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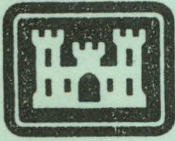
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**US Army Corps
of Engineers**

NEW YORK DISTRICT

GENERAL DESIGN MEMORANDUM SHINNECOCK INLET PROJECT

Long Island, New York

SUPPLEMENTAL DOCUMENTATION

- **COST ESTIMATE**
- **ENGINEERING AND PROJECT
DESIGN CONSIDERATION**
- **STONE STRUCTURAL
REHABILITATION AND REPAIR**
- **BENEFIT EVALUATION**

FINAL REPORT

JUNE 1987

REVISED MARCH 1988

COST ESTIMATES AND APPORTIONMENT

APPENDIX B

APPENDIX B
COST ESTIMATES AND APPORTIONMENT

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APPENDIX B - COST ESTIMATES
AND APPORTIONMENT

I - COST ESTIMATE

B1. INTRODUCTION: This Appendix presents cost estimates for initial construction, annualized maintenance, cost apportionment and total annual costs for a single purpose navigation improvement which provides the following: (1) an inner channel within Shinnecock Bay with a minimum width of 100 ft. at a depth of (-) 6 mlw, (2) an outer channel with a width of 200 ft. at el (-) 10 mlw from its connection with the inner channel at the Bay side of the Inlet, through the Inlet and across a bar area to deeper water in the ocean; the channel is to be enveloped by a deposition basin 2600 ft long, 800 ft. wide to el. (-) 20 mlw oceanward of the jetties for advanced maintenance, (3) rehabilitation of the existing east and west jetties and (4) construction of a 1,000 ft. long revetment facing the Bay, east of the Inlet, extending from the Bay side of the jetty to provide beach erosion control for the integrity of the east jetty. It is to be noted that no construction is involved for provision of the inner channel. Refer to Plate No. 4 for the plan layout.

B2. BASIS OF COSTS. Cost estimates presented herein are based on October 1986 price levels. The quantities for dredging and revetment construction are based on the detailed plans as shown in the main body on Plate No. 4 and 5 which were developed from June 1985 hydrographic and topographic surveys. The quantities for jetty rehabilitation were based, in part, on a jetty conditions survey in March 1986 and, in part, from the June 1985 survey mentioned previously. The unit prices were developed on the basis that the construction procedures and schedule will be as outlined herein.

B3. Dredging cost estimates are based on the use of a 27" hydraulic dredge. The cost estimates are based on pumping dredged material equivalent to 61,000 c.y. annually for each dredging operation on the beach front within 3,000 ft. west of the Inlet, and pumping the remaining dredged material offshore, approximately 5,000 ft. west of the Inlet. Material is required on the beach within 3,000 ft. west of the Inlet to stabilize this beach area which historically has suffered significant erosion. Without stabilization, it is anticipated, based on erosion rates discussed in Appendix C, that a breach could occur as early as 10 years (1996) which will cause serious problems to the stability of the Inlet system. Dredged material placed offshore 5,000 ft downdrift of the Inlet will provide necessary sand bypassing to maintain the littoral flow of material westward across the Inlet. A 5,000 ft. pumping distance is required to preclude pumped material from flowing back towards the Inlet area due

to the existence of a nodal point along the shoreline 5,000 ft. west of the Inlet.

B4. The production rate unit cost for dredging utilized for the (-) 20 mlw and (-) 22 mlw basin depth alternatives is \$6.50/c.y. For the (-) 18 mlw basin depth alternatives, a unit production rate of \$7.50/c.y. is utilized due to additional non pay yardage required. A mobilization and demobilization cost of \$500,000 is utilized for all alternatives.

B5. The cost for stone for the jetty rehabilitation and revetment is based on barging from a Connecticut quarry to the site where it will be rehandled. Construction of the scour blanket at the outer end of each jetty will be accomplished by floating plant.

B6. ALTERNATIVES CONSIDERED: Two basic alternative plans were studied to provide navigation improvement at the Inlet: (1) extend the east and west jetties 1400 ft. to el (-) 12 mlw to provide a sheltered area for navigation traffic and (2) provide a stabilized navigation channel 200 ft. wide with an alignment to allow for safe approach with minimum operating depths of (-) 10 mlw by constructing a deposition basin to envelope the navigation channel; this basin provides for advanced maintenance to prevent channel infringement from shoaling and thus afford stability to the navigation channel.

B7. Concerning the jetty extension plan, extension of the east jetty would trap additional sand from the littoral regime proceeding in the predominant direction to the west. By interrupting this flow of sand, downdrift beaches would suffer significant erosion. As mitigation, a fixed sand bypassing plant, as envisioned in the authorizing document plan, would be required to bypass trapped material. This plant would consist of a steel pier, adjacent to and updrift of the east jetty, supporting a dredge pump operated by diesel engine and mechanically operated derrick mounted on a rail car. The pump would be equipped with a suction pipe which would be supported by the derrick over the east edge of the pier. A discharge line connected to the pump would extend along the pier, and across the Inlet to a feeder beach approximately 5,000 ft to the west of the Inlet. The fixed sand bypassing plant would operate approximately 200 days per year and bypass approximately 300,000 c.y. of trapped sand which is the approximate equivalent net littoral drift rate to the west. The plan layout for this alternative is displayed on Plate No. 7 with a typical section of the fixed sand bypassing plant displayed on Plate No. 8. Minimal maintenance dredging of the navigation channel between the extended jetties would be required every 2 years. This alternative however, was deleted due to its high cost, i.e. total annual cost of \$6,600,000 (detailed in Table B2A) compared with between \$3,400,000 and \$4,400,000 for the

alternatives utilizing the deposition basin. In addition, the required pumping distance increase to approximately 9,000 L.F. as compared with 3,000 L.F. for the authorizing document plan would pose additional mechanical reliability problems.

