beach occurs during the spring when tremendous numbers of migrating shorebirds arrive to feed on recently deposited horseshoe crab eggs. The horseshoe crab spawning ritual is a dramatic event by itself with large numbers of crabs emerging from the Bay to deposit their eggs in the sand near the high tide line. The beaches of Delaware Bay support the highest number of spawning horseshoe crabs among the East Coast estuaries. The eggs are a major food source for the shorebirds which begin arriving in early May and remain through early June before continuing their northward migration to the nesting grounds. Delaware Bay is considered to be a critical stop-over area for shorebirds during their spring migration. The number of birds at Broadkill Beach are not generally as high as areas further up the Bay, but are nonetheless significant (Lisa Gelvin-Innvaer, DNREC, pers. com.). Semipalmated sandpiper (*Calidris pusilla*) and red knot (*Calidris canutus*) are the most common species at Broadkill Beach.

Borrow Site Areas

The benthic macrofauna of the two potential borrow sites and neighboring control areas was surveyed in July 1994 (Kropp 1994). Annelids, mollusks, and arthropods were the dominant groups. Some general differences in the benthic assemblages for the two borrow areas were noted. Many stations at Borrow Area A had strikingly high numbers of the small clam *Gemma gemma*. Haustoriid amphipods, oligochaete worms, and the capitelid polychaete *Amastigos caperatus* were also relatively more abundant at Borrow Area A. Borrow Area B tended to have relatively higher numbers of the gastropod *Acteocina canaliculata*, the clam *Tellina agilis*, and ampeliscid amphipods. Neither borrow area contains exploitable populations of commercially important species or other notable benthos characteristics.

The fish fauna inhabiting the borrow sites has not been specifically sampled. However, the annual juvenile fishes trawl survey conducted by the Delaware Division of Fish and Wildlife provides information which should be relevant for the Broadkill Beach area. Table 1 summarizes the results from monthly trawls conducted from April through October each year from 1980 through 1993 at three inshore stations between Big Stone Beach and Primehook Beach. The most abundant species in this survey were bay anchovy, weakfish, hogchoker, striped cusk-eel, Atlantic croaker, and spot. Most of the species display a pronounced seasonal fluctuation in abundance. Abundance is low in the winter as most species move to warmer waters offshore and southward. Spring brings a progressive influx of species including many which use the lower Delaware Bay for spawning and nursery purposes.

The weakfish is one of the most important species in Delaware Bay in terms of its abundance and value to the recreational and commercial fisheries. It is a seasonal resident from April through October. The southwest portion of the Bay between the Mispillion River and Lewes is a major spawning area (Price et al. 1988). Spawning occurs throughout the summer, but is particularly intense in June and July. The larvae are transported to the middle and upper portions

Table 1. Fishes collected during the DNREC juvenile trawl survey at stations 55, 61, and 63 (between Big Stone Beach and Primehook Beach within 3 miles of the shore). The survey involved monthly sampling between April and October from 1980 to 1993, and used a 16-foot trawl with a 0.5- inch liner.

Scientific name	Common name	Number
Anchoa mitchilli	bay anchovy	34,472
Cynoscion regalis	weakfish	6,967
Trinectes maculatus	hogchoker	3,374
Ophidion marginatum	striped cusk-eel	3,135
Micropogonias undulatus	Atlantic croaker	2,787
Leiostomus xanthurus	spot	2,662
Urophycis regia	spotted hake	671
Scopthalmus aquosus	windowpane	317
Bairdiella chrysoura	silver perch	139
Anchoa hepsetus	striped anchovy	133
Menticirrhus saxatilis	northern kingfish	128
Urophycis chuss	red hake	107
Syngnathus fuscus	northern pipefish	104
Paralichthys dentatus	summer flounder	101
Opsanus tau	oyster toadfish	96
Prionotus evolans	striped searobin	67
Mustelus canis	smooth dogfish	65
Brevoortia tyrannus	Atlantic menhaden	60
Prionotus carolinus	northern searobin	55
Sphoeroides maculatus	northern puffer	47
Peprilus triacanthus	butterfish	42
Anguilla rostrata	American eel	35
Pomatomus saltatrix	bluefish	31
Raja eglanteria	clearnose skate	29
Menidia menidia	Atlantic silverside	23
Etropus spp		11
Etropus crossotus	fringed flounder	10
Pogonias cromis	black drum	10
Etropus microstomus	smallmouth flounder	8
Centropristis striata	black sea bass	6
Conger oceanicus	conger eel	6
Carcharhinus plumbeus	sandbar shark	5
Astroscopus guttatus	northern stargazer	4
Pseudopleuronectes americanus	winter flounder	4
Urolophus jamaicensis	yellow stingray	4
Clupea harengus harengus	Atlantic herring	3
Peprilus alepidotus	harvestfish	3
Caranx hippos	crevalle jack	2
Dasyatis sayi	bluntnose stingray	2
Gobiosoma bosci	naked goby	2
Gymnura altavela	spiny butterfly ray	2
Hypsoblennius hentzi	feather blenny	2
Merluccius bilinearis	silver hake	2
Myliobatis freminvillei	bullnose ray	2
Selene vomer	lookdown	2
Alosa sapidissima	American shad	1

Table 1. (cont.)

Scientific name	Common name	Number
Dasyatis centroura	roughtail stingray	1
Dorosoma cepedianum	gizzard shad	1
Gymnura micrura	smooth butterfly ray	1
Monacanthus hispidus	planehead filefish	1
Morone americana	white perch	1
Mugil curema	white mullet	1
Raja erinacea	little skate	1
Stenotomus chrysops	scup	1
Synodus foetens	inshore lizardfish	1
Trachinotus carolinus	Florida pompano	1

of the Bay where they develop into juveniles. During the fall, after they have attained a length of 4 to 6 inches, they migrate through the lower Bay on their way to wintering areas off Virginia and North Carolina.

The waters off Broadkill Beach support recreational and commercial fishing activity. Anglers fish off the beach as well as from boats. Weakfish, summer flounder, and bluefish are the most popular species, but the recreational catch also includes striped bass, scup, skates, sharks, spot, croaker, hake, and sea bass (Seagraves 1988). The commercial fishery is primarily composed of gill net fishermen who target weakfish and some striped bass from April to early June (Roy Miller, DNREC, pers. com.).

Waterfowl may occur on the waters off Broadkill Beach during the wintering period. Surveys conducted within one half mile of the shoreline have noted the presence of scaup (*Aythya affinis/ marila*), scoters (*Melanitta* spp), and snow geese (*Chen caerulescens*), but the numbers are low relative to other locations up-bay or within the marshes and impoundments (Tom Whittendale, DNREC, pers. com.).

Endangered Species

Sea turtles, especially the loggerhead (*Caretta caretta*), but also the Kemp's ridley (*Lepidochelys kempii*), green (*Chelonia mydes*), and leatherback (*Deomochelys coriacea*), may occur in the lower Delaware Bay from June to November. The loggerhead and green sea turtles are Federally listed as threatened, and the Kemp's ridley and leatherback are listed as endangered. Sea turtles have been adversely impacted during dredging operations that utilized a hopper dredge. Since these species are under the regulatory jurisdiction of the National Marine Fisheries Service, we recommend that you contact Mr. Douglas W. Beach at (508) 281-9254 to determine the need for a Biological Assessment or further Section 7 Consultation pursuant to the Endangered Species Act.

Future Conditions Without the Project

The natural erosion process will continue to remove sand from the shoreline. In the absence of man's intervention, the result would be a progressive shift of the shoreline landward. Repeated beach replenishment operations have been conducted since the 1950s to counteract the erosion. While these efforts appear to have been fairly successful, the effort required to maintain the shoreline at its current location will likely increase. As the sand from the most favorable near-shore borrow areas is exhausted, replenishment efforts will have to use material imported from greater distances. The projected rise in sea level will increase the rate of erosion as well as flooding problems in the community. If the level of effort is not increased, forced relocation will become increasingly necessary.

The implications of shoreline recession for biological resources is not entirely clear. While it appears that the width of the beach could decrease, this would primarily involve a reduction of the upper beach which is relatively unproductive. Shoreline recession and overwash processes would eventually affect the saltmarsh behind the community but the rate and degree of impact is very difficult to judge at this time.

POTENTIAL IMPACTS OF THE BEACH REPLENISHMENT OPTION

Several studies have examined the impact of beach replenishment on the beach invertebrate fauna (Thompson 1973, Hayden and Dolan 1974, Reilly and Bellis 1983, Mihursky et al. 1986, and Nelson and Pullen 1990). These studies have indicated various effects depending on the compatibility of the beach and replenishment material, time of year, magnitude of the project, and the particular benthic community composition. In general, it appears that replenishment will result in the temporary elimination of benthic fauna from the primary impact area. Recolonization may begin shortly after sand deposition is terminated and may continue for up to a year before pre-project population levels are restored.

Higher level consumers such as fish and birds will probably avoid the area when sand deposition or grading operations are underway. Shorebirds could be particularly affected because of their heavy dependence on Delaware Bay beaches for feeding during May and June. Horseshoe crabs would also be vulnerable during May and June when they utilize the beach for egg laying.

Dredging sand from the borrow site would remove the existing benthic fauna. Recolonization would been expected to occur over a several month period. The composition of the recolonized benthic assemblages may be somewhat different from pre-project conditions if the grain size composition of the bottom changes. The dredging operation may also interfere with commercial gill net fishing operations which often take place in this area in the spring.

It is important to realize that the full extent of the biological impact will depend on the amount of replenishment (both volume and frequency) that will be necessary to maintain the project over its life period. This information has not yet been developed for the project.

PRELIMINARY MITIGATION MEASURES

Impacts to shorebirds and horseshoe crabs could be minimized if replenishment was not conducted from May 1 to June 10. This restriction would also reduce potential conflicts with commercial gill net fishermen. Some gill net fishermen also work in April, but we don't have enough information to estimate the potential impact during this time period. To minimize the amount of borrow source dredging the study should investigate the potential of utilizing sand from the maintenance dredging of navigation channels, such as the lower Delaware Bay main channel.

LITERATURE CITED

Hayden, B. and R, Dolan. 1974. Impact of beach nourishment on distribution of *Emerita talpoida*, the common mole crab. Journal of the Waterways, Harbors and Coastal Engineering Division 100: 123-132.

Kropp, R.K. 1994. Draft Report: Delaware Bay Coastline-Broadkill Beach Interim Feasibility Study, Sussex County, Delaware: Benthic Animal Assessment of Potential Borrow Source. Prepared for U.S. Army Research Office.

Mihursky, J.H., B. Millsaps, L. Ward, and J. Nussbaum. 1986. Benthic animal-sediment assessment of Maryland's coastal waters from Maryland-Delaware State line to Ocean City Inlet. Report from the University of Maryland Center for Environmental and Estuarine Studies to Maryland Department of Natural Resources, UM CEES/CBL Ref. No. UMCEES-86-141 CBL.

Nelson, D.A. and E.J. Pullen. 1990. Environmental considerations in using beach nourishment for dredged material placement. Pages 113-128 in R.L. Lazor and R. Medina (eds.), Beneficial Uses of Dredged Material, Proc. of the Gulf Coast Regional Workshop, April 26-28, 1988. Galveston, Texas. Tech. Rpt. D-90-3. U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Price, K.S., R.A. Beck, S.M. Tweed, and C.E. Epifanio. 1988. Fisheries. Pages 71-94 in The Delaware Bay: Rediscovering a Forgotten Resource, T.L. Bryant (ed.). University od Delaware Sea Grant College Program.

Reilly, F.J., Jr., and V.J. Bellis. 1983. The ecological impact of beach nourishment with dredged materials on the interidal zone at Bogue Banks, North Carolina. U.S. Army Corps of Engineers, Coastal Engineering Research Center, Miscellaneous Report No. 83-3.

Seagraves, R.J. 1988. Survey of the Sport Fishery of Delaware Bay. Project F-33-R-7 (Dingell-Johnson) Annual Report. Delaware Division of Fish and Wildlife. Dover, Delaware. 29pp.

Sharp, J.H. 1985. Dynamics. Pages 43-53 in The Delaware Estuary: Rediscovering a Forgotten Resource, T.L. Bryant (ed.) .University of Delaware Sea Grant College Program.

Thompson, J.R. 1973. Ecological effects of offshore dredging and beach nourishment: a review. U.S. Army Corps of Engineers, Coastal Engineering Research Center, Miscellaneous Paper No. 1-73.

U.S. Department of Commerce. 1990. Regional Tide and Current Tables 1991.

Watling, L. and D. Maurer. 1973. Guide To the Macroscopic Estuarine and Marine Invertebrates of the Delaware Bay Region. College of Marine Studies, University of Delaware.

APPENDIX D

PERTINENT CORRESPONDENCE

Delaware Bay Coastline - Delaware and New Jersey

BROADKILL BEACH, DE INTERIM FEASIBILITY STUDY

Pertinent Correspondence

Table of Contents

STATE OF DELAWARE
DEPARTMENT OF NATURAL RESOURCES
& ENVIRONMENTAL CONTROL
89 KINGS HIGHWAY
P.O. BOX 1401
DOVER, DELAWARE 19903

OFFICE OF THE
SECRETARY

August 30, 1989

Lieutenant Colonel G. William Quinby
District Engineer, Philadelphia District
U.S. Army Corps of Engineers
2nd & Chestnut Streets
Custom House
Philadelphia, Pennsylvania 19106

Dear Lieutenant Colonel Quinby:

I am writing concerning the House Committee on Public Works and Transportation Resolution dated October 1, 1986, that requests the Corps of Engineers to make a study of the shoreline of Delaware Bay, Delaware and New Jersey.

The Delaware Bay up to the Chesapeake and Delaware Canal has over 120 miles of shoreline in Delaware and New Jersey. The primary problem is the severe erosion which has occurred causing severe economic losses and social problems. Erosion of the shorelines in the study area result from the action of storm tides, tidal currents, wind, waves, and swells. Substantial quantities of material have continuously been lost, thereby narrowing and lowering the beaches. As a result, public and private property are subject to storm damage from wave attack and from tidal inundation. During times of storms, extensive flood damages have occurred, lives have been lost, and when evacuation was considered necessary, families have suffered hardships and inconvenience. There is also a void in the data base which is hampering efforts to deal with the problem and to implement remedial measures.

The study will evaluate all adverse impacts of shoreline erosion and determine the costs and benefits of reducing the impacts. In locations where the Corps of Engineers would consider plans of improvement, both structural solutions (revetments, groins, bulkheads, beachfills, breakwaters, slope stabilization, etc.) and non-structural measures (vegetation, relocation, etc.) should be considered as erosion control alternatives. Material dredged from navigation channels should also be considered for placement on eroding shorelines to provide protection. The results of the Shoreline Erosion Control Demonstration program (Section 54 of WRDA of 1974) should be reanalyzed and utilized to the maximum extent possible in the design of shore protection alternatives. The results could be recommendations for Federal projects at those particular sites which are found to be justified.

Of particular importance to this Department are problems in the vicinity of the Mispillion and Roosevelt Inlets. Local concerns have been expressed regarding the structural integrity of the Mispillion Inlet jetties, the expanding breach in the barrier beach north of the inlet and how both may affect navigation, sediment transport, shoreline erosion and the potential for storm damage and flooding. A copy of a letter and petition from the owner of the Mispillion Lighthouse Marina is attached for your information.

At Roosevelt Inlet the concerns have focused on navigation, sediment transport and shoreline erosion in the immediate vicinity of the inlet due to the previously deteriorated condition of the jetties and, more recently, the apparent intensification of those problems, including the threat of flanking of the jetties, since their removal down to the sand line.

Due to the importance of the impact of the economic losses and associated social problems, we request that necessary steps be taken to have this study initiated as soon as funding is made available. We also request that priority be given to an examination of the problems in the vicinity of the two inlets mentioned above. We understand that the Corps utilizes a two phase planning process. The first phase would be 100 percent federally funded, and calls for a reconnaissance level investigation of the study area.

We understand that funding to begin the reconnaissance phase of this study has been included in the House version of the FY90 budget. We will be supporting, through our Congressional Delegation, the inclusion of these funds in the compromise budget bill to be worked out between the House and Senate conferees in September.

The second phase involves the Feasibility Study of the proposed improvements. This phase would be cost shared on a 50/50 basis with the Corps of Engineers. If, at the conclusion of the Feasibility Study, a favorable project could be developed for construction in which both the Federal and State interests would be served, the State would be willing to enter into the necessary Local Cooperation Agreement.

If you have any questions regarding this matter, please feel free to contact me or Mr. John A. Hughes, Director, Division of Soil and Water Conservation [(302) 736-4411].

Sincerely,

Edwin H. Clark, II
Secretary

Attachments
cf: The Honorable Ruth Ann Minner
Jack Nylund
Eugene M. Racz
John A. Hughes

STATE OF DELAWARE
DEPARTMENT OF NATURAL RESOURCES
& ENVIRONMENTAL CONTROL
89 Kings Highway
P.O. Box 1401
OFFICE OF THE SECRETARY
Dover, Delaware 19903
Telephone: 302 736 4401

October 6, 1989

William E. Quinby, LTC
Department of the Army
Philadelphia District
Corps of Engineers
Custom House
2nd & Chestnut Streets
Philadelphia, Pennsylvania 19106

RE: **Delaware River Comprehensive Navigation Study, Main Channel Deepening**

Dear Colonel Quinby:

The Department is pleased to notice that the Corps is exploring beneficial uses of Delaware Bay dredge spoils.

We envision that the sandy spoil material generated from the deepening of the Delaware River shipping channel could be of considerable environmental utility in two ways which come immediately to mind.

From Pickering Beach south to Lewes, and Cape Henlopen south to Fenwick Island Delaware's accessible bay and ocean beaches are in periodic need of nourishment to enhance property protection and the recreational resource. Application of clean sand fill within the dictates of good coastal engineering practice could improve and preserve these endangered natural resources.

Much of our upper bay shoreline is unprotected by even rudimentary sand beaches. Here, wetlands are being lost at a rapid rate to erosion and sea level rise. State or Federally owned tidal wetlands and impounded waterfowl habitats could conceivably benefit greatly from the creation of barrier beaches from suitable dredge spoil. The Port Mahon area might serve as an example.

I support and encourage the Corps to continue work in this area and request that you maintain full communication with our Wetlands and Beach Preservation Sections as you do so in order that they can provide your staff with specific information on our eroding shorelines and the nature and availability of the resources with which we can assist you.

Sincerely,

Edwin H. Clark, II

Edwin H. Clark, II
Secretary

MAR 24 1993

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
WANAMAKER BUILDING, 100 PENN SQUARE EAST
PHILADELPHIA, PENNSYLVANIA 19107-3390

REPLY TO
ATTENTION OF

Planning Division

NOTICE OF STUDY INITIATION

This notice is to announce the feasibility phase initiation of the Delaware segment of the Delaware Bay Coastline, Delaware and New Jersey shoreline protection study. The Corps of Engineers is conducting this study in response to 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 Delaware segment of the study is being sponsored by the Delaware Department of Natural Resources and Environmental Control (DNREC).

The purpose of the study is to investigate shoreline erosion and storm damage problems along selected portions of the Delaware Bay coastline of Delaware with a view to providing shore protection, beach erosion control, hurricane protection, and environmental analysis of ecologically important areas. The first phase of the study, the reconnaissance phase, was completed in 1991 at 100% Federal cost. Based upon the findings of the reconnaissance phase of study, the locations scheduled for further evaluation include Broadkill Beach, Roosevelt Inlet\Lewes Beach, and Port Mahon.

The subsequent feasibility phase, began in January 1993 and is being cost shared 50%-50% between the Federal government and the State of Delaware (DNREC). The feasibility study will investigate shore protection problems, develop detailed solutions and an economic assessment of the viability of each chosen solution. Additionally, the feasibility study will include an assessment on the level of interest and support of non-Federal parties in the identified potential solutions, and establish the scope and schedule for the construction of future shore protection measures.

Any pertinent information that Federal, State or local agencies and the private sector can provide will be used to the greatest extent possible. We welcome any assistance and suggestions about the conduct of this study. All comments should be directed to the above address, ATTN: CENAP-PL-PC.