B8. Concerning the deposition basin plan, two alternative channel design depths and three alternative deposition basin widths and depths were analyzed to determine the most cost effective channel depth and deposition basin size. The three alternative basin dredge depths studied were (-) 18 mlw, (-) 20 mlw and (-) 22 mlw; the three alternative basin widths studied were 500 ft., 700 ft. and 800 ft. and the two channel depths studied were (-) 10 mlw & (-) 12 mlw.

B9. The initial construction costs and dredging maintenance costs for the various alternative widths and depths are developed in Tables B4 and B5, respectively. The maintenance costs for the alternative plans displayed in Table B5 are based on the dredge requirements displayed in Table B2 which in turn are based on the shoaling rates developed in paragraph C80 and Table C5 of Appendix C. Table B1 displays the sum of the results of Tables B4 and B5 plus a \$90,000 annual cost for stone maintenance to arrive at the total annual costs for the plan alternatives. It is to be noted that the interest rate used in screening alternatives is 8 5/8%. The recommended plan is updated to reflect an 8 7/8% current interest rate.

B10. RECOMMENDED PLAN. Although the channel annualized maintenance costs, as displayed in Table B5, for the (-) 10 mlw channel depth with an 800 ft. wide basin alternative for basin depths of (-) 20 mlw and (-) 22 mlw are comparable, the (-) 20 mlw basin depth alternative is the least costly due to the significantly higher initial construction of the (-) 22 mlw basin alternative. This is reflected in Table B1 for total annual costs. Therefore, the selected plan based on cost effectiveness incorporates a navigation channel through the Inlet offshore area of 200 ft. width and (-) 10 mlw depth enveloped by a deposition basin 800 ft. wide to a depth of (-) 20 mlw.

B11. In addition to the features indicated in paragraph B1, the recommended plan will include 3700 c.y. of initial construction dredging at the fishing facility dock area to assure necessary depths for navigability at currently shoaled areas. This dredging would be accomplished by clamshell dredge and disposed by barge and rehandled to the east of the Inlet as part of jetty rehabilitation construction.

B12. ESTIMATED FIRST COST. The estimated project first cost of the recommended plan is \$12,185,600 which includes dredging 552,000 c.y. for the construction of the deposition basin and handling 90,000 tons of stone for the jetty rehabilitation and revetment work. Also included is interest

during construction for the jetty rehabilitation and revetment work applied at the midpoint of construction or 10 month period. Excluding interest during construction, of the \$11,841,000 first cost, \$9,203,000 is Federal apportionment. Details of the first cost are presented in Table B3 with a backup of detailed estimates of dredging cost displayed in Table B6.

B13. CONTINGENCY, ENGINEERING, DESIGN, SUPERVISION AND ADMINISTRATION. A contingency of 20% is utilized for initial construction which is in compliance with EM 1110-2-1301 (31 July 1980) "Cost Estimates - Planning and Design Stages". Engineering and design costs cover preconstruction planning including preparation of the report and plans and specifications in addition to engineering during construction. Supervision and administration includes supervision, overhead and inspection.

B14. CONSTRUCTION AND FUNDING SCHEDULE. The time schedules for construction and expenditure of the recommended plan are shown on Table B10 and are based on the timeliness of the report's approval and allocation of funds by Congress, the foregoing construction procedures and the ability of local interests to implement the necessary items of local cooperation, principally the furnishing of land, easements and rights of way and the provision of a cash contribution. It is to be noted that construction of the revetment will be curtailed between April and August to preclude detrimental environmental impacts to the species piping plover.

B15. REAL ESTATE. The total area of land required for the project as shown on Plate No. 6 consists of 80 acres of permanent easement and 30 acres of temporary easement. The entire acreage required is publicly owned with 75 acres of permanent easement below mean high water. The non-Federal interests shall provide the lands, easements, rights-of-way, relocations (other than utility relocations) and dredged material disposal areas necessary for the project. The value of lands, easements, rights-of-way, relocations, and dredged material disposal areas shall be credited toward the payment required. The Federal Government will not credit the locals with lands that are under Federal ownership or control.

II - COMPARISON OF COST ESTIMATES

B16. COMPARISON OF GDM ESTIMATE WITH AUTHORIZED DOCUMENT ESTIMATE AND LATEST PB-3. Changes in the current GDM estimate from that of the authorizing document (H.D. No. 126) and the latest approved PB-3 dated October 1986 are shown in Table B9. The total estimated first cost of the GDM recommended plan is \$11,841,000 (excluding interest during construction). This represents a decrease of \$6,859,000 compared with the latest PB-3 estimate. The decrease is due primarily to the deletion of the jetty extensions and the

associated fixed sand passing

plant. The following paragraphs compare the changes by feature of the GDM estimate with the latest PB-3 estimate. Since the latest PB-3 estimate is generally reflective of the authorizing document plan with cost updating, the PB-3 estimate will be representative of the updated authorizing document plan.

B17. CHANNELS. The cost increase of \$3,787,300 is due primarily to the dredging of 552,000 c.y. for the channel construction and deposition basin for advanced maintenance in lieu of the 137,000 c.y. for channel construction only reflected in the PB-3 estimate. It is to be noted that existing channel depths for the GDM estimate are substantially deeper than the channel depths on which the PB-3 estimate was based; this held down the cost increase.

B18. JETTIES. The cost decrease of \$7,631,300 is due primarily to deletion of the jetty extensions. Navigation improvement as per GDM is to be afforded by stabilizing the navigation channel with advanced maintenance in lieu of creating a sheltered area between extended jetties.

B19. PERMANENT OPERATING EQUIPMENT. The decrease of \$2,510,000 is due to the deletion of the fixed sand bypassing plant which was associated with the deleted jetty extensions. Sand bypassing as per GDM is to be accomplished by hydraulic dredge.

B20. ENGINEERING AND DESIGN. The decrease of \$258,000 is primarily due to a decrease in the scope of work for the project improvement.

B21. SUPERVISION AND ADMINISTRATION. The decrease of \$107,000 is due primarily to a decrease in the scope of work for the project improvement.

III - ANNUAL CHARGES

B22. GENERAL. The estimates of annual charges (for comparison purposes) for all alternatives are based on a useful project life of 50 years and an interest rate of 8 5/8%. The annual charges include interest and amortization, periodic maintenance of the channel offshore of the Inlet entrance and the fish facility dock area and maintenance of the jetties and revetment. Table B7 however, summarizes the estimated annual charges for the recommended plan at 8 7/8% interest rate.

B23. PERIODIC DREDGING OF DEPOSITION BASIN. Periodic dredging of the deposition basin is required for advanced

maintenance of the channel. This dredging is recommended to be accomplished by a 27" hydraulic dredge. Based on the shoaling rate developed in Appendix C for the recommended plan of an 800 ft. wide basin to an elevation of (-) 20 m, the basin requires 456,000 c.y. of dredging every 1.5 years to prevent channel infringement. Of the 456,000 c.y., 92,000 c.y. (the prorated annual amount of 61,000 c.y.) is to be placed just to the west of the Inlet on the beach front to counter the significant erosion rate at this location and thus stabilize this beach section to preclude a breach (refer to paragraph C34 of Appendix C). The remaining 364,000 c.y. of dredged material is to be pumped a mile to the west and discharged just offshore to allow this material to continue in the littoral system. A nodal point exists along the shoreline a mile to the west of the Inlet so that placement of dredged material closer than a mile could allow for some of this material to return to the deposition basin area.

B24. Based on our experience with other Inlets on the South Shore of Long Island, it is recognized that dredged channels through bars tend to shoal rapidly. It is for this reason that the recommended plan provides for a deposition basin enveloping the channel that is large enough to handle the rapid shoaling without channel infringement. Maintenance of a channel, limited to the project channel dimensions only without a deposition basin, is not only more costly, but is impractical due to the frequency with which maintenance dredging would have to take place, i.e., to ensure project dimensions would require maintenance dredging on the average of once every 2 months at an estimated cost of \$1.2 million per operation or \$7.2 million per year. This compares unfavorably with the estimated maintenance cost of \$2.285 million associated with the recommended plan and therefore a channel only plan was not developed.

B25. PERIODIC DREDGING OF THE FISHING FACILITY DOCK AREAS. Currently shoaled areas in the dock area of the fishing facility are anticipated to require maintenance for better navigability at the fishing facility on the bay side just west of the Inlet. The estimated maintenance dredging is 1,000 c.y. to be accomplished every 2 years by clamshell dredge and disposed on an adjacent beach in the vicinity of the Inlet utilizing dragline rehandling.

B26. STONE STRUCTURE MAINTENANCE. Annual maintenance cost for stone structure maintenance is based on 2% of the estimated first cost of the east and west jetties and 1 % of the first cost of the new 1,000 ft. long revetment. Customarily, annual maintenance of a Corps designed stone structure is estimated to be 0.5% of its first cost where no

records are available to establish required maintenance costs. Since the existing jetties do not comply with Corps design criteria, but can sustain acceptable damage levels, the maintenance of the jetties has been increased to the 2% indicated to allow for higher damage levels than anticipated with Corps design criteria. The new revetment has been designed utilizing Corps criteria with the possible condition of structure submergence with design project hurricane occurrence. Therefore a 1 % of first cost is used for an annual maintenance cost.

B27. ANNUAL CHARGES. Total annual charges, as summarized in Table B7, for the recommended plan, using an interest rate of 8 7/8% with a 50 year project life is \$3,480,500.

IV - APPORTIONMENT OF COSTS BETWEEN INTERESTS

B28. GENERAL. The apportionment of the first costs of the considered improvements between Federal and non-Federal interests are based on the present policy governing navigation improvements. The basis for apportioning the costs involved is described in the following paragraph. Details are given in Table B8.

B29. APPORTIONMENT. Federal policy provides for apportioning the first cost of navigation improvements on a Federal and non-Federal basis for recreational benefits and a Federal apportionment for commercial benefits. The navigation improvement will accrue, both recreational and commercial benefits (as developed in the Benefits Appendix) which results in a first cost apportionment of 71% Federal and 29% non-Federal. Maintenance cost for commercial only apportionment is 100% Federal. This results in the total cost apportionment for maintenance of 71% Federal and 29% non-Federal.

V - DEVELOPMENT OF ALTERNATIVE CONSTRUCTION METHODS

B30. GENERAL. Alternative methods initially considered for constructing and maintaining the channel with its deposition basin include use of the following: hopper dredge with pump out capacity, clamshell and dipper dredges, fixed sand bypassing plant, and the jet pump sand bypassing system also known as the "Eductor System".