Sincerely,

Edwin H. Clark II, Secretary
Delaware Department
Natural Resources and
Environmental Control

R.F. Sliwoski, P.E.
Lieutenant Colonel,
Corps of Engineers
District Engineer

CENAP-PL-PB

Memorandum for Files

Subject: Broadkill Beach Alternatives - Phone Conversation with Bob Henry

1. On 15 August 1994, I had a phone conversation with Bob Henry of DNREC. The purpose was to discuss the State's preference(s) regarding project alternatives at Broadkill Beach.

Beachfill

2. Bob Henry told me that a beachfill would be the preferred alternative.

3. The State has done numerous beachfills in the community over the years, but may soon run out of suitable material. They are using an offshore source located near the central part of the community (the intersection of Rte 16 and the beach). A 14 in. cutterhead dredge is being used. In order to pump material to the northern limit of its project, the State must move the dredge to the northernmost limit of the borrow source. This area has been used for material extensively and is running low. Pits in the borrow site from previous dredges have filled with unsuitable borrow material. In order to maximize the available material at the site, a larger dredge or a booster pump may be needed to transport the material over long distances.

Perched Beach

4. Under the Section 54 Program, a perched beach was installed and monitored at Slaughter Beach. The opinion of the State is that the perched beach was not effective, and the community has asked that it be removed. The community feels that it is a hazard for beach users as well as boaters. For these reasons, the State does not feel that this type of structure would be appropriate for Broadkill Beach.

Offshore Breakwaters using Geotextile Tubes

5. The State does not favor the use of offshore breakwaters using geotextile tubes. The concerns of the State regarding this method include: hazards to boats, possible damage from debris, and vandalism. Under the Section 54 Program, nylon bags were used as offshore breakwaters at Kitts Hummock. The State feels that the bags did not hold up well and, as a result, were not effective.

Groins

6. Bob Henry had made a few suggestions for the use of groins. He feels that the existing groins could have been more effective if they had been constructed using other materials First, concrete-filled tubes could be used to construct groins (the State has used this method at various locations). In addition, the existing groins may be improved by using the tubes or stone. If the tubes are used, steps need to be taken to minimize scour.

Wendy Jones 16 Aug 1994

Wendy Jones Date
Study Manager

STATE OF DELAWARE
DEPARTMENT OF NATURAL RESOURCES
& ENVIRONMENTAL CONTROL
DIVISION OF FISH AND WILDLIFE
89 KINGS HIGHWAY
P O BOX 1401
DOVER, DELAWARE 19903

OFFICE OF THE
DIRECTOR

6 September 1994

Barbara Conlin
U. S. Army Corps of Engineers
100 Penn Square East
Philadlephia, PA 19107

Dear Ms. Conlin:

I am responding to your recent request for rare species information for the Broadkill Beach and nearby environs, and I apologize for the delay. We have checked the Delaware Natural Heritage Inventory's database for rare species at this site and I have enclosed list of rare species found for Beach Plum Island and the Great Marsh. No information are available, in our database, on the biota for the Broadkill Beach site. However, information on the Delaware Bay beach usage by shorebirds and horseshoe crabs should be available from the Division of Fish and Wildlife's Non-game and Endangered Species Program (contact Lisa Gelvin-Innvaer at (302) 653-2882).

Please take caution when using these lists in your evaluation of the beach replenishment project. Most of the species on the lists were found to be utilizing the salt marsh habitat, and are not likely to be impacted by the replenishment project.

There is one species not on the enclosed lists that, remotely, may occur along the beaches at Broadkill: the Federally Threatened seabeach pigweed, *Amaranthus pumilus*. The possibility of its presence is remote due to the fact that it was last collected in Delaware in 1875 (south of Indian River inlet), and high beach usage by humans would also diminish the possibility of this species becoming established along the beach at Broadkill.

I hope that the information provided will be helpful as you develop the beach replenishment plans for Broadkill Beach. If you have any questions about the material provided, please call me at (302) 739-5285.

Sincerely,

Keith Clancy

Keith Clancy
Ecologist
Delaware Natural Heritage Inventory

SPECIES OF SPECIAL CONCERN FOR BEACH PLUM ISLAND NATURE PRESERVE

SCIENTIFIC NAME	COMMON NAME	STATE RANK	GLOBAL RANK	DOT
CICINDELA HIRTICOLLIS	BEACH-DUNE TIGER BEETLE	S1	G5	10
CICINDELA MARGINATA	A TIGER BEETLE	S1	G5	10
STERNA ANTILLARUM	LEAST TERN	S1B,S2N	G4	9
STERNA NILOTICA	GULL-BILLED TERN	SHB,S2N	G5	9

SPECIES OF SPECIAL CONCERN FOR THE GREAT MARSH

SCIENTIFIC NAME	COMMON NAME	STATE RANK	GLOBAL RANK	DOT
AMMODRAMUS SAVANNARUM	GRASSHOPPER SPARROW	S3B	G4	8
ARDEA HERODIAS	GREAT BLUE HERON	S2B	G5	8
BIDENS CONNATA	PURPLE-STEM SWAMP BEGGAR-TICKS	S1	G5	23
BIDENS MITIS	TICKSEED SUNFLOWER	S1	G3G4	23
BIDENS MITIS	TICKSEED SUNFLOWER	S1	G3G4	24
BUTEO PLATYPTERUS	BROAD-WINGED HAWK	S1B,SZN	G5	11
CIRCUS CYANEUS	NORTHERN HARRIER	S1B,S3N	G5	8
EGRETTA THULA	SNOWY EGRET	S1B	G5	8
EUPATORIUM COELESTINUM	BLUE BONESET	S2	G5	14
EUPATORIUM COELESTINUM	BLUE BONESET	S2	G5	22
HYDROCOTYLE VERTICILLATA VAR VERTICILLATA	WHORLED PENNYWORT	S2	G5T5	15
PASSIFLORA LUTEA	YELLOW PASSION FLOWER	S1	G5	14
QUERCUS SPP.-LIRIODENDRON/ ILEX OPACA-CORNUS FLORIDA FOREST	OAK-TULIP POPLAR/AMERICAN HOLLY -DOGWOOD	S2S3		20
RYNCHOPS NIGER	BLACK SKIMMER	S1B	G5	8
SPARTINA ALTERNIFLORA SALT MARSH	CORDGRASS SALT MARSH	S3		8
STERNA HIRUNDO	COMMON TERN	S1B,S3N	G5	8

SPECIES OF SPECIAL CONCERN FOR THE GREAT MARSH

SCIENTIFIC NAME	COMMON NAME	STATE RANK	GLOBAL RANK	DOT
AMMODRAMUS CAUDACUTUS	SHARP-TAILED SPARROW	S3B,S2N	G5	7
AMMODRAMUS HENSLOWII	HENSLOW'S SPARROW	SZN	G4	7
AQUILA CHRYSAETOS	GOLDEN EAGLE	SZN	G4	7
ARDEA HERODIAS	GREAT BLUE HERON	S2B	G5	7
ASIO FLAMMEUS	SHORT-EARED OWL	SHB,S2N	G5	7
BARTRAMIA LONGICAUDA	UPLAND SANDPIPER	S1B	G5	7
BOTAURUS LENTIGINOSUS	AMERICAN BITTERN	S2B,SZN	G4	7
BUBULCUS IBIS	CATTLE EGRET	S2B	G5	7
CASMERODIUS ALBUS	GREAT EGRET	S2B	G5	7
CHARADRIUS MELODUS	PIPING PLOVER	S1B	G3	7
CIRCUS CYANEUS	NORTHERN HARRIER	S1B,S3N	G5	7
CISTOTHORUS PLATENSIS	SEDGE WREN	S1B	G5	7
COCCYZUS ERYTHROPTHALMUS	BLACK-BILLED CUCKOO	S1B	G5	7
EGRETTA CAERULEA	LITTLE BLUE HERON	S2B	G5	7
EGRETTA THULA	SNOWY EGRET	S1B	G5	7
EGRETTA TRICOLOR	TRICOLORED HERON	S1B	G5	7
HAEMATOPUS PALLIATUS	AMERICAN OYSTERCATCHER	S2B	G5	7
HALIAEETUS LEUCOCEPHALUS	BALD EAGLE	S1B,S1N	G3	7
HIMANTOPUS MEXICANUS	BLACK-NECKED STILT	S2B	G5	7
LANIUS LUDOVICIANUS	LOGGERHEAD SHRIKE	SHB,SZN	G4	7
LARUS MARINUS	GREAT BLACK-BACKED GULL	S1B;S5N	G5	7
LATERALLUS JAMAICENSIS	BLACK RAIL	S2B	G4?	7
NYCTANASSA VIOLACEA	YELLOW-CROWNED NIGHT-HERON	S1B	G5	7
NYCTICORAX NYCTICORAX	BLACK-CROWNED NIGHT-HERON	S2B	G5	7

GADIS FALCINELLUS	GLOSSY IBIS	S2B	G5	7
PODILYMBUS PODICEPS	PIED-BILLED GREBE	S2B,S2N	G5	7
RIPARIA RIPARIA	BANK SWALLOW	S2B	G5	7
RYNCHOPS NIGER	BLACK SKIMMER	S1B	G5	7
STERNA ANTILLARUM	LEAST TERN	S1B,S2N	G4	7
STERNA FORSTERI	FORSTER'S TERN	S1B,S3N	G5	7
STERNA HIRUNDO	COMMON TERN	S1B,S3N	G5	7
STERNA NILOTICA	GULL-BILLED TERN	SHB,S2N	G5	7

OCT 06 1994

Environmental Resources Branch

Mr. George Ruddy
U.S. Fish & Wildlife Service
Annapolis Field Office
1825 Virginia Street
Annapolis, Maryland 21401

Dear Mr. Ruddy:

Enclosed please find a draft report titled "Delaware Bay Coastline - Broadkill Beach Interim Feasibility Study, Sussex County, Delaware: Benthic Animal Assessment of Potential Borrow Source."

Forty benthic grab samples were collected from two potential borrow areas and two control sites offshore of Broadkill Beach, Delaware for the purpose of assessing potential impacts of dredging on benthic macrofauna for a proposed beach nourishment project. Please review the draft report and provide any comments that you would like to have addressed in the final report by 25 October 1994.

If you should have any questions, please contact Ms. Barbara Conlin of the Environmental Resources Branch at (215) 656-6555.

Sincerely,

Robert L. Callegari
Chief, Planning Division

Enclosure

JAN 0 4 1995

Environmental Resources Branch

Ms. Faye L. Stocum
Environmental Review Coordinator
Bureau of Archaeology and Historic Preservation
Division of Historical and Cultural Affairs
#15 The Green, P.O. Box 1401
Dover, Delaware 19901

Dear Ms. Stocum:

The U.S. Army Corps of Engineers, Philadelphia District, has recently conducted a cultural resources investigation in Broadkill Beach, Delaware. This study included an underwater remote sensing survey of two potential sand borrow areas and a tidal zone shoreline survey. A draft report of this investigation entitled A Phase 1 Submerged and Shoreline Cultural Resources Investigation, Broadkill Beach, Broadkill Hundred, Sussex County, Delaware (Hunter Research, Inc., November 1994) is enclosed for your review. The underwater survey identified one potentially significant remote sensing target within Borrow Area 2. No cultural resources were observed along the shoreline. Avoidance of the remote sensing target during proposed sand dredging activities is recommended.

Your review and comments of this report would be most helpful if received within 30 days. Please do not hesitate to contact Michael Swanda, Environmental Resources Branch at (215) 656-6556 if you have any questions or need further information.

Sincerely,

Robert L. Callegari
Chief, Planning Division

Enclosure

CF:
CENAP-PL-PC, Jones

MFR: This letter requests Section 106 comments from the Delaware SHPO.

Mike Swanda
CENAP-PL-E

STATE OF DELAWARE
DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL
DIVISION OF SOIL AND WATER CONSERVATION
89 KINGS HIGHWAY
P.O. BOX 1401
DOVER, DELAWARE 19903

OFFICE OF THE DIRECTOR

TELEPHONE: (302) 739-4411

February 16, 1995

Lt. Col. Robert P. Magnifico
Corps of Engineers
District Engineer
Department of the Army
Philadelphia District
Corps of Engineers
Wanamaker Building
100 Penn Square East
Philadelphia, Pennsylvania 19107-3390

Dear Lt. Col. Magnifico:

Your staff has advised me of the implication of the President's budget here in Delaware. I have a few questions. Please accept a few basic premises as discussion points:

The Corps process towards project initiation is a long, expensive and laborious one, the State would never enter into it without the anticipated payoff of Corps funding on a 75/25% basis.

Our three main projects are all well along in the planning stages, but all short of project initiation.

Reversing the cost share ratio to 25-75 federal/local eliminates the cost effectiveness of working with the Corps for anticipated projects here in Delaware.

With these points in mind, my inclination is to cover our losses by freezing all our work immediately and requesting the return of all unspent funds. Before I recommend this to my superiors, I need to know if this can be done. I also wish to know if this freezing of our three projects which are the Delaware Bay Coastline Study-Delaware and New Jersey, the Delaware Coast Study-Cape Henlopen to Fenwick and the Little Mill Flood Control Study can be reversed later, since such draconian measures as you anticipate may not eventuate and we may later wish to join you in the completion of the projects we entered

into in good faith, for in truth, Delaware could have amassed the pile of paper which will be the sole result of the expenditure of $3,975,000 in taxpayer's money for far less had we handled these problems ourselves from the beginning.

Sincerely,

John A. Hughes
Director

JAH9:kmt:magn

CENAP-PL-PB

Memorandum for Files

Subject: Broadkill Beach Final Selected Plan - Phone Conversation with Bob Henry

1. On 20 October 1995, I had a phone conversation with Bob Henry of DNREC. The purpose was to provide an update of study status and to discuss the final selected plan.

Study Status

2. I explained that a final plan for Broadkill Beach had been selected. I also described our efforts to optimize a periodic nourishment cycle. Bob stated that, based on DNREC's experience at Broadkill with beachfills, a 5-year nourishment cycle has been reasonable.

Final Selected Plan

3. The selected plan for Broadkill Beach is a 100 ft. wide berm at an elevation of +8 ft. NGVD, with a dune that has a top elevation of +16 ft. NGVD.

4. Bob emphasized that the beachfill material be placed in areas of the project where it is most needed. The erosion in Broadkill Beach varies along the shoreline, with the central portion of the community being the most severely impacted. I explained that the without project analysis results agree with that statement. Because some areas of Broadkill experience greater erosion than others, the amount of beachfill material necessary to meet the design will vary. As a result, the selected plan design will provide a greater beachfill quantity in the central portion of the community.

Action Items

5. Bob requested drawings of the selected plan, as well as a plan description (including features, dimensions, and quantities). Coordination is underway to provide these items.

Wendy Jones 20 Oct

Wendy Jones Date
Study Manager

STATE OF DELAWARE
DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL
DIVISION OF SOIL AND WATER CONSERVATION
89 KINGS HIGHWAY
P.O. BOX 1401
DOVER, DELAWARE 19903

OFFICE OF THE DIRECTOR

TELEPHONE: (302) 739 - 4411

September 6, 1996

LTC Robert B. Keyser
District Engineer
Philadelphia District
U.S Army Corps of Engineers
Wanamaker Building
100 Penn Square East
Philadelphia, PA 19107-3390

Dear Colonel Keyser:

This letter is in regard to the Broadkill Beach, DE Interim Feasibility Study - Draft Feasibility Report and Draft Environmental Impact Statement dated December 1995, as revised. The plan recommended by this (revised) report is a beach nourishment project consisting of berm and dune restoration along approximately 13,500 linear feet of beach extending from a point between California and Arizona Avenues southeast to a approximately 1,600 feet southeast of the old government jetty, with tapered sections extending northwest 1,000 feet into the North Shores - Section 2 subdivision and southeast 500 feet to the southern limits of the Old Inlet - Section 3, respectively. The proposed dune would have a top width of 25 feet at an elevation of +16 feet NGVD throughout the project area while the berm elevation would be at +8 feet NGVD with a width of 100 feet. The project would require placement of approximately 1.3 million cubic yards of sand for initial construction with 358,400 cubic yards anticipated for periodic renourishment every five (5) years over the 50 year life of the project. The sand for the project would be obtained from two (2) offshore borrow areas totaling 661 acres in area.

Please be advised that we have reviewed the Draft Report ,as revised, and are in general agreement with the findings and recommended plan. We look forward to participating with you in the detailed planning, engineering, design and construction phases of this project.

We feel that the processing of the final feasibility report should proceed as far as possible, in case the future political environment proves more conducive to construction of this shore protection project. As a conclusion to the processing of the final feasibility report we would like to proceed with the development and processing of a final Chief of Engineers report for transmittal to Congress. If you have any questions, please do not hesitate to contact me.

Sincerely,

John A. Hughes
Director

STATE OF DELAWARE
DEPARTMENT OF STATE
DIVISION OF HISTORICAL AND CULTURAL AFFAIRS
HISTORIC PRESERVATION OFFICE
15 THE GREEN
DOVER • DE • 19901-3611
TELEPHONE: (302) 739-5685
FAX: (302) 739-5660

September 10, 1996

Mr. Robert L. Callegari
Chief, Planning Division
Environmental Resources Branch
Philadelphia District, Corps of Engineers
100 Penn Square East
Philadelphia, PA 19107-3390

ATTN: Michael Swanda

Dear Mr. Callegari:

I have received and reviewed the *Broadkill Beach, Delaware Interim Feasibility Study: Draft Feasibility Report and Environmental Impact Statement*. Based on my review of this document as it pertains to the Philadelphia District, Corps of Engineers' requirement to comply with Section 102 of the National Environmental Policy Act of 1969, as amended, and Section 106 of the National Historic Preservation Act of 1966, as amended, this Office cannot concur with your agency's determination of that the implementation of the preferred shoreline protection alternative will have "No Effect" on any historic properties which are either eligible for or listed in the National Register of Historic Places. Within the Offshore Borrow Area B, an archaeological survey/remote sensing investigation identified a target or anomaly with a magnetic signature strongly suggesting a significant submerged archaeological property(shipwreck). For the purposes of our Section 106 review and without additional archaeological investigation, we would expect this submerged property be treated as National Register eligible. On this matter, your staff has agreed. In applying the Criteria of Effect and Adverse Effect, it is our opinion the proposed utilization of Borrow Area B has the potential to adversely affect this potentially eligible archaeological property, pursuant to 36 CFR 800.9(b)(1) of the Advisory Council on Historic Preservation's (Council) regulations. The Draft Feasibility Study and DEIS identify the Corps' intent to employ a 200 foot buffer around this property to ensure it would not be impacted during the excavation of the offshore borrow. Such a measure would satisfactorily mitigate this potential adverse effect. Thus, in accordance with the Council's regulations (36 CFR 800.5(d), we would concur with a "No Adverse Effect" determination conditioned upon the employment of this 200 foot buffer.

If you have any questions or require any further assistance in seeking the comments of the Council, please do not hesitate to contact me at your convenience. Thank you.

Sincerely,

Faye L. Stocum
Archaeologist

cc: R. Cox, ACHP

APPENDIX E

REAL ESTATE PLAN

REAL ESTATE PLAN

1. This Real Estate Plan is for the interim feasibility study of the Broadkill Beach, Delaware portion of the Delaware Bay Coastline, Delaware and New Jersey project, for hurricane and storm damage reduction. The above mentioned study is being conducted under the authority of a resolution adopted by the Committee on Public Works and Transportation, U.S. House of Representatives, on 1 October 1986. The Reconnaissance Report was approved on 13 August 1992.

2. The study area is located in Sussex County, Delaware and has a total project length of 14,600 feet (2.76 miles) of bay frontage. The most viable plan for the project is the placement of a dune and beachfill material on Broadkill Beach for shore protection. The average width of the berm is 100 feet, extending from the northern end of Alaska Avenue to the southern end of Broadkill Beach, for a distance of approximately 13,100 feet. A taper of 1,000 feet will extend from the northern end of the project and a taper of 500 feet will extend southward from the intersection of South Bayshore Drive and Truman Avenue on the southern end of the project. The dune will be situated on top of the berm.