B31. OTHER DREDGING PLANTS CONSIDERED. A hopper dredge with pump out capacity would be suitable for the dredging construction required, however, plant availability is better for a 27" hydraulic dredge, the selected plant.

SUPPORTING DOCUMENTATION

APPENDIX

TITLE

A	PERTINENT CORRESPONDENCE (Contained in Main Report)
A1	COMMENT RESPONSE SECTION (Contained in Main Report)
B	COST ESTIMATE
C	ENGINEERING AND PROJECT DESIGN CONSIDERATIONS
D	STONE STRUCTURAL REHABILITATION AND REPAIR
E	BENEFIT EVALUATION
F	FISH AND WILDLIFE RESOURCE INVENTORY

B32. Clamshell or dipper dredge would operate on a spudded floating plant to anchor against the rough ocean environment during its operation and deposit material, taken from the basin, onto a tug drawn split hull type scow for delivery to the disposal area - offshore to the beach one mile west of the Inlet in 10 to 12 foot deep water. the operation of this dredge in the ocean environment is considered impractical and highly inefficient. This dredge can only operate in seas with waves less than about one foot high; since this wave height is exceeded much of the time, the dredge would require a significant amount of down time. In addition, the production rate of such a dredge would be less than 2,000 c.y. per day compared to approximately 13,000 c.y. per day for the hopper and hydraulic dredges. Costs were not developed for this alternative.

B33. The Fixed Sand Bypassing Plant consists of a permanently mounted dredge on the east (updrift) jetty which would pump up material from the required area and pump it across the Inlet onto the beach on the downdrift side of the Inlet. This plant has a limited range from where material can be pumped. Because the deposition basin extends to 1800 feet oceanward of the end of the east jetty, the plant cannot be utilized since much of the basin lies outside of the dredge's range.

B34. The Jet Pump Sand Bypassing System consists of a water pump permanently mounted on land that supplies water under pressure through a submerged pipe to jet pumps which are buried under the area to be excavated; the jet pumps then suck in the sand to be removed with the incoming water under pressure to form a slurry which is pumped through another submerged pipeline to booster pumps back on land and then pumped to disposal site on the beach. The disadvantage of this system is that the distance between the jet pump and booster pump should be no more than approximately 600 ft., the maximum jet pumping distance. This system cannot be used at this location since the jet pump to booster pump distance reaches a maximum of some 2,600 ft.

TABLE B1
ALTERNATIVE CHANNEL/BASIN SIZES (a)(b)
TOTAL ANNUAL COSTS

CHANNEL DESIGN DEPTH (MLW) / BASIN DREDGE DEPTH (MLW)	<u>ALTERNATIVE BASIN WIDTH (FT)</u>		
	<u>500</u>	<u>700</u>	<u>800</u>
10/18	\$3,916,700	\$3,761,900	\$3,709,400
10/20	\$3,572,300	\$3,470,000	\$3,439,400
10/22	\$3,572,700	\$3,512,000	\$3,535,500
12/18	\$4,418,500	\$4,130,600	\$4,055,400
12/20	\$3,873,800	\$3,719,400	\$3,679,300
12/22	\$3,787,900	\$3,704,300	\$3,696,700

^a Developed for an interest rate of 8 5/8% for a 50 year project life.

^b Excludes non-Federal dredging.

TABLE B2

DEPOSITION BASIN - INITIAL CONSTRUCTION VOLUMES
AND MAINTENANCE DREDGING REQUIREMENTS OF
CHANNEL ALTERNATIVES

CHANNEL DESIGN DEPTH (MLW)/ BASIN DREDGING DEPTH (MLW)	INITIAL CONSTRUCTION/ MAINTENANCE DREDGING (a)	<u>ALTERNATIVE BASIN WIDTH(FT)</u>		
		500	700	800
10/18	INITIAL CONSTRUCTION	295,300 C.Y.	379,100 C.Y.	418,500 C.Y.
	MAINTENANCE REQUIREMENTS	213,000 C.Y. every 0.7 years	293,000 C.Y. every 1.0 years	332,000 C.Y. every 1.2 years
10/20	INITIAL CONSTRUCTION	382,000 C.Y.	496,000 C.Y.	552,000 C.Y.
	MAINTENANCE REQUIREMENTS	294,000 C.Y. every 1.0 years	402,000 C.Y. every 1.3 years	456,000 C.Y. every 1.5 years
10/22	INITIAL CONSTRUCTION	475,400 C.Y.	620,600 C.Y.	691,800 C.Y.
	MAINTENANCE REQUIREMENTS	387,000 C.Y. every 1.3 years	527,000 C.Y. every 1.7 years	597,000 C.Y. every 1.9 years
12/18	INITIAL CONSTRUCTION	295,300 C.Y.	379,100 C.Y.	418,500 C.Y.
	MAINTENANCE REQUIREMENTS	175,000 C.Y. every 0.6 years	240,000 C.Y. every 0.8 years	273,000 C.Y. every 0.9 years

(a) Dredging cycles shown are rounded to the nearest tenth of a year.