3. The estates required for the project are a perpetual beach nourishment easement and a perpetual restrictive dune easement for approximately 24.26 acres, and a temporary work area easement (Estate No. 15) for approximately 0.49 of an acre, for a two year duration. The recommended standard estate language for the project is as follows:

PERPETUAL BEACH NOURISHMENT EASEMENT

A perpetual and assignable easement and right-of-way in, on, over and across the land described in Schedule A to construct, operate, maintain, patrol, repair, renourish, and replace the beach berm and appurtenances thereto, including the right to borrow and/or deposit fill, together with the right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions, and any other vegetation, structures, or obstacles within the limits of the easement; reserving, however, to the grantor(s), (his) (her) (its) (their) (heirs,) successors and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

PERPETUAL RESTRICTIVE DUNE EASEMENT

A perpetual and assignable easement and right-of-way in, on, over and across the land described in Schedule A to construct, operate, maintain, patrol, repair, rehabilitate, and replace a dune system and appurtenances thereto, together with the right to post signs, plant vegetation and prohibit the grantor(s), (his) (her) (its) (their) (heirs,) successors, assigns and all others from entering upon or crossing over said dune easement; reserving, however, the grantor(s), (his) (her) (its) (their) (heirs,) successors and assigns, the right to construct dune walkover structures in accordance with any applicable Federal, State or local laws or regulations, provided that such structures shall not violate the integrity of the dune in shape or dimension and prior approval of the plans and specifications for such structures shall have been obtained from the District Engineer, U.S. Army Engineer District, Philadelphia, and all other rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

TEMPORARY WORK AREA EASEMENT

A temporary easement and right-of-way in, on, over and across the land described in Schedule A, for a period not to exceed two (2) years, beginning with date possession of the land is granted to the United States, for use by the United States, its representatives, agents, and contractors as a work area, including the right to move, store and remove equipment and supplies, and erect and remove temporary structures on the land and to perform any other work necessary and incident to the construction of the Delaware Bay Coastline, Delaware and New Jersey Project, together with the right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions, and any other vegetation, structures, or obstacles within the limits of the right-of-way; reserving, however, to the landowners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

4. The lands required for the project are privately-owned recreational properties. In the past, the State of Delaware has obtained easements for beach restoration work over the majority of the project area from the owner of the bay frontage, with a condition of public access. Copies of those easements are attached in Exhibit A; however, they are not adequate for construction of this project. There are approximately 86 privately-owned parcels affected by the project; 84 requiring perpetual beach nourishment/restrictive dune easements and 2 requiring temporary work area easements. A total of 65 owners will be affected. A listing of the affected properties is included in Exhibit A. Only one structure is located within the project area. This structure is an old trailer on pilings, which is no longer habitable or used by the owner. The structure has no value for continued use or salvage.

5. The permanent and temporary easements will be acquired from the private landowners by the local sponsor. Due to the offsetting benefits attributable to the placement of beachfill, the value of the permanent easements is zero, and there is no anticipated cost to the sponsor to acquire these easements. This project will increase the value of the project lands. The credit for the sponsor's administrative costs associated with acquisition of these easements is shown in Exhibit B. For the 0.29 acre of temporary easements to be acquired from private landowners the fair market value is estimated at $23,620.00. The remaining 0.20 acre is under the ownership/jurisdiction of the non-Federal sponsor and has no value due to offsetting benefits.

6. There is no federally owned land contained within or adjacent to the study area. The nearest federally owned project is the Lewes and Rehoboth Canal Project located approximately three miles from the Broadkill Beach area.

7. No lands or rights below the ordinary high water mark must be acquired, nor will they be considered for credit.

8. There are no relocations under Public Law 91-646, as amended, associated with this project.

9. The State of Delaware, Department of Natural Resources and Environmental Control (DNREC), is the local sponsor for the project. The State has the necessary experience and resources, including quick take authority, to acquire the real estate interests required for the project.

10. The Baseline Cost Estimate for Real Estate, in M-CACES format, is attached as Exhibit B.

11. A Real Estate Map, Plates R-1 to R-5, dated 29 February 1996, is attached as Exhibit C, which delineates the project lands and estates to be acquired.

12. There is no known mineral activity either existing or anticipated within the project area.

13. The local sponsor will initiate real estate acquisition activities after final execution of the Project Cooperation Agreement. Title search will be done through review of courthouse records by in-house personnel. For the perpetual beach nourishment and restrictive dune easements, it is expected that acquisition will take approximately six months. Appraisals will not be required under Public Law 91-646, based on a review of available data. Nearly 50% of the owners reside out of state, and much of the negotiations will be conducted by mail and telephone. No condemnations are expected because of the public support demonstrated for this project. However, if condemnation is required, it can only be initiated after 2/3 of the affected properties are acquired by direct purchase, to confirm public support of the project. The State will obtain immediate possession of the property once a condemnation action is filed, although final settlement will take approximately one year. For the temporary work area easements, property surveys will be accomplished using in-house personnel, which can be completed within a week. Appraisals will be accomplished by a contract appraiser, and can be completed within three months. Total acquisition time for the temporary easements is also expected to be six months.

14. There are no facility relocations associated with this project.

15. There are no known hazardous or toxic waste sites existing within or adjacent to the project boundaries.

16. The project is considered to be essential by the local populace of Broadkill Beach and no negative reactions have been detected from the general public.

EXHIBIT A

11069 706 PAGE 61

EASEMENT

THIS EASEMENT, granted this 4th day of May A.D. 1973 by JENNIE H. J. LAYTON, widow, of the Town of Georgetown, Delaware, hereinafter "The Owner" to THE DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL OF THE STATE OF DELAWARE, hereinafter "The Department", with respect to a beach along the Delaware Bay near Broadkill Beach, Delaware, and more particularly described as follows:

All that property lying between a line midway between and parallel to Truman and Harrison Avenues, said line being 1,800 feet southeast of the centerline of the Bay terminus of Delaware Route 16, and a line midway between and parallel to Texas and Louisiana Avenues, said line being 2,700 feet northwest of the centerline of the Bay terminus of Delaware Route 16, being all of the land west of the mean low water line of Delaware Bay and east of the eastern boundary line of each of the following: (1) Blocks H, I, J, K and the south half of Block L, North Shores, Section I, as shown upon a plot of North Shores of record in the Office of the Recorder of Deeds for Sussex County, Delaware, in Plot Book 8, page 89; (2) Blocks A, B, C, D, E, F and G, Broadkiln Beach, as shown upon a plot of Broadkiln Beach of record in the Office of the Recorder of Deeds for Sussex County, Delaware, in Deed Book 288, page 598; (3) Blocks 1, 2, 3, 4, 5, and 6, Old Broadkiln Beach, as shown upon a plot of Old Broadkiln Beach of record in the Office of the Recorder of Deeds for Sussex County, Delaware, in Deed Book 300, page 600; (4) Block 7 of "Extension to the South of Old Broadkiln Beach" made by H. F. Bressler, copies of which are on file with the Department of Natural Resources and Environmental Control; and (5) Block 7 extended in a southeasterly direction, parallel to Bay Shore Drive, a distance of one hundred sixty-five (165) feet more or less.

WHEREAS, the Department has sole authority within the government of the State of Delaware to enhance, preserve, and protect private beaches, by virtue of 7 Delaware Code §6803; and

WHEREAS, the Department wishes to enter upon the Owner's beach to perform maintenance and preservation work thereon;

NOW, THEREFORE, in consideration of the mutual promises hereinafter made, the parties hereto do agree as follows:

State of Delaware STATE TAX DEPT. SUSSEX REALTY TRANSFER TAX 0.00

706 PAGE 62

1. That the Department may and does have the right of ingress to and egress from the above described beach, at any and all reasonable hours, by any and all authorized persons, whether employed by the Department or acting under contract with the Department, with any and all equipment which the Department deems necessary, for any purpose, including but not limited to, enhancement, protection or preservation of the beach as follows: Construction of a 50 foot wide berm to an elevation of 10 feet above mean low water, with a bayward slope of approximately 1 on 15 extending 4,500 feet from a point 2,700 feet northwest of the centerline of the Bay terminus of Delaware Route 16 to a point 1,800 feet southeast of the centerline of Delaware Route 16.

2. That the Owner will permit the use of the beach as more particularly described in the second paragraph of page 1 hereof for normal recreational use by the public as if it were a public beach.

3. The Department will perform the work described in paragraph 1 hereof.

4. The Department will be and will remain the owner of any erosion control structure left on the Owner's beach as a result of the work performed hereunder.

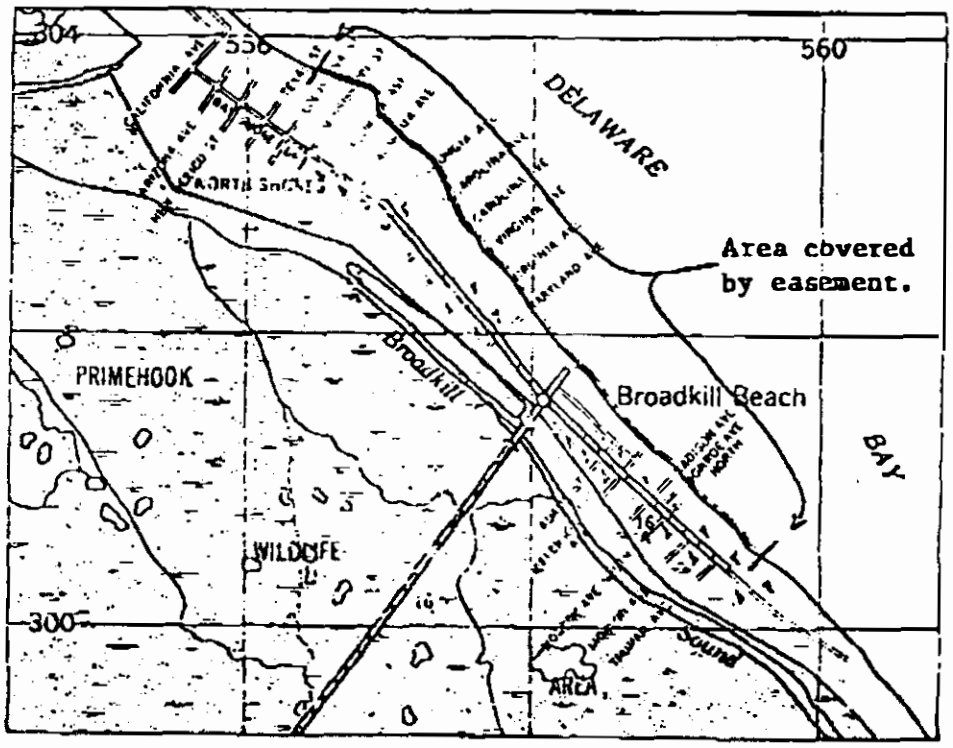
Owner

DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL

By John C Bryson

706 PAGE 53

BROADKILL BEACH



RECEIVED

MAY 10 9 33 AM '73

DEEDS
SUSSEX COUNTY

THIS EASEMENT AND AGREEMENT, Made and Entered into this 26th day of July, A.D. 1974, by and between JENNIE H. J. LAYTON, widow, of the Town of Georgetown, Sussex County and State of Delaware, Party of the First Part, and THE DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL OF THE STATE OF DELAWARE, Party of the Second Part:

WITNESSETH AS FOLLOWS:

That the said Party of the First Part for and in consideration of the sum of One ($1.00) Dollar, lawful money of the United States of America, the receipt whereof is hereby acknowledged, hereby grants and conveys unto the said Party of the Second Part, its successors and assigns,

ALL

that easement and those conditions contained in the easement between the said Party of the First Part and the said Party of the Second Part, dated the 4th of May, A.D. 1973 and recorded in the Office of the Recorder of Deeds in and for Sussex County, Delaware, in Deed Book 706, Page 61, the same acknowledged by this instrument as an easement that was intended to, and hereby does run with the land.

FURTHER, that easement was intended to, and hereby does, bind JENNIE H. J. LAYTON, her heirs, successors and assigns to the terms, rights and conditions contained therein.

IN WITNESS WHEREOF, the parties hereto have hereunder set their hands

and seals the day and year first above written.

Signed, Sealed and Delivered in the Presence of:

Jennie H. J. Layton (SEAL)

DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL OF THE STATE OF DELAWARE

By: John C. Bryson (SEAL)
John C. Bryson, Secretary

STATE OF DELAWARE)
) SS.:
COUNTY OF SUSSEX)

BE IT REMEMBERED, That on this 26th day of July, A.D. 1974, personally came before me, the subscriber, a Notary Public for the State and County aforesaid, Jennie H. J. Layton, widow, party to the foregoing Indenture of Writing, known to me personally to be such, and she acknowledged this Indenture of Writing to be her Act and Deed.

GIVEN under my Hand and Seal of Office the day and year aforesaid.

Notary Public

STATE OF DELAWARE)
) SS.:
COUNTY OF KENT)

BE IT REMEMBERED, That on this 7th day of August, A.D. 1974, personally came before me, the subscriber, a Notary Public for the State and County aforesaid, John C. Bryson, Secretary of the Department of Natural Resources and Environmental Control of the State of Delaware, party to the foregoing Indenture of Writing, known to me personally to be such, and he acknowledged this Indenture of Writing to be his Act and Deed and the Act and Deed of the said Department of Natural Resources and Environmental Control of the State of Delaware.

GIVEN under my Hand and Seal of Office the day and year aforesaid.

Notary Public

Book 742 Page 11

EASEMENT

THIS EASEMENT AND AGREEMENT, Made and Entered into this 22nd day of November, A.D. 1974, by and between JENNIE H. J. LAYTON, Widow, of the Town of Georgetown, Sussex County and State of Delaware, Party of the First Part, and THE DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL OF THE STATE OF DELAWARE, Party of the Second Part;

WHEREAS, the Party of the Second Part has sole authority within the government of the State of Delaware to enhance, preserve and protect private beaches, by virtue of 7 Del. C., Section 6803; and

WHEREAS, the Party of the Second Part wishes to enter onto the beach land of the Party of the First Part as hereinafter described to perform maintenance, protection and preservation work thereon;

WITNESSETH AS FOLLOWS:

That the said Party of the First Part for and in consideration of the sum of One ($1.00) Dollar, lawful money of the United States of America, the receipt whereof is hereby acknowledged, hereby grants and conveys unto the said Party of the Second Part, its successors and assigns, an easement in, to, from, over, upon and across the following described lands and premises:

Beginning at a point located S88° 31'48"E a distance of 331.25' from a monument situated on the south corner of Truman Avenue and Bay Shore Drive and thence from said point of origin along the following courses and distances:

1.	S33°E	675.00' more or less	24.	S33° 00'27"E	20.66' more or less
2.	S19°E	489.52' more or less	25.	S33° 15'24"E	51.19' more or less
3.	S12° 02'16"E	170.39' more or less	26.	S33° 36'43"E	51.25' more or less
4.	S20° 54'30"E	990.00' more or less	27.	S33° 58'04"E	51.33' more or less
5.	S21° 18'48"E	50.00' more or less	28.	S34° 19'27"E	51.40' more or less
6.	S23° 10'05"E	50.04' more or less	29.	S34° 40'52"E	51.48' more or less
7.	S25° 09'17"E	50.14' more or less	30.	S34° 55'16"E	51.53' more or less
8.	S27° 08'31"E	50.30' more or less	31.	S34° 55'30"E	51.53' more or less
9.	S23° 16'30"E	20.83' more or less	32.	S34° 42'39"E	51.49' more or less
10.	S28° 23'43"E	50.43' more or less	33.	S33° 45'43"E	20.72' more or less
11.	S29° 44'34"E	50.47' more or less	34.	S32° 39'02"E	51.27' more or less
12.	S29° 05'35"E	50.51' more or less	35.	S31° 04'25"E	50.90' more or less
13.	S27° 26'37"E	50.56' more or less	36.	S29° 30'16"E	50.57' more or less
14.	S29° 47'41"E	50.61' more or less	37.	S28° 26'12"E	50.48' more or less
15.	S30° 02'28"E	20.46' more or less	38.	S28° 24'17"E	353.01' more or less
16.	S30° 17'17"E	50.68' more or less	39.	S32° 09'57"E	50.98' more or less
17.	S30° 38'23"E	50.73' more or less	40.	S46° 19'13"E	55.36' more or less
18.	S30° 59'31"E	50.78' more or less	41.	S24° 54'11"E	50.12' more or less
19.	S31° 20'40"E	50.84' more or less	42.	S31° 36'32"E	815.10' more or less
20.	S31° 41'50"E	50.90' more or less	43.	S54° 59'44"E	60.37' more or less
21.	S32° 03'02"E	50.96' more or less	44.	S34° 57'04"E	51.54' more or less
22.	S32° 24'16"E	51.02' more or less	45.	S27° 11'27"E	50.30' more or less
23.	S32° 45'31"E	51.09' more or less	46.	S15° 46'15"E	100.40' more or less

Thence by and with a line in a northeasterly direction, parallel to and twenty (20) feet more or less northwest of an old stone jetty, to the mean low water line of Delaware Bay, thence with the mean low water line of Delaware Bay in a northwesterly direction 5,900 feet more or less, thence S51°W from the mean low water line of Delaware Bay back to the point of origin.

A plat of the above described lands is attached hereto and made a part hereof.

The Party of the First Part herein does further grant and convey unto the Party of the Second Part herein, its successors and assigns, the right of ingress, egress and regress in, from, to, over, upon and across the lands hereinabove described from adjoining beach areas or public access points, at any and all reasonable hours, by any and all authorized persons, whether employed by the Party of the Second Part, or acting under contract with the Party of the Second Part, with any and all equipment which the Party of the Second Part deems necessary, for any purpose authorized by Statute including, but not limited to, enhancement, protection or preservation of the beach above described, as follows:

Construction of a beach berm not to exceed 70 feet in width at an elevation of not less than 10 feet above mean low water, with a bayward slope of approximately 1 on 12.

To have and to hold the said easement unto the said Party of the Second Part, its successors and assigns, for public beach purposes, and the Party of the First Part herein hereby dedicates her interests in the above described lands covered by this easement to public use for such purposes.

It is understood and agreed by, among and between the parties hereto that any and all work performed by the Party of the Second Part herein, its successors and assigns, shall be at no cost or expense whatever to the Party of the First Part herein, her heirs and assigns, and that any erosion control structures built on the lands covered by this Easement shall be and remain the property of the Party of the Second Part herein, its successors and assigns.

It is understood and agreed by, among and between the parties hereto that this grant of Easement shall run with the land and shall be binding upon and shall inure to the benefit of the parties hereto and their respective heirs, executors, administrators, successors and assigns.

IN WITNESS WHEREOF, the parties hereto have hereunto set their hands and seals the day and year first above written.

Signed, Sealed and Delivered
in the Presence of:

Jessie R. Beals

Jennie H. J. Layton (SEAL)

DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL OF THE STATE OF DELAWARE

By: John C. Bryson (SEAL)
John C. Bryson, Secretary

STATE OF DELAWARE)
) SS.:
COUNTY OF SUSSEX)

BE IT REMEMBERED, That on this 22 day of November, A.D. 1994, personally came before me, the subscriber, a Notary Public for the State and County aforesaid, Jennie H. J. Layton, party to the foregoing Indenture of Writing, known to me personally to be such, and she acknowledged this Indenture of Writing to be her Act and Deed.

GIVEN under my Hand and Seal of Office the day and year aforesaid.

Joyce P. Beatty
Notary Public

STATE OF DELAWARE)
) SS.:
COUNTY OF KENT)

BE IT REMEMBERED, That on this day of , A.D. , personally came before me, the subscriber, a Notary Public for the State and County aforesaid, John C. Bryson, Secretary of the Department of Natural Resources and Environmental Control of the State of Delaware, party to the foregoing Indenture of Writing, known to me personally to be such, and he acknowledged this Indenture of Writing to be his Act and Deed and the Act and Deed of the said Department of Natural Resources and Environmental Control of the State of Delaware.

GIVEN under my Hand and Seal of Office the day and year aforesaid.

Notary Public

2-35-11-1

4385

BK 1867 PG 164

17859

Prepared By:
Robert D. Henry
Division of Soil & Water
Conservation, DNREC
P.O. Box 1401
Dover, DE 19903

EASEMENT

THIS EASEMENT AND AGREEMENT, Made and Entered into this 27 day of June, A.D. 92, by and between JENNIE H. J. LAYTON, Widow, of the Town of Georgetown, Sussex County and State of Delaware, Party of the First Part, and THE DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL OF THE STATE OF DELAWARE, Party of the Second Part;

WHEREAS, the Party of the Second Part has sole authority within the government of the State of Delaware to enhance, preserve and protect beaches, by virtue of 7 Del. C., Section 6803; and

WHEREAS, the Party of the Second Part wishes to enter onto the beach land of the Party of the First Part located at Broadkill Beach as hereinafter described to perform maintenance, protection and preservation work therein;

WITNESSETH AS FOLLOWS:

That the said Party of the First Part for and in consideration of the sum of One ($1.00) Dollar, lawful money of the United States of America, the receipt whereof is hereby acknowledged, hereby grants and conveys unto the said Party of the Second Part, its successors and assigns, an easement in, to, from, over, upon and across the following described lands and premises;

Beginning at a point located N69 05'30"E a distance of 110 feet from a concrete marker situated on the northwest corner of Lot 1, Old Inlet Beach-Section 3, and Bay Shore Drive as shown on a plot of lots of Old Inlet Beach-Section 3, Broadkill Beach prepared by Donald J. McCann, PLS, and approved by the Sussex County Planning and Zoning Commission on November 8, 1978. Thence from said point of beginning along the following courses and distances:

1. S 15 50'55" E 100.00 feet more or less
2. S 19 40'08" E 292.50 feet more or less
3. S 22 16'05" E 100.12 feet more or less
4. S 25 07'50" E 100.00 feet more or less
5. S 22 51'50" E 104.73 feet more or less
6. S 22 24'50" E 25.00 feet more or less
7. N 67 35'10" E 35.00 feet more or less
8. S 22 24'50" E 300.00 feet more or less
9. S 22 02'34" E 75.87 feet more or less
10. S 22 02'26" E 900.00 feet more or less

Thence S 25 23'41" E a distance of 343.40 feet more or less to point located on the southern boundary of said lands with lands of the State of Delaware, thence by and with said boundary N 68 48'42" E a distance of 45.00 feet more or less to the mean high water line of Delaware Bay, thence by and

with said mean high water line in a northwesterly direction a distance of 2,341.62 feet more or less, thence S 69 05'30" E a distance of 37.00 feet more less from the mean high water line of Delaware Bay back to the point of beginning.

The Party of the First Part herein does further grant and convey unto the Party of the Second Part herein, its successors and assigns, the right of ingress, egress and regress in, from, to, over, upon and across the lands herein-above described from adjoining beach areas or public access points, at any and all reasonable hours, by any and all authorized persons, whether employed by the Party of the Second Part, with any and all equipment which the Party of the Second Part deems necessary, for any purpose authorized by Statute including, but not limited to, enhancement, protection or preservation of the beach above described.

To have and to hold the said easement unto the said Party of the Second Part, its successors and assigns, for public beach purposes, and the Party of the First Part herein hereby dedicates her interests in the above described lands covered by this easement to public use for such purposes.

It is understood and agreed by, among and between the parties hereto that any and all work performed by the Party of the Second Part herein, its successors and assigns, shall be at no cost or expense whatever to the Party of the First Part herein, her heirs and assigns, and shall be at the sole discretion of the Party of the Second Part and that any erosion control structures built on the lands covered by this Easement shall be and remain the property of the Party of the Second Part herein, its successors and assigns.

It is understood and agreed by, among and between the parties hereto that this grant of Easement shall run with the land and shall be binding upon and shall inure to the benefit of the parties hereto and their respective heirs, executors, administrators, successors and assigns.

IN WITNESS WHEREOF, the parties hereto have hereunto set their hands and seals the day and year first above written.

Signed, Sealed and Delivered in the Presence of:

_____ _____ (SEAL)
Jennie H. J. Layton

DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL OF THE STATE OF DELAWARE

_____ By: _____ (SEAL)
Edwin H. Clark, II, Secretary

STATE OF DELAWARE)
) SS.:
COUNTY OF SUSSEX)

BE IT REMEMBERED, That on this 27 day of June A.D. 1992, personally came before me, the subscriber, a Notary Public for the State and County aforesaid, Jennie H. J. Layton, party to the foregoing Indenture of Writing, known to me personally to be such, and she acknowledged this Indenture of Writing to be her Act and Deed.

Given under my Hand and Seal of Office the day and year aforesaid.

_____
Notary Public
Merritt Burke, III
Attorney at Law

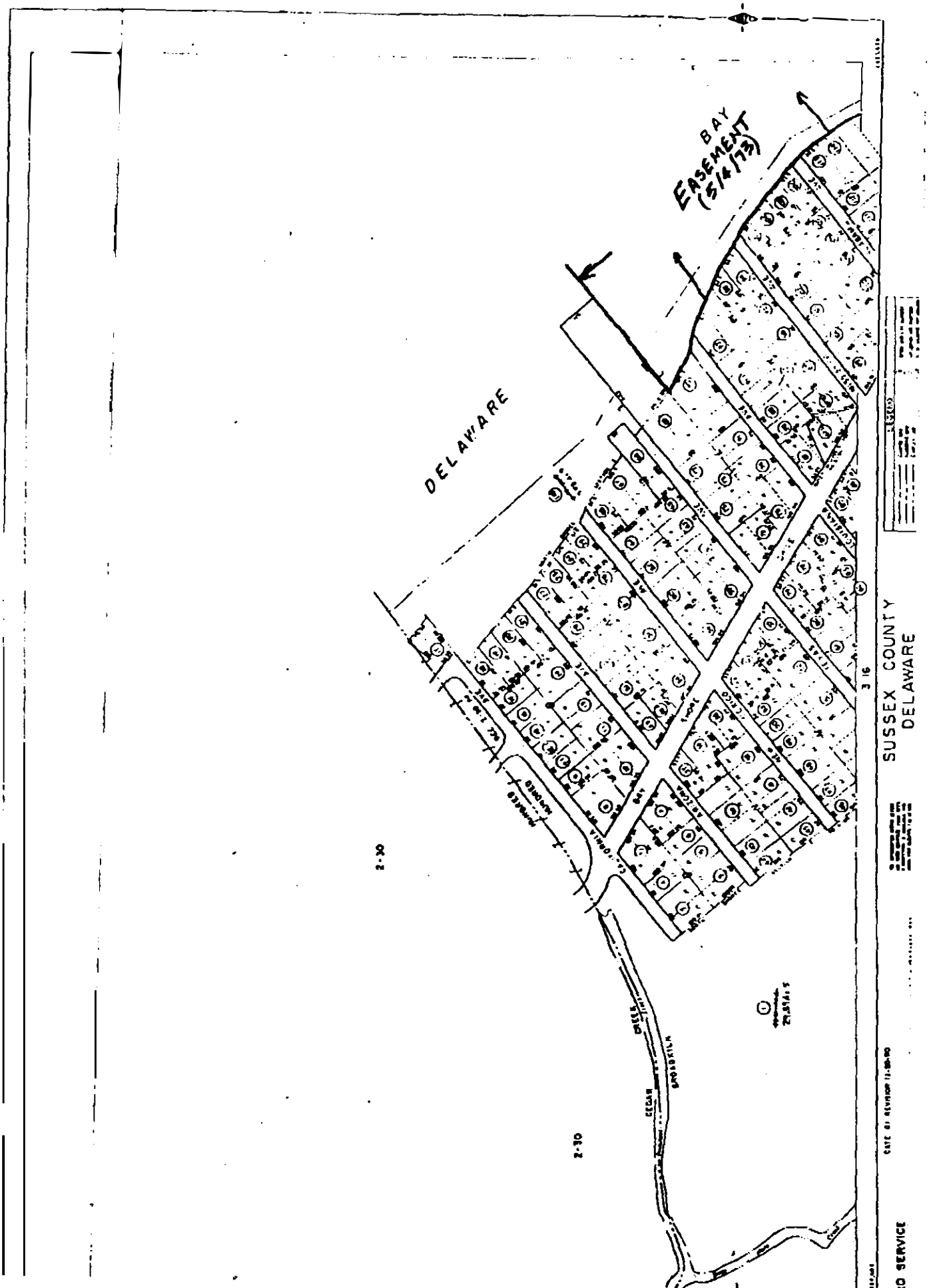
STATE OF DELAWARE)
) SS.:
COUNTY OF KENT)

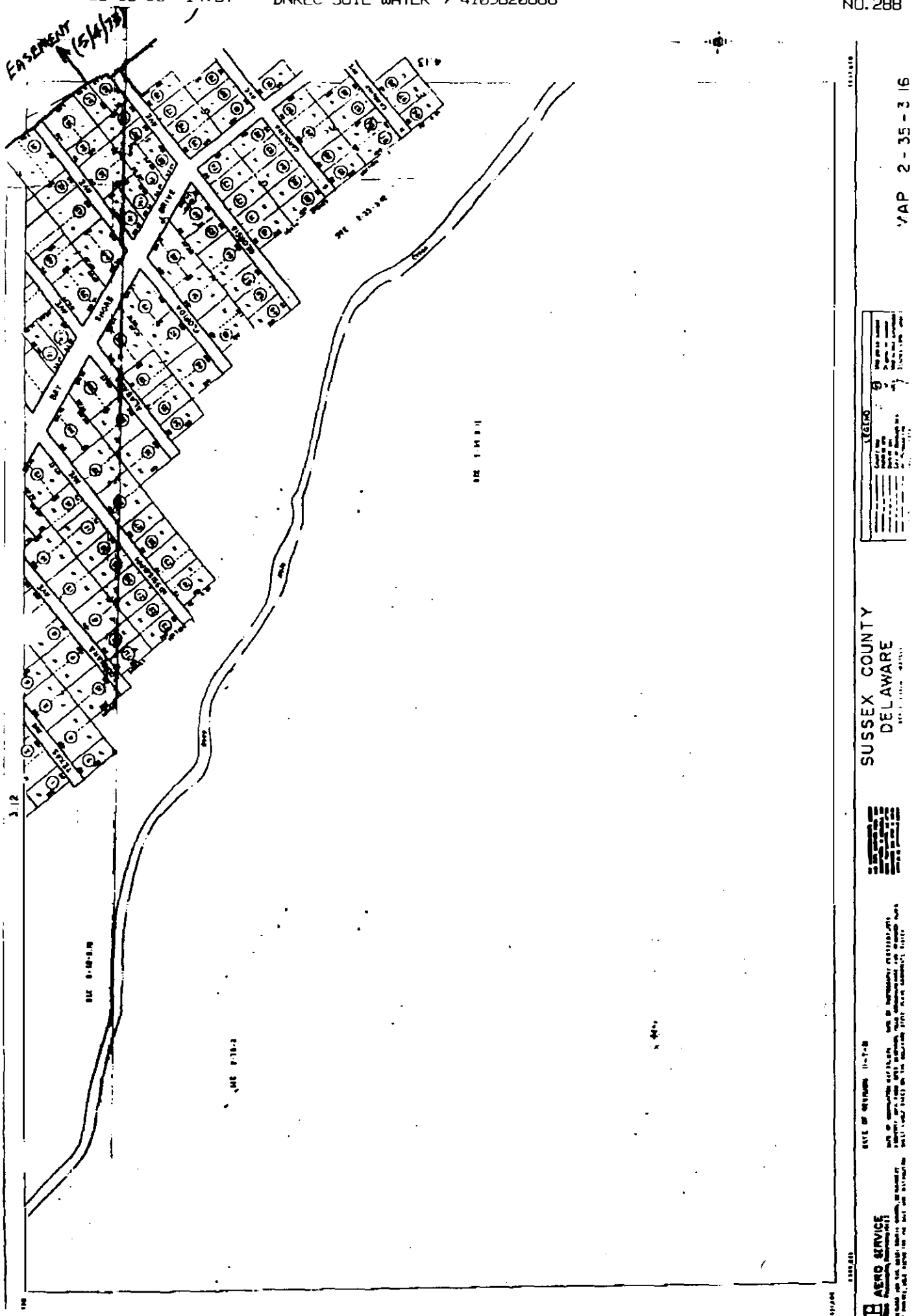
BE IT REMEMBERED, That on this 27th day of June, A.D. 1992, personally came before me, the subscriber, a Notary Public for the State and County aforesaid, Edwin H. Clark, II, Secretary of the Department of Natural Resources and Environmental Control of the State of Delaware, party to the foregoing Indenture of Writing, known to me personally to be such, and he acknowledged this Indenture of Writing to be his Act and Deed and the Act and Deed of the said Department of Natural Resources and Environmental Control of the State of Delaware.

GIVEN under my Hand and Seal of Office the day and year aforesaid.

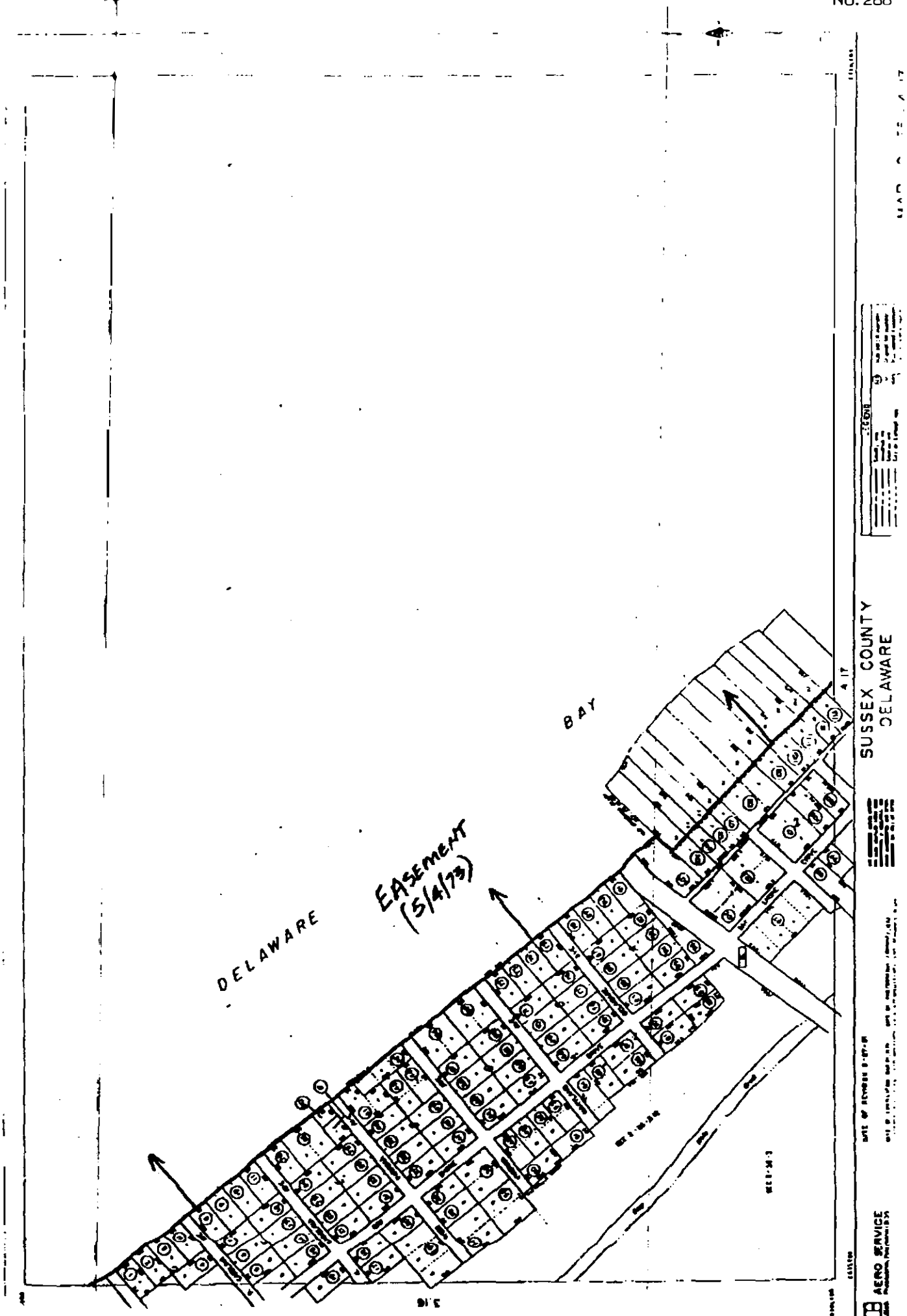
Kathy M. Turner
Notary Public
Kathy M. Turner
Term Expires May 3, 1995