TABLE B2 - (CONTINUED)

DEPOSITION BASIN - INITIAL CONSTRUCTION VOLUMES
AND MAINTENANCE DREDGING REQUIREMENTS OF
CHANNEL ALTERNATIVES

CHANNEL DESIGN DEPTH (MLW)/ BASIN DREDGING DEPTH (MLW)	INITIAL CONSTRUCTION/ MAINTENANCE DREDGING ^(a)	<u>ALTERNATIVE BASIN WIDTH(FT)</u>		
		500	700	800
12/20	INITIAL CONSTRUCTION	382,000 C.Y.	496,000 C.Y.	552,000 C.Y.
	MAINTENANCE REQUIREMENTS	255,000 C.Y.	350,000 C.Y.	397,000 C.Y.
		every 0.8 years	every 1.1 years	every 1.3 years
12/22	INITIAL CONSTRUCTION	475,400 C.Y.	620,600 C.Y.	691,800 C.Y.
	MAINTENANCE REQUIREMENTS	347,000 C.Y.	475,000 C.Y.	539,000 C.Y.
		every 1.1 years	every 1.4 years	every 1.6 years

(a) Dredging cycles shown are rounded to the nearest tenth of a year.

TABLE B2A

Total First Cost and Total Annual Cost for the Jetty Extension
with Fixed Sand Bypassing Plant Alternative.

I. First Costs:

a) Jetty Rehabilitation & new revetment (1)	\$ 6,100,000
b) Initial Bypassing (2)	\$ 7,935,000
c) Stonework for Jetty Extension (3)	\$25,170,000
d) Fixed Bypassing Plant @ East Jetty (4)	\$ 6,918,000
e) Navigation Channel Dredging (to el-14 mlw) (5)	\$ 2,000,000
f) Interest During Construction (2 yrs.)	<u>\$ 4,630,000</u>
Total First Cost	\$52,753,000

II. Annual Costs:

a) Annualized First Cost (6)	\$ 4,624,000
b) Annual Channel Maintenance (7)	\$ 700,000
c) Annual Fixed Bypassing Maintenance and Pumping Costs	\$ 880,000
d) Stone Maintenance	\$ 340,000
e) Non-Federal Maintenance @ Dock Facility	<u>\$ 9,000</u>
Total Annual Cost	\$ 6,553,000
Rounded	\$ 6,600,000

- 1) From Table B3.
- 2) Based on bypassing 2 years of drift (600,000 c.y) for trapped material during construction of jetty extensions.
- 3) From Table B2C.
- 4) From Table B2B.
- 5) 150,000 c.y. of dredging required.
- 6) Based on n=50 years for 8 5/8% interest rate.
- 7) Based on Shoaling rate developed in authorizing document (20,000 c.y./yr.) for 2 years, or 40,000 c.y. (60,000 c.y. incl. overpumping).

TABLE B2B
Detailed Estimato of Fixed Bypassing Plant (Dollars)

<u>Description</u>	<u>Estimated Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Estimated Amount</u>
I. Steel Pier				
Mobil. & Demobil.	-	Job	L.S.	\$ 125,000
Falsework & Footbridge	-	Job	L.S.	\$ 60,000
Steelpiles - vertical	7,000	L.F.	\$37.50	\$ 262,500
Steelpiles - battered	4,000	L.F.	\$44	\$ 176,000
Structural Steel	800	Tons	\$2,500	\$2,000,000
Aluminum Floor Crating	15,000	S.F.	\$12	\$ 180,000
Railing & buffer	-	Job	L.S.	\$ 20,000
Miscellaneous Steel	60	Tons	\$2,800	\$ 168,000
Timber wales 10"x10"	4,000	L.F.	\$12	\$ 48,000
Timber fenders 10"x10"	1,500	L.F.	\$12	\$ 18,000
Concrete encasement	7,000	L.F.	\$15	\$ 105,000
			Subtotal	\$3,162,500

II. Pumps, Engines, Rail Car & Equipment

Dredge pumps	1	ea.	\$60,000	\$ 60,000
Booster pumps	1	ea.	\$40,000	\$ 40,000
Diesel engine	1	ea.	\$85,000	\$ 85,000
Jet pump	1	ea.	\$50,000	\$ 50,000
Derrick 25'boom (15'most)	1	ea.	\$ 7,000	\$ 7,000
Hoist - 6 ton capacity	1	ea.	\$17,000	\$ 17,000
14" dia. suction flexpipe w/nipples & flanges	50	L.F.	\$320	\$ 16,000
14" dia. Steel pipe	20	L.F.	\$30	\$ 600
14" dia. flanged steel angle	2	ea.	\$300	\$ 600
4" dia. suction hose w/ couplings	100	L.F.	\$20	\$ 2,000
Miscellaneous piping	-	Job	L.S.	\$ 6,000
Monorail hoist track	500	L.F.	\$17	\$ 8,500
2-ton monorail electric hoist w/motor driven trolley	1	ea.	\$15,000	\$ 15,000
Rail car	-	Job	L.S.	\$ 60,000
Track	5,000	L.F.	\$40	\$ 200,000
Car towing system	-	Job	L.S.	\$ 50,000
Cables, ropes, etc.	-	Job	L.S.	\$ 5,000
Galvanized sheet metal shell w/timber framing for car	-	Job	L.S.	\$ 17,000
			Subtotal	\$ 639,700

III. Discharge Pipe Line

14" dia. steel pipe	8,000	L.F.	\$70	\$ 560,000
14" dia. steel submerged pipe	1,000	L.F.	\$70	\$ 70,000
14" dia. armored flex. pipe	50	L.F.	\$320	\$ 16,000
Dresser couplings	500	ea.	\$210	\$ 105,000

TABLE B2B (Con't)
Detailed Estimated of Fixed Bypassing Plant (Dollars)