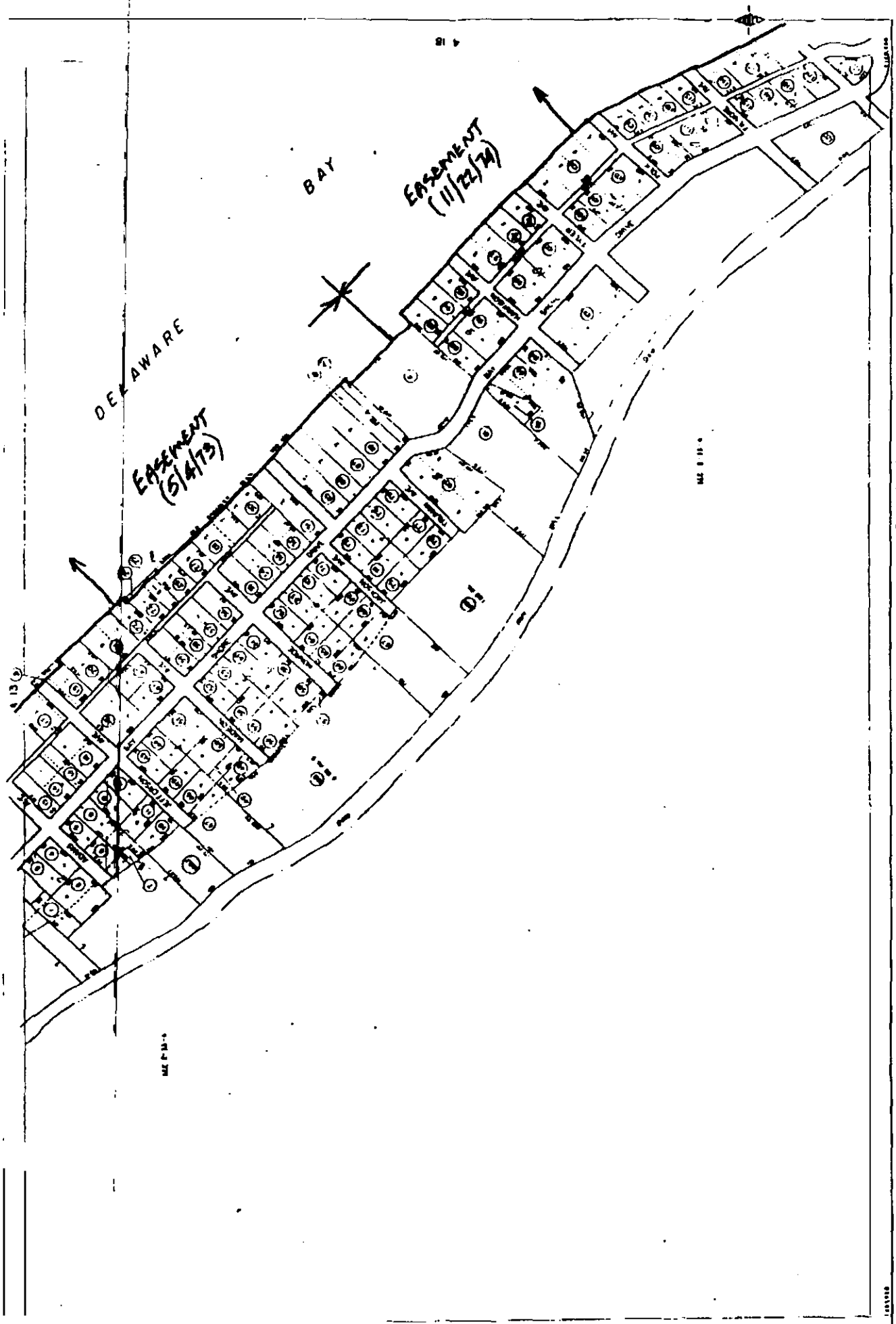
RECORDER OF DEEDS
SUSSEX COUNTY

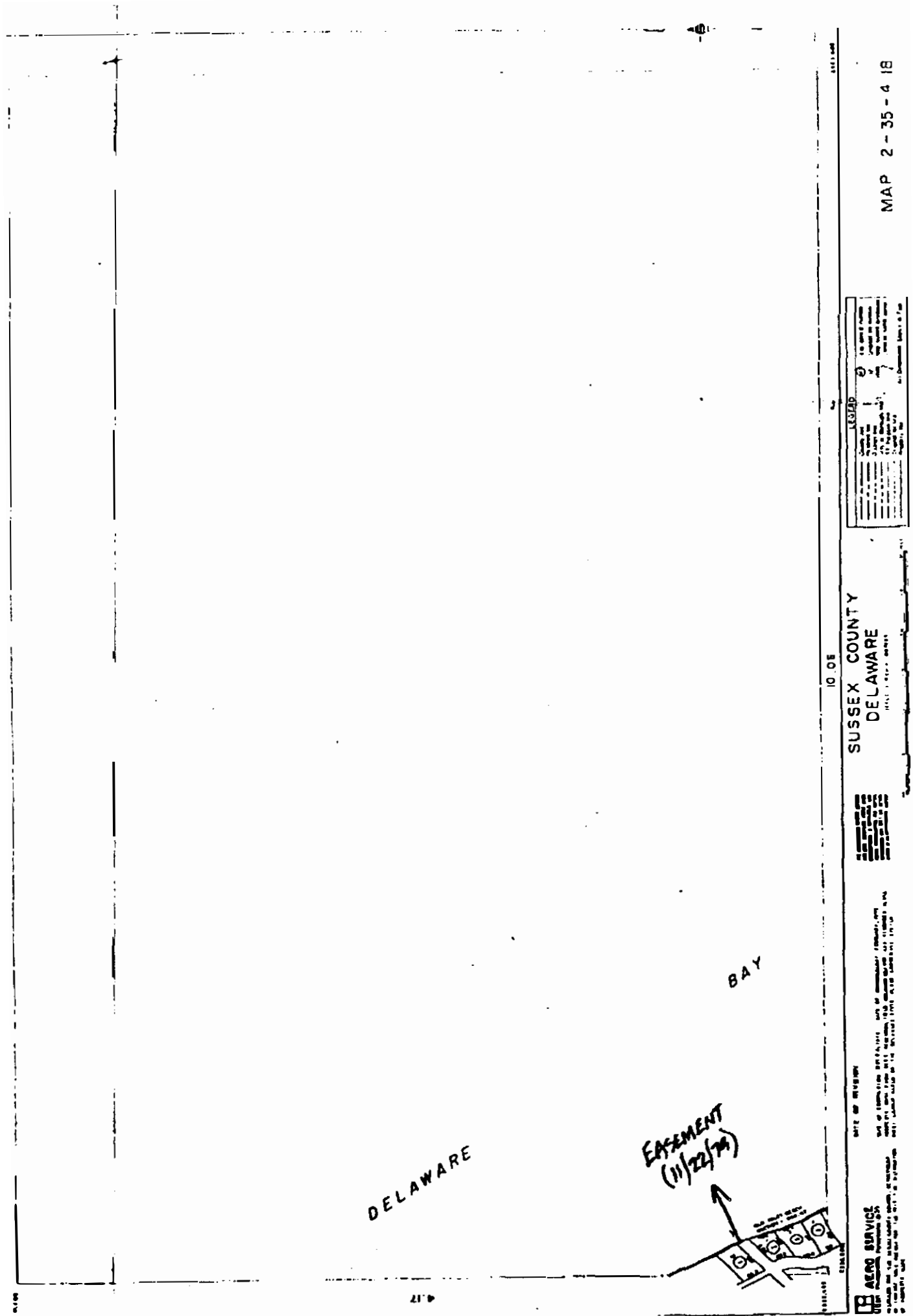

BAY
EASEMENT
(5/4/73)
DELAWARE
SUSSEX COUNTY
DELAWARE
2-30
3 16



MAP 2-35-3 16

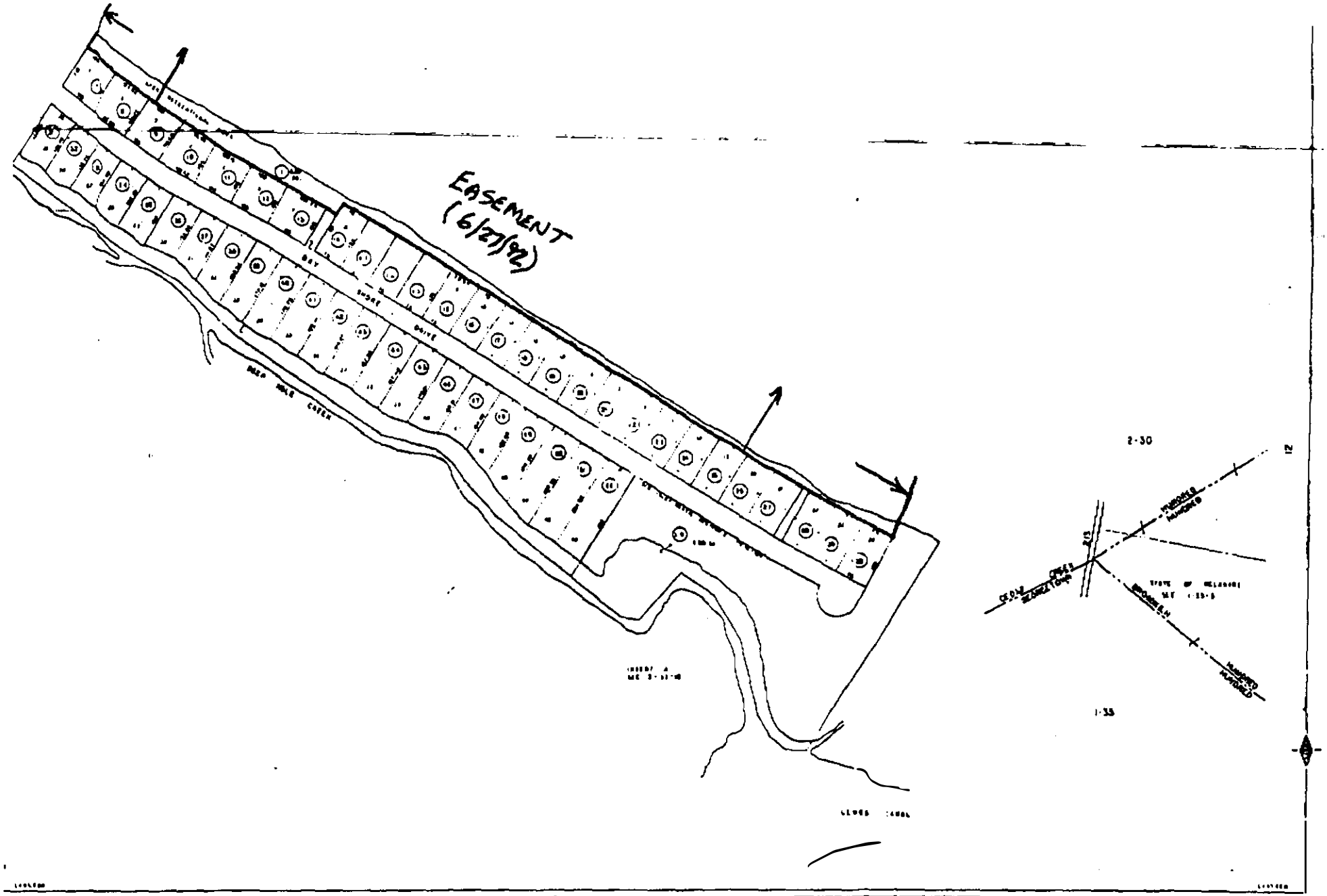

BAY
DELAWARE
EASEMENT
(5/4/73)
SUSSEX COUNTY
DELAWARE
AERO SERVICE


BAY
DELAWARE
EASEMENT (11/22/74)
EASEMENT (5/4/73)
MAP 2-35-4
SUSSEX COUNTY
DELAWARE


MAP 2-35-4 18
SUSSEX COUNTY
DELAWARE
10.05
BAY
DELAWARE
EASEMENT
(11/22/96)
AERO SURVICE

SUSSEX COUNTY
DELAWARE
BAY
DELAWARE
EASEMENT
(11/22/94)
MAP 2-35.10 06

SUSSEX COUNTY
DELAWARE
MAP 2-35-10
DELAWARE
BAY
EASEMENT
(11/22/74)



DATE OF REVISION

SUSSEX COUNTY
DELAWARE

LEGEND

MAP 2 - 35 - 11

BROADKILL BEACH

DIST	MAP	PARCEL	NAME OF OWNER (PERMANENT)
2-35	3.12	104	HAWKINS, Sally V.
2-35	3.12	105	BEVERIDGE, Reid K.
2-35	3.12	106	WRIGHT, Robert & Catherine Z.
2-35	3.12	113	MCCORRY, Mary Dail
2-35	3.12	114	MCCORRY, Mary Dail
2-35	3.16	41	DAVIS, Eugene W. & Harriet V.
2-35	3.16	56.01	CASA BOELIUM GRAFIOCRATIGUE
2-35	3.16	57	MARGE, Emidio & Anna Theresa
2-35	3.16	58	MARGE, Emidio & Anna Theresa
2-35	4.13	1	O'SULLIVAN, Dennis P. & Jamie J.
2-35	4.13	2	SIMMERS, Mary Norton
2-35	4.13	3	MOORE, H. RIchard & Edna V.
2-35	4.13	3.01	MOORE, H. RIchard & Edna V.
2-35	4.13	8	MOORE, H. RIchard & Edna V.
2-35	4.13	9	WALLS, H. Michail
2-35	4.13	10	BURTON, Patricia Ann
2-35	4.13	11	MORTON, James B., Jr. & Florence A.
2-35	4.13	25	GRAVES, Charls L. & Gladys E.
2-35	4.13	26	WRIGHT, Robert I. & Catherine Z.
2-35	4.13	27.01	LAYTON, Jennie H. J.
2-35	4.13	41	ROTZ, Robert A. & Edwinna M.
2-35	4.13	42	LAYTON, Jennie H. J.
2-35	4.13	58	WEST, WIlson Donald & Joyce Ann
2-35	4.13	59	SCHELLENBERGER, Henry E. & Doris E.
2-35	4.13	72	LAYTON, Anne L. ETAL
2-35	4.13	73	LAYTON, Anne L. & Patricia L.
2-35	4.13	74	LAYTON, Anne L. ETAL
2-35	4.13	75	LAYTON, Anne L. & Patricia L.
2-35	4.13	88	LAYTON, Anne L. ETAL
2-35	4.13	89	LAYTON, Anne L. ETAL
2-35	4.13	90	LAYTON, Anne L. ETAL
2-35	4.13	91	LAYTON, Anne L. ETAL
2-35	4.13	103	LAYTON, Anne L. ETAL
2-35	4.13	104	HOPKINS, John A. & Elizabeth C.
2-35	4.13	104.01	CRABB, Patricia H.
2-35	4.13	106	MOORE, George W. & Martha Ann
2-35	4.13	107	SHORT, Hune E. & Sandra Lynn
2-35	4.13	108	PENUEL, C. Bruce
2-35	4.13	109	COPENHAVER, Robert D., Sr. & Bessie R.
2-35	4.13	110	MILLIKEN, Jane Crowl
2-35	4.13	111	SEGERSTROM, Carl A., III & Karen B.
2-35	4.13	112	WALIUS, Burton P.
2-35	4.13	113	THOMAS, Robert Lee
2-35	4.17	17	THOMAS, Robert L. & Phyllis C.
2-35	4.17	18	LAYTON, Jennie H.
2-35	4.17	19	CONLEY, James W. & Clara M.

2-35	4.17	20	CONLEY, James W. & Clara M.
2-35	4.17	21	HUDSON, F. Olivia
2-35	4.17	22	HEARN, Martha B.
2-35	4.17	23	REED, Nancy L.
2-35	4.17	24	LAYTON, Jennie H.
2-35	4.17	25	REED, Nancy L.
2-35	4.17	26	CULVER, Doris H.
2-35	4.17	27	LAWSON, Jessie D. & WM. H.
2-35	4.17	28	WOMACH, W. Richard
2-35	4.17	30	BICKEL , Harry H. & Frances F.
2-35	4.17	31	BICKEL , Harry H. & Frances F.
2-35	4.17	85	LARNICK, Lucie
2-35	4.17	86	MACOWSKI, John M. & Dorothy
2-35	4.17	87	ABLER, Henry W. & Mary F.
2-35	4.17	88	PLUMMER, Carlton L. & Shirley
2-35	4.17	89	PLUMMER, Carlton L. & Shirley
2-35	4.17	90	THOMPSON, Patricia L. & Anne
2-35	4.17	91	MORAN, Andrew J.
2-35	4.17	93	BERKOWITZ, Maureen Stark
2-35	4.17	94	MARRINGTON, George S. &
2-35	4.17	95	MANNEMAN, William H. & Marjorie
2-35	4.17	97	MIHALIK, Joseph J. & Eulalia L.
2-35	4.17	98	MIHALIK, Stephen Richard
2-35	4.17	98.01	MIHALIK, Eulalia Lobo
2-35	4.17	106	MARTIN, Mary Elizabeth Lobo
2-35	4.17	108	MILLER, Gregory M. & Bonnie M.
2-35	4.17	109	RASER, Randall A.
2-35	4.17	110	GAMBERG, Richard B.
2-35	4.17	113	GAMBERG, Richard B.
2-35	4.17	114	SHIMSHICK, Edward J. & Herbjorg Lund
2-35	4.17	117	SMITH, Dolly
2-35	4.18	1	SODER, Susan
2-35	10.10	32	LOELIGER, William & Joanne
2-35	10.10	38	MURPHY, JUDITH
2-35	10.10	39	LANZILLO, Joseph & Hennriette
2-35	3.12	116	LAYTON, Jennie H. J.
2-35	10.10	27	O'CONNEL, Tim & Eugina
2-35	4.13	96	LAYTON, Jennie H. J.
2-35	11	7	SAMANS, Rose
2-35	11	8	ROLAND, Carroll
2-35	11	9	DATTILO, Francis & Susan
2-35	11	10	SONDERBY, Pamela
2-35	11	11	REITZ INVESTMENT GROUP, LP
2-35	11	12	ENGLISH, Frank
2-35	11	13	ENGLISH, Frank & Katherine
2-35	11	14	HASSLER, John & Janis
2-35	11	15	ROBERTS, Dennis
2-35	11	16	DROBNOCK, David & Ann Marie
2-35	11	17	GAYNOR, John & Joan
2-35	11	18	PORAT, Albert & Jenevie
2-35	11	19	CARRICK, Shawn & Walter Kutrick
2-35	11	20	VERICA, John & Karen
2-35	11	21	DUCKETT, Melvin & Catherine
2-35	11	22	LAROTONDA, DONATO & Genevieve
2-35	11	23	JACQUES, Willam & Rosalie
2-35	11	24	JACQUES, Joy

2-35	11	25	ARGP, L. P.
2-35	11	26	MAY, John & Evelyn
2-35	11	27	GRADY, Virginia
2-35	11	28	TREGANOWAN, Jr., Willis & Evelyn
2-35	11	29	KELLY, Dennis & Alice
2-35	11	30	STRICK, George & Eileen
2-35	10 - Sec. A	1.08	BURKE, Merritt, IV, ETAL

EXHIBIT B

COST ESTIMATE
DELAWARE BAY COASTLINE, DELAWARE AND NEW JERSEY
FEASIBILITY STUDY
BROADKILL BEACH

ESTIMATED 65 TAKINGS

			AMOUNT	CONTINGENCY	SUBTOTAL
01010401	Real Estate Acquisition Documents (Cadastral prep. of R. E. Requirements Mapping)				
0102---ACQUISITIONS					
010201-By Gov't					
010202--By Local Sponsor (LS)					
01020201	Survey & Legals	(4 @ $500)	2,000	300	2,300
01020202	Title Evidence	(4 @ $600)	2,400	360	2,760
01020203	Negotiations	(65 @ $150)	9,750	1,462	11,212
010203--By Gov't on behalf of LS					
010204--Review of LS					
01020401	Survey & Legals	(4 @ $75)	300	45	345
01020402	Title Evidence	(4 @ $75)	300	45	345
01020403	Negotiations	(65 @ $75)	4,875	731	5,606
0103----CONDEMNATIONS			N/A	N/A	N/A
010301--By Gov't					
010302--By Local Sponsor(LS)		(4 @ $3,000)	12,000	1,800	13,800
010303--By Gov't on behalf of LS					
010304--Review of LS		(4 @ $250)	1,000	150	1,150
0105----APPRAISALS					
010501--By Gov't					
010502--By Local Sponsor(LS)		(4 @ $500)	2,000	300	2,300
010503--By Gov't on behalf of LS					
010504--Review of LS		(4 @ $180)	720	108	828
0107----TEMPORARY PERMITS/LICENSES/RIGHTS-OF-WAY					
010701--By Gov't					
010702--By Local Sponsor (LS)		(1 @ $100)	100	15	115
010703--By Gov't on behalf of LS					
010704--Review of LS		(1 @ $25)	25	4	29

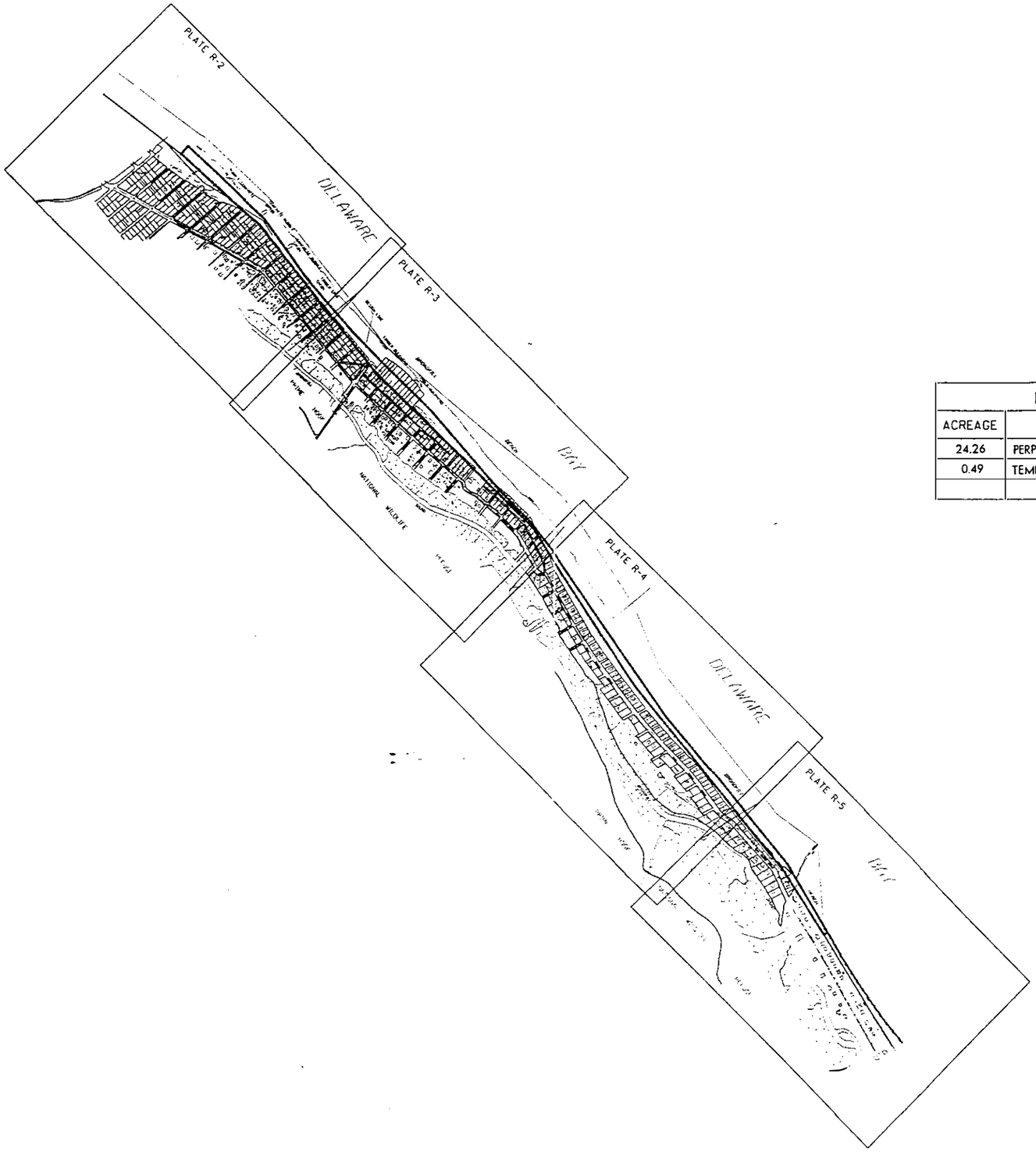
0115----REAL ESTATE PAYMENTS

011501--Land Payments			
01150101--By Gov't			
01150102--By Local Sponsor (LS)	23,620	5,905	29,525
01150103--By Gov't on behalf of LS			
01150104--Review of LS (1 @ $75)	75	11	86
011502--PL 91-646 Assistance Payments	N/A	N/A	N/A
01150201--By Gov't			
01150202--By Local Sponsor (LS)			
01150203--By Gov't on behalf of LS			
01150204--Review of LS (@ $75)			
TOTALS	59,165	11,236	70,401

EXHIBIT C

CORPS OF ENGINEERS

U. S. ARMY



NORTH

GRID

ESTATES REQUIRED FOR PROJECT		
ACREAGE	ESTATE	PLAN SHEET SYMBOL
24.26	PERPETUAL HURRICANE AND SHORE PROTECTION EASEMENT	(P)
0.49	TEMPORARY WORK AREA EASEMENT	(T)

MICROFILMED	DATE AUDIT APPROVED	DATE	REVISIONS (AS AS UP)	BY

REAL ESTATE PLANNING MAP

DEPARTMENT OF THE ARMY
LOCATION OF PROJECT
STATE DELAWARE
COUNTY SUSSEX
DIVISION NORTH ATLANTIC
DISTRICT BALTIMORE
ARMY AREA
MILES
MILES

USING SERVICE
TRANSPORTATION FACILITIES
RAILROADS
STATE ROADS STATE ROUTE 16
FEDERAL ROADS
AIRLINES
OF
OF

PLATE INDEX

DEPARTMENT OF THE ARMY
U. S. ARMY ENGINEER DISTRICT, BALTIMORE
CORPS OF ENGINEERS
NORTH ATLANTIC DIVISION

DRAWN BY SLM
TRACED BY
CHECKED BY CMB
SUBMITTED BY: J. H. Burns, CADASTRAL
RECOMMENDED BY: Mary L. Roberts, CHIEF, P&C BRANCH

REAL ESTATE
BROADKILL BEACH
HURRICANE AND SHORE
PROTECTION PROJECT
SUSSEX COUNTY, DELAWARE

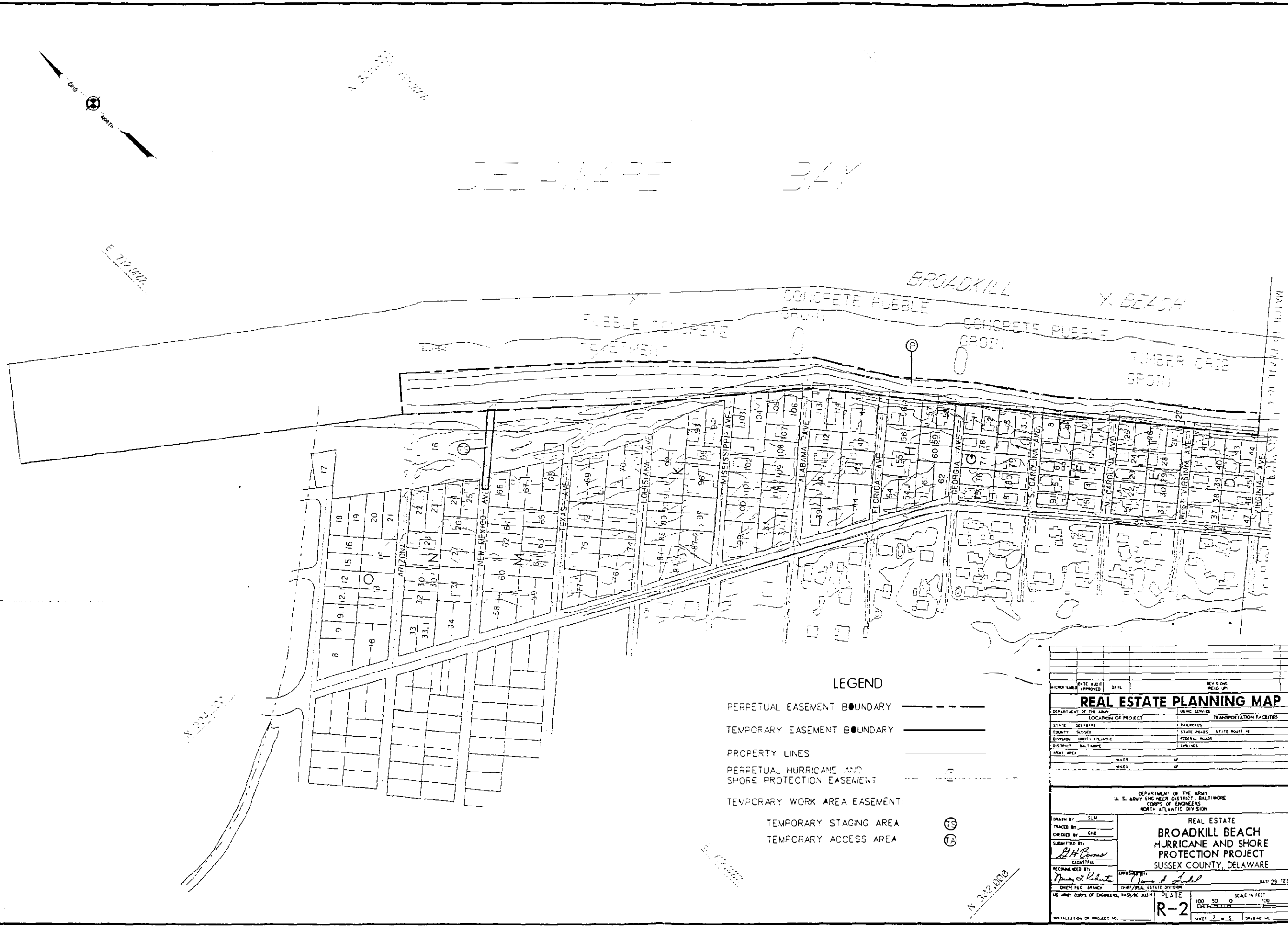
APPROVED BY: Thomas L. Todd, CHIEF, REAL ESTATE DIVISION, DATE 29 FEB 1996

US ARMY CORPS OF ENGINEERS, WASH, DC 20314
INSTALLATION OR PROJECT NO.

PLATE R-1

SCALE IN FEET
NOT TO SCALE

SHEET 1 OF 5
DRAWING NO.



LEGEND

PERPETUAL EASEMENT BOUNDARY

TEMPORARY EASEMENT BOUNDARY

PROPERTY LINES

PERPETUAL HURRICANE AND SHORE PROTECTION EASEMENT (P)

TEMPORARY WORK AREA EASEMENT:

TEMPORARY STAGING AREA (TS)

TEMPORARY ACCESS AREA (TA)

MICROFILMED | DATE AUDIT APPROVED | DATE | REVISIONS (READ UP) | BY

REAL ESTATE PLANNING MAP

DEPARTMENT OF THE ARMY	USING SERVICE
LOCATION OF PROJECT	TRANSPORTATION FACILITIES
STATE DELAWARE	* RAILROADS
COUNTY SUSSEX	STATE ROADS STATE ROUTE 16
DIVISION NORTH ATLANTIC	FEDERAL ROADS
DISTRICT BALTIMORE	AIRLINES
ARMY AREA	
MILES	OF
MILES	OF

DEPARTMENT OF THE ARMY
U. S. ARMY ENGINEER DISTRICT, BALTIMORE
CORPS OF ENGINEERS
NORTH ATLANTIC DIVISION

DRAWN BY SLM
TRACED BY
CHECKED BY GKB
SUBMITTED BY: CADASTRAL
RECOMMENDED BY: CHIEF, P&C BRANCH
APPROVED BY: CHIEF, REAL ESTATE DIVISION DATE 29 FEB 1996

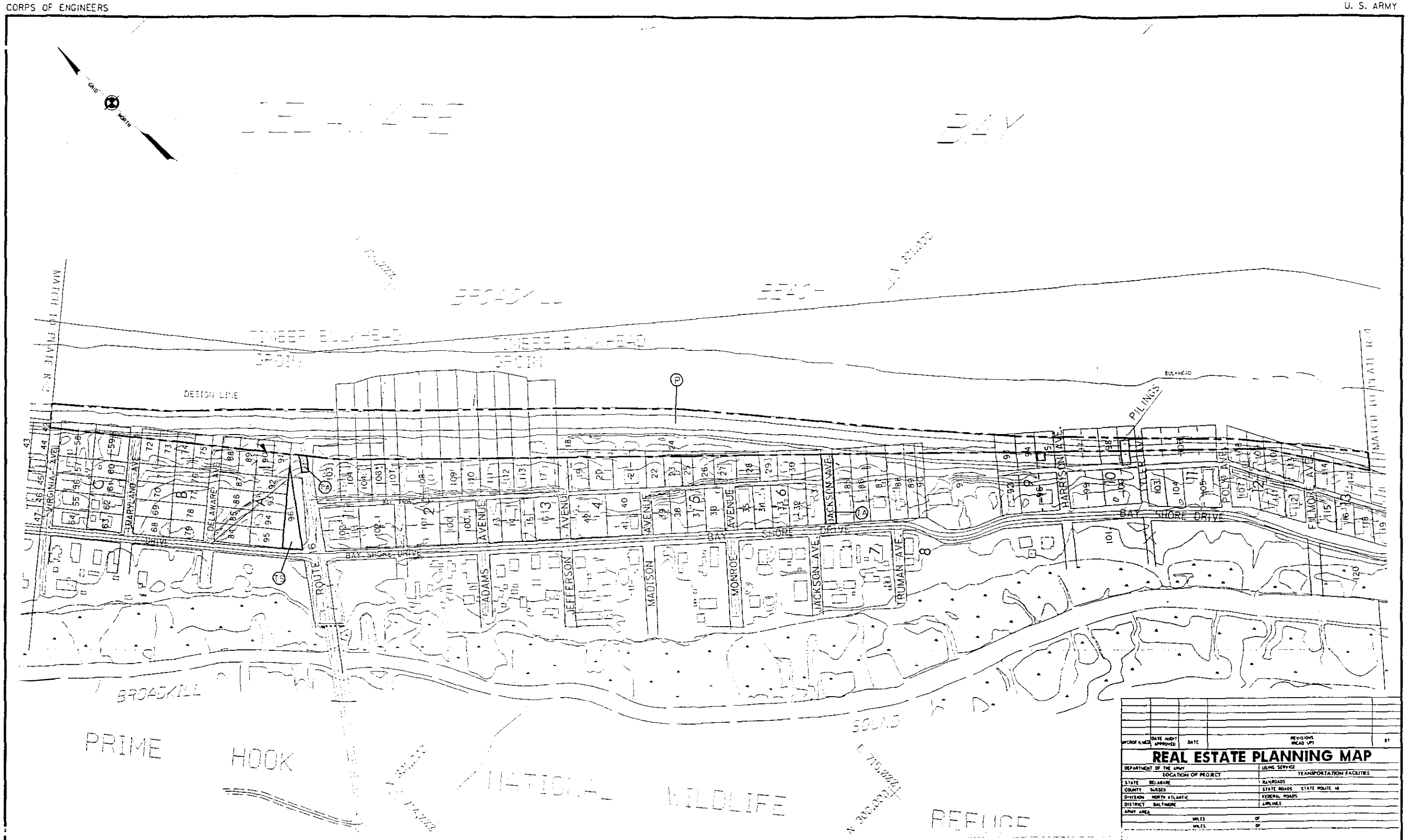
REAL ESTATE
BROADKILL BEACH
HURRICANE AND SHORE PROTECTION PROJECT
SUSSEX COUNTY, DELAWARE

US ARMY CORPS OF ENGINEERS, WASH, DC 20314 | PLATE R-2 | SCALE IN FEET 100 50 0 100 200

INSTALLATION OR PROJECT NO. | SHEET 2 OF 5 | DRAWING NO.

CORPS OF ENGINEERS

U. S. ARMY



LEGEND

PERPETUAL EASEMENT BOUNDARY

TEMPORARY EASEMENT BOUNDARY

PROPERTY LINES

PERPETUAL HURRICANE AND SHORE PROTECTION EASEMENT (P)

TEMPORARY WORK AREA EASEMENT:

TEMPORARY STAGING AREA (TS)

TEMPORARY ACCESS AREA (TA)

MICROFILMED	DATE MUST APPROVED	DATE	REVISIONS (READ UP)	BY

REAL ESTATE PLANNING MAP

DEPARTMENT OF THE ARMY	USING SERVICE
LOCATION OF PROJECT	TRANSPORTATION FACILITIES
STATE DELAWARE	RAILROADS
COUNTY SUSSEX	STATE ROADS STATE ROUTE 16
DIVISION NORTH ATLANTIC	FEDERAL ROADS
DISTRICT BALTIMORE	AIRLINES
ARMY AREA	
MILES	OF
MILES	OF

DEPARTMENT OF THE ARMY
U. S. ARMY ENGINEER DISTRICT, BALTIMORE
CORPS OF ENGINEERS
NORTH ATLANTIC DIVISION

REAL ESTATE

BROADKILL BEACH
HURRICANE AND SHORE PROTECTION PROJECT
SUSSEX COUNTY, DELAWARE

DRAWN BY SLM
TRACED BY
CHECKED BY CHB
SUBMITTED BY: J.H. Barnes, CADASTRAL
RECOMMENDED BY: Mary L. Robert, CHIEF, R&C BRANCH
APPROVED BY: James E. Seibel, CHIEF, REAL ESTATE DIVISION
DATE 29 FEB 1996

US ARMY CORPS OF ENGINEERS, WASH DC 20314

INSTALLATION OR PROJECT NO.

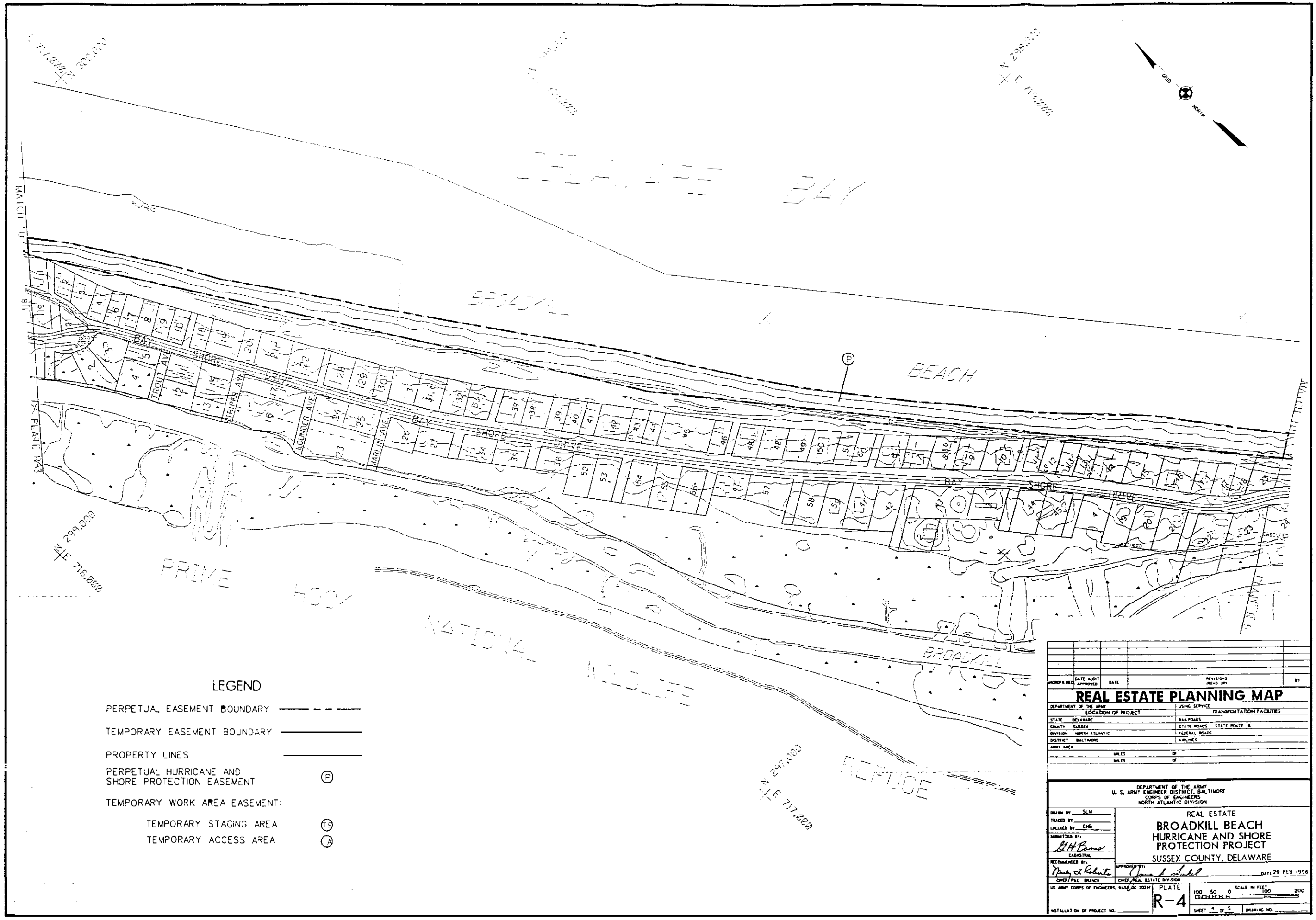
PLATE R-3

SCALE IN FEET: 100 50 0 100 200

SHEET 3 OF 3 DRAWING NO.