<u>Description</u>	<u>Estimated Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Estimated Amount</u>
III. Discharge Pipe Line (Con't)				
12" steel T sections	20	ea.	\$400	\$ 8,000
Miscellaneous hose & pipe connections	-	Job	L.S.	\$ <u>7,000</u>
			Subtotal	\$ 766,000
IV. Electrical Lines				
Power line	3,000	L.F.	\$10	\$ 30,000
Monorail hoist conductors	1,000	L.F.	\$25	\$ 25,000
Communication devices & lines	-	Job	L.S.	\$ 45,000
Rail insulators	-	Job	L.S.	\$ 10,000
Cable power supply	-	Job	L.S.	\$ 50,000
Pier lighting	-	Job	L.S.	\$ <u>40,000</u>
			Subtotal	\$ 200,000
V. Fuel Storage Tanks				
15,000 gallon tank and accessories	-	Job	L.S.	\$ 15,000
5,000 gallon tank and accessories	-	Job	L.S.	\$ 6,000
Fuel lines	-	Job	L.S.	\$ <u>15,000</u>
			Subtotal	\$ 36,000

Subtotal I, II, IV, & V	\$4,804,200
Contingencies (20%)	\$ 960,000
	\$5,765,000
Eng., Des., Supp. & Administration (20%)	\$1,153,000
Total Fixed Bypassing Plant	\$6,918,000

TABLE B2C
Detailed Estimated Stone Work For Jetty Extension Plan

<u>Description</u>	<u>Estimated Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Estimated Amount</u>
Capstone (10-12 ton)	219,000	tons	\$52	\$11,388,000
Corestone	120,000	tons	\$40	\$ 4,800,000
Bedding Stone	50,000	tons	\$37	\$ 1,850,000
Mob. & Demob.	-	Job	L.S	\$ 200,000
			Subtotal	\$18,238,000
			Contingency (20%)	\$ 3,648,000
				<u>\$21,886,000</u>
			Eng., Des., Sup., & Administration	
			(15%)	<u>\$ 3,284,000</u>
			Total	\$25,170,000

TABLE B3

SUMMARY OF INVESTMENT COSTS - RECOMMENDED PLAN

<u>ITEM</u>	<u>DESCRIPTION</u>	<u>ESTIMATED QUANTITY</u>	<u>UNIT PRICE</u>	<u>ESTIMATED AMOUNT</u>
1.	Dredging-Channel/ Deposition Basin to El -20 mlw	552,000 c.y.	(a) \$7.41/c.y.	\$4,089,400
2.	<u>Repair of East Jetty</u>			
a.	420 ft. armor stone	7,300 tons	\$57/ton	\$416,100
b.	420 ft. corestone	4,000 tons	\$45/ton	180,000
c.	remove and replace 730 ft. armor stone	12,600 tons	\$30/ton	378,000
d.	remove & replace 730 ft. core stone	7,200 tons	\$30/ton	216,000
e.	new armor stone	1,000 tons	\$57/ton	57,000
f.	new core stone	500 tons	\$45/ton	22,500
g.	<u>Replace N.E. Revetment</u>			
	260 ft. armor stone	2,340 tons	\$45/ton	105,300
	260 ft. core stone	1,300 tons	\$45/ton	58,500
	filter cloth	1,600 s.y.	3.5/s.y.	5,600
h.	regrading beach at east jetty	12,000 c.y.	\$7/c.y.	84,000
i.	<u>Sand Fill</u>			
	large north breach	19,000 c.y.		
	small pond area	4,000 c.y.		
		23,200 c.y.	\$5/c.y.	116,000
j.	Scour Blanket	16,000 tons	\$57/ton	912,000
3.	<u>Repair of West Jetty</u>			
a.	remove and replace capstone & corestone	4,500 tons	\$35/ton	\$157,500
b.	additional capstone	1,700 tons	\$62/ton	105,400
c.	additional corestone	900 tons	\$50/ton	45,000
d.	scour blanket	10,000 tons	\$57/ton	570,000
4.	Mobilization and demobilization			
				85,000
			subtotal	\$3,513,900
5.	<u>Construction of Bay Revetment</u>			
a.	1000 ft.- revetment stone	9,900 tons	\$40/ton	\$396,000
b.	filter cloth	11,700 sq. yds.	\$3.5/s.y.	41,000
c.	sand fill in bay	56,000 c.y.	\$8/c.y.	448,000
			subtotal	\$885,000

TABLE B3 - (CONTINUED)

SUMMARY OF INVESTMENT COSTS - RECOMMENDED PLAN

<u>ITEM</u>	<u>DESCRIPTION</u>	<u>ESTIMATED AMOUNT</u>
6.	Subtotal-Rehab & Revetment	\$4,398,900
7.	Subtotal - Dredging & Stone Work	\$8,488,300
8.	Contingencies (20%)	<u>\$1,697,700</u>
9.	Subtotal	\$10,186,000
10.	Engineering and Design	\$820,000
11.	Supervision and Administration	\$790,000
12.	Interest during Construction	<u>\$344,600</u>
13.	Total	\$12,140,600
14.	Non-Federal Dredging at Fishing Facility	
	a. 3700 c.y. at \$9.00/c.y.	\$33,300
	b. Contingency 20%	6,700
	c. Engineering, Design, Supervision & Admin.	<u>5,000</u>
	Total Non-Federal Dredging	\$45,000
15.	Total Project First Cost	\$12,185,600 *

(a) Excludes contingency, includes \$500,000 for mobilization and demobilization and a \$6.50/c.y. unit price for production.

* The above table does not include the estimated value for lands, easements, and rights-of-way for non-Federal publically owned land, since there will be no actual cash outlay for these lands by the local sponsor.

TABLE B4
ALTERNATIVE CHANNEL/BASIN SIZES
TOTAL FIRST COSTS (EXCLUDING NON-FEDERAL DREDGING)

<u>CHANNEL DESIGN DEPTH (MLW)/ BASIN DREDGE DEPTH (MLW)/ DEPOSITION BASIN WIDTH (FT)</u>	<u>INITIAL CONSTRUCTION DREDGING COST (a)</u>	<u>INITIAL CONSTRUCTION COST- JETTY REHAB. & REVETMENT</u>	<u>E&D + S&A</u>	<u>TOTAL FIRST COST</u>
10/18/500 & 12/18/500	295,300 c.y. @ \$11.03/c.y.= \$3,257,200	\$5,623,300	\$1,585,000	\$10,465,500
10/18/700 & 12/18/700	379,100 c.y. @ \$10.58/c.y.= \$4,010,900	\$5,623,300	\$1,595,000	\$11,229,200
10/18/800 & 12/18/800	418,500 c.y. @ \$10.43/c.y.= \$4,365,000	\$5,623,300	\$1,605,000	\$11,593,300
10/20/500 & 12/20/500	382,000 c.y. @ \$ 9.37/c.y.= \$3,579,400	\$5,623,300	\$1,595,000	\$10,797,700
10/20/700 & 12/20/700	496,000 c.y. @ \$ 9.01/c.y.= \$4,469,000	\$5,623,300	\$1,605,000	\$11,697,300
10/20/800 & 12/20/800	552,000 c.y. @ \$ 8.89/c.y.= \$4,907,300	\$5,623,300	\$1,610,000	\$12,140,600
10/22/500 & 12/22/500	475,400 c.y. @ \$ 9.06/c.y.= \$4,307,100	\$5,623,300	\$1,605,000	\$11,535,400
10/22/700 & 12/22/700	620,600 c.y. @ \$ 8.77/c.y.= \$5,442,700	\$5,623,300	\$1,625,000	\$12,691,000
10/22/800 & 12/22/800	691,800 c.y. @ \$ 8.67/c.y.= \$5,998,000	\$5,623,300	\$1,635,000	\$13,256,300

(a) Includes mobilization & demobilization

TABLE B5

ALTERNATIVE CHANNEL/BASIN SIZES
ANNUALIZED DREDGING MAINTENANCE COSTS (EXCLUDING NON-FEDERAL DREDGING)

CHANNEL DESIGN DEPTH (MLW)/ BASIN DREDGE DEPTH (MLW)/ DEPOSITION BASIN WIDTH (FT)	DREDGING MAINTENANCE COST PER OPERATION (a)	ANNUALIZING FACTOR @ 8 5/8% INT. PRESENT WORTH X CAPITAL RECOVERY (e)	ANNUALIZED DREDGING MAINTENANCE COST (b)
10/18/500	213,000 c.y. @ \$10.18/c.y.=\$2,168,300 (c)	(15.15) (0.08765)	\$2,909,200
10/18/700	293,000 c.y. @ \$ 9.45/c.y.=\$2,768,800 (c)	(10.95) (0.08765)	\$2,687,400
10/18/800	332,000 c.y. @ \$ 9.22/c.y.=\$3,061,000 (c)	(9.59) (0.08765)	\$2,603,000
10/20/500	294,000 c.y. @ \$ 8.44/c.y.=\$2,481,400 (d)	(11.52) (0.08765)	\$2,535,600
10/20/700	402,000 c.y. @ \$ 7.92/c.y.=\$3,183,800 (d)	(8.33) (0.08765)	\$2,354,500
10/20/800	456,000 c.y. @ \$ 7.75/c.y.=\$3,534,000 (d)	(7.28) (0.08765)	\$2,285,000
10/22/500	387,000 c.y. @ \$ 7.97/c.y.=\$3,084,400 (d)	(9.03) (0.08765)	\$2,471,300
10/22/700	527,000 c.y. @ \$ 7.58/c.y.=\$3,994,700 (d)	(6.51) (0.08765)	\$2,309,400
10/22/800	597,000 c.y. @ \$ 7.45/c.y.=\$4,447,600 (d)	(5.78) (0.08765)	\$2,283,300
12/18/500	175,000 c.y. @ \$11.01/c.y.=\$1,926,700 (c)	(20.02) (0.08765)	\$3,410,900
12/18/700	240,000 c.y. @ \$ 9.88/c.y.=\$2,371,200 (c)	(14.56) (0.08765)	\$3,056,100
12/18/800	273,000 c.y. @ \$ 9.59/c.y.=\$2,618,100 (c)	(12.72) (0.08765)	\$2,949,000
12/20/500	255,000 c.y. @ \$ 8.74/c.y.=\$2,228,700 (d)	(14.37) (0.08765)	\$2,837,100
12/20/700	350,000 c.y. @ \$ 8.13/c.y.=\$2,845,500 (d)	(10.32) (0.08765)	\$2,603,900
12/20/800	397,000 c.y. @ \$ 7.94/c.y.=\$3,152,200 (d)	(9.03) (0.08765)	\$2,524,900
12/22/500	347,000 c.y. @ \$ 8.14/c.y.=\$2,824,600 (d)	(10.73) (0.08765)	\$2,686,500
12/22/700	475,000 c.y. @ \$ 7.70/c.y.=\$3,657,500 (d)	(7.71) (0.08765)	\$2,501,700
12/22/800	539,000 c.y. @ \$ 7.56/c.y.=\$4,074,900 (d)	(6.76) (0.08765)	\$2,444,500

(a) Includes \$500,000 mobilization & demobilization \$70,000 E&D + S&A.