CORPS OF ENGINEERS

U. S. ARMY



LEGEND

PERPETUAL EASEMENT BOUNDARY

TEMPORARY EASEMENT BOUNDARY

PROPERTY LINES

PERPETUAL HURRICANE AND SHORE PROTECTION EASEMENT (P)

TEMPORARY WORK AREA EASEMENT:

TEMPORARY STAGING AREA (TS)

TEMPORARY ACCESS AREA (TA)

MICROFILMED	DATE AUDIT APPROVED	DATE	REVISIONS (READ UP)	BY

REAL ESTATE PLANNING MAP

DEPARTMENT OF THE ARMY	USING SERVICE
LOCATION OF PROJECT	TRANSPORTATION FACILITIES
STATE DELAWARE	RAILROADS
COUNTY SUSSEX	STATE ROADS STATE ROUTE 16
DIVISION NORTH ATLANTIC	FEDERAL ROADS
DISTRICT BALTIMORE	AIRLINES
ARMY AREA	
MILES	OF
MILES	OF

DEPARTMENT OF THE ARMY
U. S. ARMY ENGINEER DISTRICT, BALTIMORE
CORPS OF ENGINEERS
NORTH ATLANTIC DIVISION

DRAWN BY SLM
TRACED BY
CHECKED BY GHB
SUBMITTED BY: G.H. Barnes
CADASTRAL
RECOMMENDED BY: Mary A. Roberts
CHIEF, P&C BRANCH

REAL ESTATE
BROADKILL BEACH
HURRICANE AND SHORE PROTECTION PROJECT
SUSSEX COUNTY, DELAWARE

APPROVED BY: James A. Seidel
DATE 29 FEB 1996
CHIEF, REAL ESTATE DIVISION

US ARMY CORPS OF ENGINEERS, WASH, DC 20314

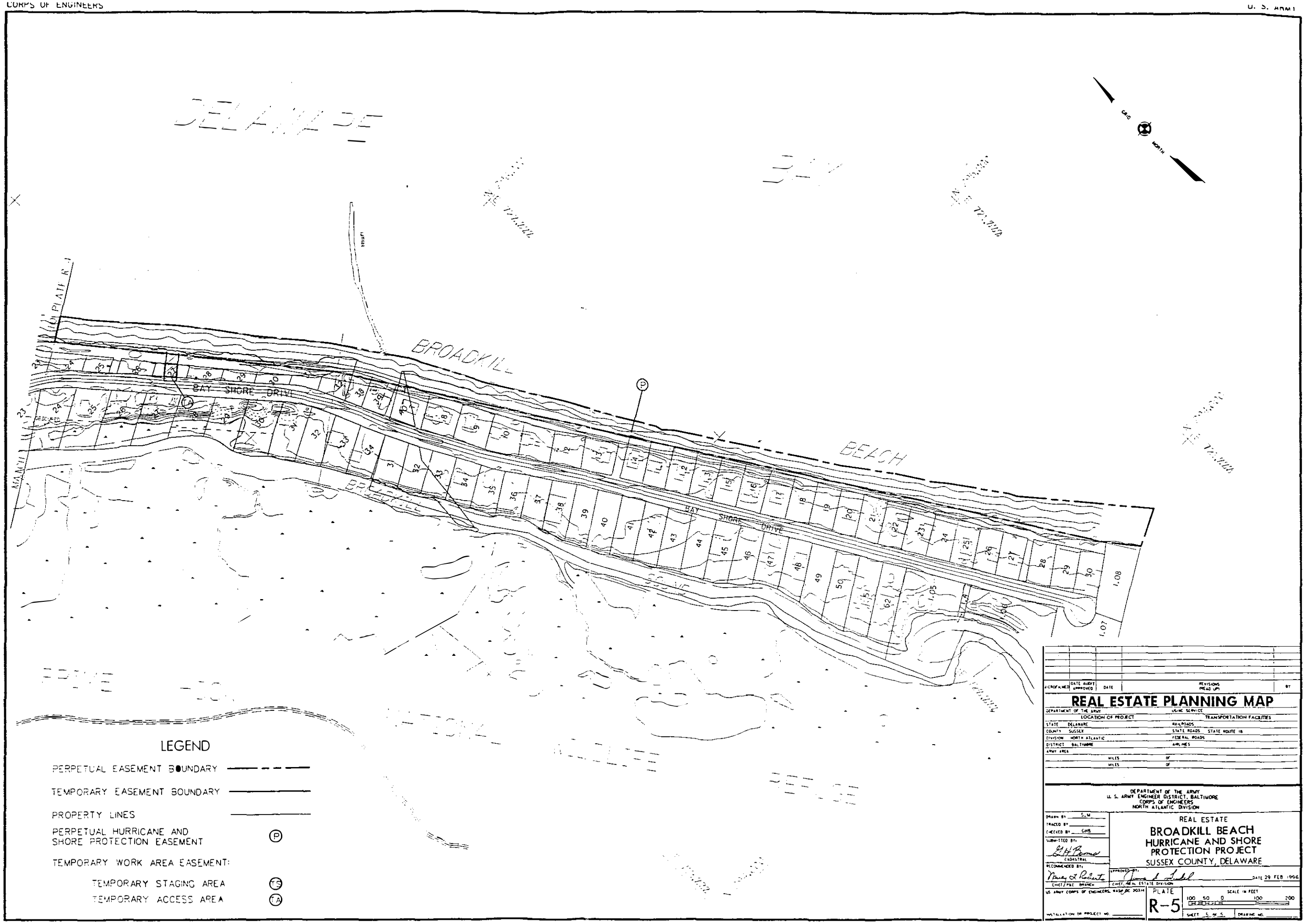
PLATE R-4

SCALE IN FEET 100 50 0 100 200

INSTALLATION OF PROJECT NO.

SHEET 4 OF 5

DRAWING NO.



MICROFILMED	DATE ALREADY APPROVED	DATE	REVISIONS (READ ☞)	BY

REAL ESTATE PLANNING MAP

DEPARTMENT OF THE ARMY — USING SERVICE

LOCATION OF PROJECT — TRANSPORTATION FACILITIES

STATE DELAWARE — RAILROADS

COUNTY SUSSEX — STATE ROADS STATE ROUTE 16

DIVISION NORTH ATLANTIC — FEDERAL ROADS

DISTRICT BALTIMORE — AIRLINES

ARMY AREA

MILES OF

MILES OF

DEPARTMENT OF THE ARMY
U. S. ARMY ENGINEER DISTRICT, BALTIMORE
CORPS OF ENGINEERS
NORTH ATLANTIC DIVISION

DRAWN BY S.M
TRACED BY
CHECKED BY GHB
SUBMITTED BY: G. H. Barnes, CADASTRAL
RECOMMENDED BY: Mary E. Robert, CHIEF, REAL ESTATE BRANCH
APPROVED BY: Chief, Real Estate Division — DATE 29 FEB 1996

REAL ESTATE

BROADKILL BEACH HURRICANE AND SHORE PROTECTION PROJECT SUSSEX COUNTY, DELAWARE

US ARMY CORPS OF ENGINEERS, WASH DC 20314

INSTALLATION OR PROJECT NO.

PLATE R-5

SCALE IN FEET: 100 50 0 100 200

SHEET 5 OF 5 — DRAWING NO.

APPENDIX F

PUBLIC ACCESS PLAN

Draft

BROADKILL BEACH PUBLIC ACCESS PLAN

1. Background

a. Purpose

The purpose of the public access plan is to describe public accessibility to the proposed dune and beach area that will be created as a result of the U.S. Army Corps of Engineer's Broadkill Beach Hurricane and Storm Damage Reduction Project. In order for the project to be consistent with Federal and State Policies regarding shore protection projects, public access is required.

b. Scope

The geographical scope of this public access plan extends for the entire 14,600 l.f. of the project in the community of Broadkill Beach.

2. Property Ownership

Broadkill Beach is an unincorporated bay community, and is under the jurisdiction of Sussex County. The bayfront beaches are under both municipal and private ownership, and subject to the direct jurisdiction of the State of Delaware, Department of Natural Resources and Environmental Control, for all beachfront property lying between the existing high water line and the natural and/or artificial dune line. The beaches are managed by the County of Sussex and the local municipalities, and the restrictive dune line is under the direct control of the State of Delaware. Any encroachments onto private land will be addressed in the Real Estate Plan.

3. Public Use

Full public use is available for the general public along the project area. There are no operative restrictions to public use in place within the project area, except for the restrictive dune line for which general public access is restricted. Dune walkovers will be constructed for access to the beaches at intermittent intervals along the dune line, but the remainder of the dune line will be fenced and 'no access' signs will be posted.

4. Accessways and Dune Walkover Structures

a. Location of Accessways

As noted above, this plan affirms the right of access to the restored beach by all members of the public at all public accessways. All accessways are located at existing street ends. All accessways are located on publicly owned/controlled property and are readily available for use by the general public.

b. Number of Accessways

There are 20 public accessways/crossovers for use by pedestrians and 1 vehicular accessway.

c. Ownership and Use of Accessways

Ownership of all accessways/crossovers will be secured by the non-Federal Sponsor as part of their responsibilities under the Project Cooperation Agreement (PCA), and will be addressed in all permanent easement deeds provided by the non-Federal Sponsor to the Government.

d. Dune Walkovers

Dune walkovers will be located at public accessways and oriented over the dune to protect and maintain the integrity and stability of the dune. The design of the respective walkover will reflect the anticipated pedestrian traffic of the area in which it is located, and the vehicular access will not impact the restrictive dune line.

5. Parking Accommodations

Vehicle parking is available adjacent to all thoroughfares and within walking distance of the beach areas. Parking is on a first come first served basis, and no residency restrictions or privileged parking requirements are in effect anywhere along the public beachfront.

APPENDIX G

PUBLIC REVIEW COMMENTS AND RESPONSES

STATE OF DELAWARE
DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL
DIVISION OF SOIL AND WATER CONSERVATION
89 KINGS HIGHWAY
P.O. BOX 1401
DOVER, DELAWARE 19903

OF THE
CTOR

TELEPHONE: (302) 739

June 28, 1996

Mr. Robert L. Callegari
Chief, Planning Division
Philadelphia District Corps of Engineers
Wanamaker Building
100 Penn Square East
Philadelphia, PA 19107-3390

RE: Federal Consistency Determination
Draft Broadkill Beach Interim Feasibility Study

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 Broadkill Beach Project. Our concurrence is based upon the restrictions and/or conditions placed on any and all permits issued to you for this project.

If you have any questions regarding our concurrence please do not hesitate to contact me at (302) 739-3451.

Sincerely,

Sarah W. Cooksey, Administrator
Delaware Coastal Management Program

SWC/mal

cc: File 95.084
Robert Henry, DNREC-DSWC

1. **No response required.**

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Chesapeake Bay Field Office
177 Admiral Cochrane Drive
Annapolis, MD 21401

July 12, 1996

Lt. Colonel Robert P. Magnifico
District Engineer
U.S. Army Corps of Engineers
100 Penn Square East
Philadelphia, PA 19107-3390

Attn: Barbara Conlin

Re: Broadkill Beach Storm
Damage Reduction Project

Dear Colonel Magnifico:

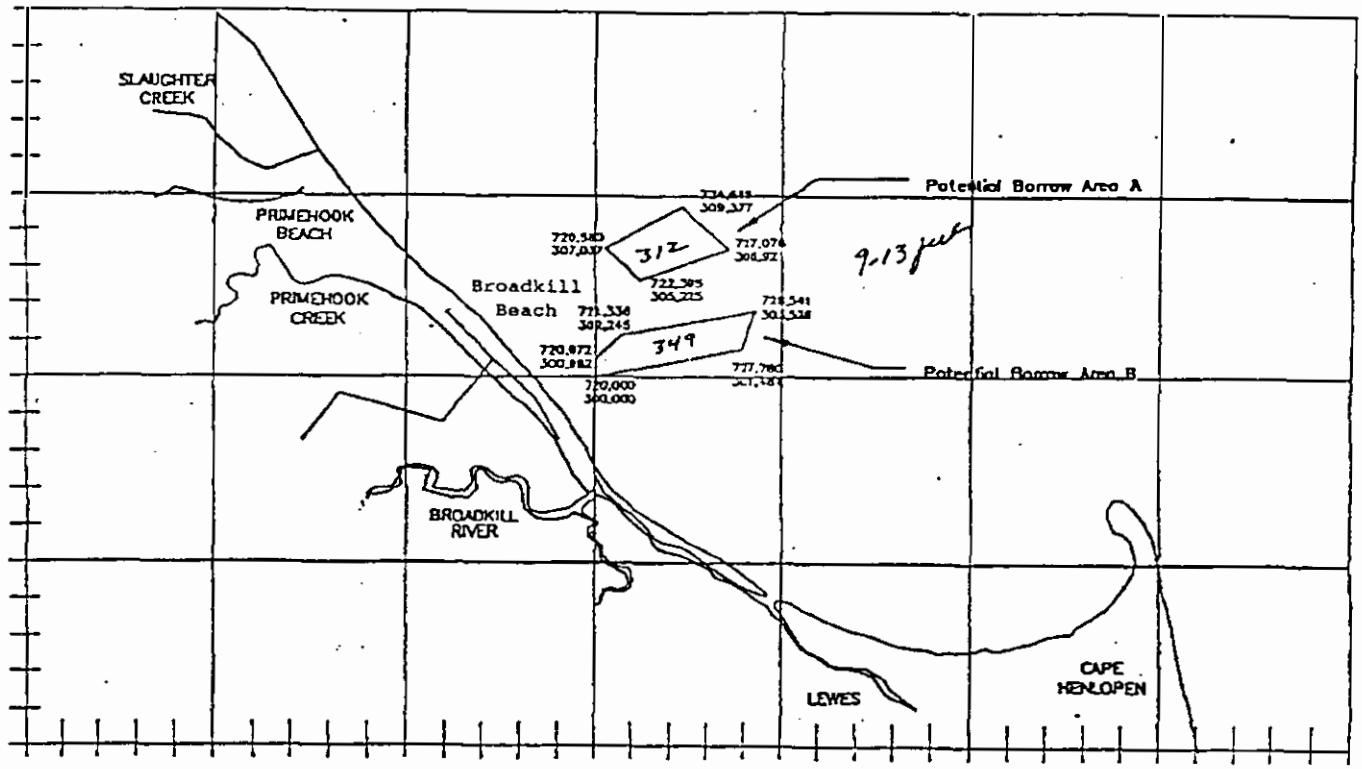
This constitutes the report of the U.S. Fish and Wildlife Service on the proposed storm damage reduction project at Broadkill Beach, Sussex County, Delaware. It is submitted in accordance with Section 2(b) of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 *et seq.*) and Section 7 of the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*). The Service previously submitted a planning aid report dated December 1994. The present report summarizes pertinent information from our previous report and sets forth the Service's official position on the Corps' recommended plan as described in the draft feasibility report and environmental impact statement dated December 1995.

PROJECT DESCRIPTION

The project involves the initial placement of 1,066,000 cubic yards of sand along 13,500 feet of shoreline at Broadkill Beach. The sand would be placed to extend the beach berm 100 feet seaward. The berm would have an elevation of +8 feet NGVD. A vegetated dune with a top elevation of +16 feet NGVD and a top width of 25 feet would be constructed on top of the berm. The dune would have 18,800 linear feet of sand fence, pedestrian walkovers at each street end, and a vehicular access ramp at Route 16. To counterbalance the rate of erosion 358,400 cubic yards of sand would be placed along the shoreline every 5 years.

The sand for the initial construction and subsequent project maintenance would be obtained by dredging sand from two areas located between 0.5 and 2.5 miles offshore in 9 to 13 feet of water (Figure 1). Site A is 312 acres and site B is 349 acres in

Figure 1. Location of the Broadkill Beach study area. Approximate scale is 1 inch=1.5 mile.



area. Together they are estimated to contain 7.3 million cubic yards of suitable material. This exceeds the estimated amount of 4.7 million cubic yards that will be needed over the 50-year project life.

FISH AND WILDLIFE RESOURCES WITHOUT THE PROJECT

Broadkill Beach is a small bay-side residential community of approximately 430 dwellings, many of which are used as vacation cottages. The permanent population is slightly under 500. The community exists on a narrow band of land with Delaware Bay on one side and extensive salt marsh (part of the Prime Hook National Wildlife Refuge) on the other. The existing beach receives periodic replenishment by the state of Delaware. A very narrow low vegetated dune zone exists between the beach and the community. The intertidal and subtidal shoreline zones are expected to be populated with a variety of small invertebrate animals such as polychaete worms, bivalve mollusks, and crustaceans. While the open beach above the intertidal zone is a relatively barren environment, various foraging birds (e.g., gulls, shorebirds, fish crows, and grackles), mammals (e.g., raccoons, red foxes), and crustaceans (e.g., ghost crabs) may occur.

The most striking biological activity at Broadkill Beach occurs during the spring when tremendous numbers of migrating shorebirds arrive to feed on recently deposited horseshoe crab eggs. The horseshoe crab spawning ritual is a dramatic event by itself with large numbers of crabs emerging from the Bay to deposit their eggs in the sand near the high tide line. The beaches of Delaware Bay support the highest number of spawning horseshoe crabs among the East Coast estuaries. The eggs are a major food source for the shorebirds which begin arriving in early May and remain through early June before continuing their northward migration to the nesting grounds. Delaware Bay is considered to be a critical stop-over area for shorebirds during their spring migration. In recognition of its international significance as a vital shorebird staging area, the lower 25 miles of the Delaware Bay shoreline in Delaware and New Jersey has been included in the Western Hemisphere Shorebird Reserve Network. The number of birds at Broadkill Beach are not generally as high as areas further up the Bay, but are nonetheless significant. Semipalmated sandpiper and red knot are the most abundant species at Broadkill Beach.

The benthic macrofauna at the two offshore borrow sites was surveyed in July 1994. It was found to consist of a rather typical community composed primarily of annelids, mollusks, and arthropods. No exploitable populations of commercially important species are believed to be present. Regular inshore trawl surveys conducted by the Delaware Division of Fish and Wildlife have shown that over 50 fish species occur in this area. The

most abundant species were bay anchovy, weakfish, hogchoker, striped cusk-eel, Atlantic croaker, and spot. Most of the species display a pronounced seasonal fluctuation in abundance. Numbers are low in the winter due to migration to warmer waters offshore and southward. Spring brings a progressive influx of species many of which use the lower Delaware Bay for spawning and nursery purposes.

The waters off Broadkill Beach support recreational and commercial fishing activity. Anglers fish off the beach as well as from boats. Weakfish, summer flounder, and bluefish are the most popular species, but the recreational catch also includes striped bass, scup, skates, sharks, spot, croaker, hake, and sea bass. The commercial fishery is primarily composed of gill net fishermen who target weakfish and some striped bass from April to early June.

Waterfowl may occur on the waters off Broadkill Beach during the wintering period. Surveys conducted within one half mile of the shoreline have noted the presence of scaup (*Aythya affinis/marila*), scoters (*Melanitta* spp), and snow geese (*Chen caerulescens*), but the numbers are low relative to other locations up-bay or within the marshes and impoundments.

Endangered Species

Sea turtles, especially the loggerhead (*Caretta caretta*), but also the Kemp's ridley (*Lepidochelys kempii*), green (*Chelonia mydes*), and leatherback (*Dermochelys coriacea*), may occur in the lower Delaware Bay from June to November. The loggerhead and green sea turtles are Federally listed as threatened, and the Kemp's ridley and leatherback are listed as endangered. Sea turtles have been adversely impacted during dredging operations that utilized a hopper dredge. These species are under the regulatory jurisdiction of the National Marine Fisheries Service. We understand that NMFS will issue a Biological Opinion that will specify any special measures required to avoid impacts to these species.

BIOLOGICAL EFFECTS OF THE PROJECT

The benthic invertebrate community at the borrow site and project shoreline will be impacted by the dredging, sand placement, and grading operations. Adjacent areas may also be affected by the transport of sediment suspended during construction. The reduction in the benthic community will reduce the food sources available for bottom feeding fishes, other motile aquatic species such as crabs, and shorebirds.

Recovery of the benthos should occur in the months following the dredging and material placement. The depression which is created by dredging at the borrow sites will likely fill in with somewhat

finer sediments transported from the surrounding areas. Bottom instability during the filling period may slow the rate of benthic recolonization. At the shoreline placement area benthic recolonization will be facilitated if the placement material is similar in grain size composition to the existing beach material. Surface sediment samples collected by Battelle during their July 1994 survey showed some significant variability in the grain size composition. Borrow site A was predominately sand with the silt/clay fraction comprising only 0-4% at the 14 stations sampled. The material at borrow site B contains a higher silt/clay fraction. The median silt/clay value of the 16 stations sampled was 11% and the range was 2-51%. At four stations the silt/clay fraction exceeded 25%. Beach replenishment using the higher silt/clay content material would result in high turbidity and substrate instability. This could expand the adverse impact further into adjacent areas, and would delay biological recovery.

Beach replenishment during May and early June could have a particular impact on horseshoe crabs and shorebirds. Horseshoe crabs would be vulnerable to dredging when they are massing along the shoreline just prior to spawning. Since they deposit their eggs on the beach, they could also be impacted by the beach replenishment operation. Grading and other construction disturbance associated with beach replenishment could also interfere with the normal heavy use of the beach by shorebirds attempting to feed on horseshoe crab eggs. This is a critical time for these birds since they must feed intensively to regain body weight before resuming their northward migration to the nesting areas. Birds that are unable to adequately replace their body reserves will probably have low reproductive success on the breeding grounds.

The additional habitat provided as a result of dune construction will probably have modest wildlife value, especially considering the presence of the adjacent development.

MITIGATION MEASURES

Biological impacts will be minimized if the replenishment material has grain size characteristics similar to the beach. Because the surface samples reported in the draft feasibility/EIS report indicate that the sediments in borrow site B have a substantially higher silt/clay content, it appears that it would be preferable to use material from site A.

Impacts to horseshoe crabs and shorebirds can be minimized if the construction is scheduled to avoid the period between May 1 and June 10.

1. In order to determine the characteristics of the material in the borrow areas, a subbottom acoustical survey was done in conjunction with a series of vibracores which were 20 feet in length. Although sediment samples retrieved during the benthic sampling study in Borrow Area B exhibited fine-grained materials, sediment samples retrieved during the benthic sampling are an indication of what lies on the surface of the borrow area only, not an indication of soil type at any appreciable depth. Dredging operations will be conducted so that the contractor will be cutting into a bank of material a minimum of 5 feet. The dredging operation will cause the sediment layers to become mixed and as such, the subbottom acoustical survey is designed to more accurately reflect the soil characterisitics of the borrow material. The surface sediment characterized by the banthic study does not adequately characterize borrow areas. Benthic survey sediment samples are evaluated for grain size to characterize the top layer of sediment where the organisms are present.

2. No dredging activities for the beach replenishment project will take place during the spring when horseshoe crab spawning takes place in the intertidal zone and the shorebird northern migration and feeding period occurs.

3. Please refer to response #1 above. When the borrow areas were initially configured, very little information was known about them. Since that time, a detailed analysis of the subbottom acoustical survey and additional vibracores, specifically placed in the borrow areas, have been done. With this additional information, it has been determined that there are areas in Borrow Area B that are unsuitable for use as beachfill (i.e. fine-grained sediment). These areas will not be dredged for beachfill on Broadkill Beach. However, there are still portions of Borrow Area B which have good beach quality material and may be used for future beachfill for Broadkill Beach. The Feasibility Report states that there is approximately 7.3 million cubic yards of beach quality material in Borrow Areas A and B combined. It should be noted that this estimate does not include any areas of fine-grained material within these two borrow areas. Dredging of the borrow areas will be examined further during any subsequent phase of study to determine the best locations within the site for cost-effectiveness and compatibility of material to the existing beach.

4. No construction activities are scheduled to take place during the period between May 1 and June 10.

CONCLUSIONS AND RECOMMENDATIONS

The recommended plan consisting of beach replenishment and dune creation is designed to mimic a naturally functioning system. This design minimizes the potential for long-term adverse environmental impacts. Use of material with grain size characteristics similar to the beach is an important measure that should be taken step to reduce biological impacts. For this reason, absent more detailed information, the Service recommends that borrow site A be utilized in lieu of site B. To minimize impacts to horseshoe crabs and shorebirds, the Service further recommends that the construction be scheduled to avoid the period of May 1 to June 10. If there are any questions, please contact George Ruddy of my staff at (410) 573-4528.

Sincerely,

ACTING

John P. Wolflin
Supervisor
Chesapeake Bay Field Office

5

5. Please refer to responses #1,2, 3, and 4 above.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
841 Chestnut Building
Philadelphia, Pennsylvania 19107-4431

Lt. Col. Robert P. Magnifico
District Engineer
U.S. Army Corps of Engineers,
Philadelphia District
Wanamaker Building
100 Penn Square East
Philadelphia, Pennsylvania 19107-3390

JUL 15 1996

RE: DELAWARE BAY COASTLINE -- DELAWARE AND NEW JERSEY
BROADKILL BEACH
SUSSEX COUNTY, DELAWARE
DRAFT ENVIRONMENTAL IMPACT STATEMENT (DEIS)

Dear Lt. Col. Magnifico:

Pursuant to it's authority under Section 309 of the Clean Air Act and the National Environmental Policy Act of 1969 (NEPA), EPA has completed a review of the Draft Environmental Impact Statement (DEIS) for the above referenced project.

The preferred alternative for the storm damage and erosion control project for the community of Broadkill Beach, Delaware consists of beach nourishment utilizing 1,065,879 cubic yards of sand obtained from two offshore borrow areas for initial placement. Beach nourishment will result in a 100 foot minimum design width berm with a top elevation of +8 foot NGVD and an 11,500 foot long dune along 13,500 linear feet of the bayfront. Beach renourishment will occur every 5 years, using 358,000 cubic yards, over a 50 year project life.

Based on the review, EPA has assigned a rating of "EC-2" (Environmental Concerns -- Insufficient Information). The "EC" is based on potential impacts to sea turtles, horseshoe crabs, and other aquatic species as a result of dredging the borrow area for use of sediments to nourish the beach. The "2" refers to the need for additional information in portions of the DEIS. A copy of EPA's rating system is attached for your information.

Based on our review, EPA's comments are summarized below. These comments are further explained and followed by specific recommendations in our enclosed Technical Comments.

1 • **The DEIS does not explain why certain alternatives were eliminated from consideration.** A written explanation of the alternatives screening process, which cross-

1. An additional section, including matrices (Section 3.4. Alternatives Evaluation) has been added to the FEIS to provide additional information on the decision-making process undertaken to determine the selected plan. This information has been augmented with references to appendices and sections in the Main Report.

references all enclosed appendices, followed by a matrix of all viable alternatives greatly aids the reader in understanding the decision-making process.

2 • **The DEIS is unclear in explaining the time of year when dredging will occur.** Dredging during the winter months is a common form of mitigation because impacts to the dredging area are not as severe during such months.

3 • **The DEIS does not specify the type of dredge that will be utilized for construction activities.** Of the two main types of dredges -- hydraulic cutter head dredges and hopper dredges -- the former typically results in fewer environmental impacts.

Thank you for providing EPA with the opportunity to review and comment on this project. If you have any questions regarding our comments or recommendations, please feel free to contact Ms. Danielle Algazi of my staff at (215) 566-2722.

Sincerely,

Roy E. Denmark Jr., Chief
Environmental Programs Branch

Enclosure

cc: George Ruddy, USFWS
Tim Goodger, NMFS
Bob Henry, DNREC

2. The construction schedule is currently planned to occur in June 1999 through April 2000. The construction period entails more than just dredging, such as mobilization and demobilization, site preparation, final grading of the slope, and dune fencing installation. Mobilization and demobilization typically takes 2 months at both the beginning and end of the construction period. The COE proposes to limit actual dredging to low productivity months of the year, typically the fall and winter months to minimize impacts to aquatic organisms. This is stated in Sections 1.2, 5.3 and 5.10. The exact dredging schedule will be determined during any subsequent phase of the study.

3. The FEIS has been modified to clarify that only hydraulic dredging will be conducted. Dredging activities are outlined in the Cost Engineering Appendix.

BROADKILL BEACH TECHNICAL COMMENTS

The FEIS should:

- Specify the type of dredge to be used.
- Specify time-of-year restrictions for dredging in order to reduce biological impacts to aquatic organisms.

- **Include written discussion of the decision-making process, which should precede and reference the matrices.**

- **Include a matrix for each one of the three Cycles,** so that the Corps' decision-making process is more clearly described to the reader.

Time-of-Year Restrictions

The DEIS is unclear in stating the time of year when dredging will occur. On page 52, it states that conducting dredging during the months of lowest biological activity is a measure of minimizing the effects to benthic organisms. Also, the U.S. Fish and Wildlife Service recommended (Appendix B) that construction not occur during the spring and summer as a way to mitigate potential adverse effects to staging shorebirds and spawning horseshoe crabs.

Page 53 of the DEIS states that several measures to avoid or minimize impacts to sea turtles may not be necessary "if" dredging is conducted within the winter months when turtle activity is lowest in the project area. EPA interprets this as a conditional statement which means that the Corps is not committed to dredging during a specific time of year.

The Final Environmental Impact Statement (FEIS) should:

- **Clearly state that dredging will occur during the winter months** -- the period of lowest biological activity for sea turtles, horseshoe crabs, and other aquatic species.

Type of Dredge

The DEIS does not specify the type of dredge to be utilized. It states that if a hopper dredge is utilized, a National Marine Fisheries Service (NMFS) approved sea turtle observer is required to be on the dredge to monitor for sea turtles during dredging (page 48). However, hydraulic cutter dredges, which move more slowly than hopper dredges, do not require such a NMFS approved sea turtle observer to be on the dredge because the potential impacts to sea turtles are significantly reduced.

EPA recommends that a hydraulic cutter head dredge be used to avoid potential adverse effects to sea turtles, some of which are classified as Federally-listed threatened or endangered species.

Alternatives Analysis

As stated in the Council on Environmental Quality (CEQ) Regulations (40 CFR Part 1502.14), the alternatives analysis is the "heart of the environmental impact statement." NEPA requires that the evaluation of alternatives "sharply define the issues and provide a clear basis for choice among options by the decision-maker and the public" (40 CFR Part 1502.14).

EPA is concerned with the adequacy of the alternatives analysis, the elimination of alternatives during Cycle 3 of the alternatives screening process, and the lack of written explanations describing the decision-making process.

The screening process, whereby various alternatives are evaluated and eliminated, is composed of 3 Cycles (Feasibility Study, pages 99-117). Cycles 1 and 2 adequately eliminate alternatives based on their applicability and merit while also considering environmental, socio-economic, and institutional factors. Measures which were prohibitively expensive were eliminated from further consideration.

In Cycle 3, the remaining three alternatives were formulated and optimized to develop the NED plan for the study area. The Feasibility Study mentions (pages 113 & 117) that further analysis of the Groins with Berm Restoration and Dune Alternative is available in Appendix A section 2. However, this appendix is not included in the Feasibility Study or in the DEIS.

Furthermore, the DEIS does not explain why this particular alternative was eliminated from consideration during Cycle 3. The Feasibility Study implies that this alternative fails to withstand a benefit-cost comparison (Page 117), but without the information from Appendix A section 2, or a written description of the decision-making process provided in the DEIS, it is not clear why this alternative was excluded from the Preferred Plan of Action (DEIS, page 25).

The matrix (Table 3) found in the "Alternatives" section of the DEIS aids the reader in understanding Cycle 2 of the Corps' decision-making process. Matrices aid the reader even greater when they include the viable alternatives considered in all three cycles.

The FEIS should:

- **Include and cross-reference Appendix A section 2,** which discusses the alternative "Groins with Berm Restoration and Dune Alternative."

United States Department of the Interior

OFFICE OF THE SECRETARY
Washington, D.C. 20240

JUL 22 1996

ER 96/488

Mr. Robert L. Callegari
Chief, Planning Division
Philadelphia District, Corps of Engineers
Wanamaker Building, 100 Penn Square East
Philadelphia, Pennsylvania 19107-3390

Dear Mr. Callegari:

This is in regard to the request for the Department of the Interior's comments on the Draft Environmental Report/Statement concerning the **Broadkill Beach** Interim Feasibility Study, Sussex County, DE.

This is to inform you that the Department will have comments, but will be unable to reply within the allotted time as we have just received your transmittal of sufficient copies to satisfy our intradepartmental needs. Please consider this letter as a request for an extension of time in which to comment on the statement.

Our comments should be available by early September 1996.

Sincerely,

Terence N. Martin
Team Leader, Natural Resources
Management Team
Office of Environmental Policy
and Compliance

1. No response required.

United States Department of the Interior

OFFICE OF THE SECRETARY
Office of Environmental Policy and Compliance
Custom House, Room 244
200 Chestnut Street
Philadelphia, Pennsylvania 19106-2904

IN REPLY REFER TO

August 23, 1996

ER96/0448

Mr. Robert L. Callegari
Chief, Planning Division
Philadelphia District
U.S. Army Corps of Engineers
Wanamaker Building
100 Penn Square East
Philadelphia, PA 19107-3390

Dear Mr. Callegari:

The Department of Interior has reviewed the Philadelphia District's December 1995 report, entitled Broadkill Beach, Delaware Interim Feasibility Study, Draft Feasibility Report (FR) and Environmental Impact Statement (EIS). Please consider these comments in completing the final version of the document.

Specific Comments - FR

P. 9, para. 22. The statement which identifies the existence of a unit of the Coastal Barrier Resources System (CBRS) between Broadkill Beach and Primehook Beach, is incorrect. While this section of shoreline was originally included within the CBRS, it was deleted during the 1990 amendments. Therefore, the references to the Coastal Barrier Resources Act (also on page 103 and in the EIS on pages 2, 15, and 17) should be deleted.

Specific Comments - EIS

P. 17, sect. 3.1. One obvious alternative which should be discussed in the EIS is to continue with the current practice in which the State conducts beach replenishment according to its ability on an as needed basis. This is the baseline condition used for determining damages (see FR, p. 97).

P. 17, sect. 3.2.1. While the permanent evacuation of the entire community would be prohibitively expensive, the relocation of only the most vulnerable structures could be feasible. We suggest that this alternative be considered.

P. 43, sect. 5.2.1. The conclusion that, based on a coastwide acoustic subbottom profile and vibracore study, borrow sites A and B contain suitable beach nourishment material appears to conflict with the results of the surface bottom samples taken at the sites for the benthic animal assessment (Appendix C). The latter study found that whereas site A was predominantly sand (the silt/clay fraction was less than 4%), the median silt/clay composition of 16 stations at site B was 11% with a range of 2-51%. This indicates that the surface material at site B would not be well suited for beach nourishment.

1. Concur. References to a CBRS Unit under the Coastal Barrier Resources Act in the vicinity of the project area have been deleted from the Main Report and FEIS.

2. Continued nourishment by the State is the No Action alternative. The without project hydraulic and economic analyses account for the State's intent to continue nourishment in the absence of a Federal project. This alternative is discussed in the Cycle 1 evaluation. Despite the State's renourishment efforts, average annual damages of $1,892,000 still occur.

3. There are approximately 430 single family homes and one commercial structure in Broadkill Beach. Development inland is limited by the Primehook National Wildlife Refuge to the west. As a result, development occurs north and south along the bay shoreline. With the majority of homes lying along the bayfront, Broadkill Beach is more vulnerable to damages from relatively low to average strength storms which occur more frequently. It is estimated that 120 structures (28 percent of the structures in the community) will be damaged at a 20-year storm event. The costs to acquire lands, relocate structures as well as roads, water suppy facilities, electric power, telephone and sewage facilities for these structures would be prohibitively high.

4. In order to determine the characteristics of the material in the borrow areas, a subbottom acoustical survey was done in conjunction with a series of vibracores which were 20 feet in length. Although sediment samples retrieved during the benthic sampling study in Borrow Area B exhibited fine-grained materials, sediment samples retrieved during the benthic sampling are an indication of what lies on the surface of the borrow area only, not an indication of soil type at any appreciable depth. Dredging operations will be conducted so that the contractor will be cutting into a bank of material a minimum of 5 feet. The dredging operation will cause the sediment layers to become mixed and as such, the subbottom acoustical survey is designed to more accurately reflect the soil characterisitics of the borrow material. The surface sediment characterized by the benthic study does not adequately characterize borrow areas. Benthic survey sediment samples are evaluated for grain size to characterize the top layer of sediment only, where the organisms are present.

When the borrow areas were initially configured, very little information was known about them. Since that time, a detailed analysis of the subbottom acoustical survey and additional vibracores, specifically placed in the borrow areas, have been done. With this additional information, it has been determined that there are areas in Borrow Area B that are unsuitable for use as beachfill (i.e. fine-grained sediment). These areas will not be dredged for beachfill on Broadkill Beach. However, there are still portions of Borrow Area B which have good beach quality material and may be used for future beachfill for Broadkill Beach. The Feasibility Report states that there is approximately 7.3 million cubic yards of beach quality material in Borrow Areas A and B combined. It should be noted that this estimate does not include any areas of fine-grained material within these two borrow areas. Dredging of the borrow areas will be examined further during any subsequent phase of study to determine the best locations within the sites for cost-effectiveness and compatibility of material to the existing beach.

The document should resolve the discrepancy between the two studies. Additional sediment samples should be taken if necessary to resolve this issue.

5 P. 44, sect 5.3. This section should discuss the potential impact of the project on horseshoe crab spawning and the associated shorebird feeding activity. As noted previously in the document (pages 16 and 35), Delaware Bay is considered to be a critical stop-over area for shorebirds during their spring migration.

6 P. 51, sect. 5.10. As an additional mitigation measure, the project should avoid construction during the spring period (May 1 to June 10) when shorebirds are staging along the Delaware Bay shoreline.

7 Thank you for the opportunity to present these comments. Any questions or further coordination on fish and wildlife resources should be directed to George Ruddy of the U.S. Fish and Wildlife Service's Chesapeake Bay Field Office at (410) 573-4528.

Sincerely,

Don Henne

Don Henne
Regional Environmental Officer

c:\wp51doc\er96-488.fin

5. No dredging activities for the beach replenishment project will take place during May and early June when horseshoe crab spawning takes place in the intertidal zone or during the spring shorebird migration and feeding period. This has been added to Section 5.3 of the FEIS.

6. Concur. See response #5 above.

7. No response required.

STATE OF DELAWARE
DEPARTMENT OF STATE
DIVISION OF HISTORICAL AND CULTURAL AFFAIRS
HISTORIC PRESERVATION OFFICE
[illegible] Green
TELEPHONE: (302) 739-5685 DOVER • DE • 19901-3611

September 10, 1996

Mr. Robert L. Callegari
Chief, Planning Division
Environmental Resources Branch
Philadelphia District, Corps of Engineers
100 Penn Square East
Philadelphia, PA 19107-3390

ATTN: Michael Swanda

Dear Mr. Callegari:

I have received and reviewed the *Broadkill Beach, Delaware Interim Feasibility Study: Draft Feasibility Report and Environmental Impact Statement*. Based on my review of this document as it pertains to the Philadelphia District, Corps of Engineers' requirement to comply with Section 102 of the National Environmental Policy Act of 1969, as amended, and Section 106 of the National Historic Preservation Act of 1966, as amended, this Office cannot concur with your agency's determination of that the implementation of the preferred shoreline protection alternative will have "No Effect" on any historic properties which are either eligible for or listed in the National Register of Historic Places. Within the Offshore Borrow Area B, an archaeological survey/remote sensing investigation identified a target or anomaly with a magnetic signature strongly suggesting a significant submerged archaeological property(shipwreck). For the purposes of our Section 106 review and without additional archaeological investigation, we would expect this submerged property be treated as National Register eligible. On this matter, your staf has agreed. In applying the Criteria of Effect and Adverse Effect, it is our opinion the proposed utilization of Borrow Area B has the potential to adversely effect this potentially eligible archaeological property, pursuant to 36 CFR 800.9(b)(1) of the Advisory Council on Historic Preservation's (Council) regulations. The Draft Feasibility Study and DEIS identify the Corps' intent to employ a 200 foot buffer around this property to ensure it would not be impacted during the excavation of the offshore borrow. Such a measure would satisfactorily mitigate this potential adverse effect. Thus, i accordance with the Council's regulations (36 CFR 800.5(d), we would concur with a "No Adverse Effect" determination conditioned upon the employment of this 200 foot buffer.

1

1. The District concurs with Delaware's SHPO opinion of "no adverse effect". The Advisory Council on Historic Preservation has been notified.

If you have any questions or require any further assistance in seeking the comments of the Council, please do not hesitate to contact me at your convenience. Thank you.

Sincerely,

Faye L. Stoeum
Archaeologist

cc: R. Cox, ACHP

STATE OF DELAWARE
DEPARTMENT OF NATURAL RESOURCES
& ENVIRONMENTAL CONTROL
DIVISION OF WATER RESOURCES
89 KINGS HIGHWAY, P.O. Box 1401
DOVER, DELAWARE 19903

WETLANDS & SUBAQUEOUS LANDS SECTION

TELEPHONE (302) 739-4691
FACSIMILE (302) 739-3491

September 13, 1996

Mr. Robert J. Callegari
Chief, Planning Division
Philadelphia District, Corps of Engineers
Wanamaker Building, 100 Penn Square East
Philadelphia, PA 19107-3390

Dear Mr. Callegari:

This office is in receipt of the "Broadkill Beach, Delaware, Interim Feasibility Study, Draft Feasibility Report and Environmental Impact Statement" for the Broadkill Beach Storm Damage Reduction Plan. The document has been reviewed and based on our preliminary findings, Section 401 Water Quality Certification will be issued/waived pending submittal and favorable review of a subaqueous lands permit application. The application should include the final EIS, plans and specifications and a water quality monitoring program that will be conducted during project construction.

If you have any further questions, please feel free to contact this office.

Sincerely,

fc< William F. Moyer
Program Manager II
Wetlands and Subaqueous
Lands Section

pc: Laura Herr

WFM:dir
wfm96065