(b) Includes \$30,000 annualized cost of monitoring program (\$100,000/yr. for first 6 years of project).

(c) Based on a \$7.50/c.y. unit price.

(d) Based on a \$6.50/c.y. unit price.

(e) Based on Table B2.

TABLE B6

DETAILED ESTIMATE - INITIAL CONSTRUCTION
OF RECOMMENDED PLAN FOR DREDGING

<u>ITEM</u>	<u>QUANTITY</u>
1. Estimated quantities to be removed	
a. Total pay yardage	552,000 c.y.
b. Pay yardage removed	552,000 c.y.
c. Non-pay yardage	110,000 c.y.
d. Total yardage removed	662,000 c.y.
2. Output of dredge - c.y./day	13,000
3. Effective working days/month	18
4. Output of dredge - c.y./month	234,000
5. Job duration - months	2.83
6. Total monthly operating cost of dredge - \$	910,000
7. Total cost of job - \$	2,575,300
8. Material and construction costs - \$	57,000
9. Field engineering and supervision - \$	80,400
10. Distributed costs(taxes, ins, soc sec, etc.)	171,700
11. Contractor's overhead, 12% - \$	346,100
12. Bond cost - \$ (1%)	32,300
13. Profit, 10% - \$	<u>326,300</u>
14. Total contract cost	3,589,100
15. Estimated cost (\$)/c.y. (14/lb)	6.50
16. Revised total contract cost (15 x 1a) -	\$3,588,000
17. Mobilization and demobilization - \$	<u>500,000</u>
18. Total direct cost - \$	4,088,000
19. Contingency, 20% - \$	<u>817,600</u>
20. Subtotal - \$	4,905,600
21. Engineering & Design - \$	383,000
22. Supervision & Administration - \$	<u>392,000</u>
23. Total - \$	5,680,600

TABLE B7

TOTAL ANNUAL COST - RECOMMENDED PLAN

<u>ITEM</u>	<u>DESCRIPTION</u>	<u>ANNUAL COST FOR</u> <u>INTEREST RATE OF 8 7/8%</u>
1.	Annualized First Cost of \$12,185,600 (a)	\$1,097,100 (c)
2.	Deposition Basin Maintenance per operation - 456,000 c.y. @ \$7.75/c.y. (b) = \$3,534,000.	\$2,284,400 (d)
3.	Jetty Maintenance	\$90,000
4.	Non-Federal Dredging Maintenance at Fishing Dock Facility (e)	<u>\$9,000</u>
5.	Total Annual Cost	\$3,480,500

(a) From Table B3

(b) Based on a production unit cost of \$6.50/c.y (refer to Table B6), \$500,000 for mobilization and demobilization and \$70,000 for engineering, design, supervision and administration.

(c) Utilizing a CRF of 0.09003.

(d) Utilizing a PWF of 7.085 (dredging cycle from Table B2) a CRF of 0.09003 and \$30,000 for annualized monitoring costs.

(e) Based on dredging 1,000 c.y. every 2 years with a clamshell dredge.

TABLE B8

APPORTIONMENT OF COSTS

RECOMMENDED PLAN

October 1986

Price Level

First Cost

Federal

\$ 9,203,000

Non-Federal

2,638,000

Total

11,841,000

Annual Maintenance, Operations and
Replacement

Federal

\$ 1,691,000

Non-Federal

692,000

2,383,000

TABLE B9

UNIFORM FEATURE BREAKDOWN OF ESTIMATE OF FIRST COST

<u>Account Number</u>	<u>House Document No. 126</u>	<u>Latest PB-3 (October 1986)</u>	<u>General Design Memorandum</u>	<u>Difference Between H.D. and GDM</u>	<u>Difference Between PB-3 and GDM</u>
09 Channels	\$378,500	\$1,160,000	\$4,947,300	+\$4,568,800	+\$3,787,300
10 Jetties	\$4,202,900	\$12,910,000	\$5,278,700	+\$1,075,800	-\$7,631,300
20 Permanent Operating Equipment	\$650,600	\$2,510,000	-	-\$650,600	-\$2,510,000
30 Engineering and Design	\$48,500	\$1,080,000	\$822,000	+\$773,500	-\$258,000
31 Supervision and Administration	\$317,500	\$900,000	\$793,000	+\$475,500	-\$107,000
Total Cost (COE and Non-Federal Contribution)	\$5,598,000	\$18,560,000	\$11,841,000	+\$6,243,000	-\$6,719,000
Total COE Cost	\$3,529,000	\$11,500,000	\$9,203,000	+\$5,674,000	-\$2,297,000
Total Non-Federal Cost	\$2,069,000	\$7,060,000	\$2,638,000	+\$ 569,000	-\$4,422,000
<u>Summary of Estimated Costs</u>					
<u>Federal Cost</u>					
Corps of Engineers	\$3,529,000	\$11,500,000	\$9,203,000	+\$5,674,000	-\$2,297,000
Coast Guard	\$40,000	\$140,000	0	-\$40,000	-\$140,000
<u>Non-Federal Costs</u>					
	\$2,069,000	\$7,060,000	\$2,638,000	+\$ 569,000	-\$4,422,000
<u>Total Federal and Non-Federal Cost</u>					
	\$5,638,000	\$18,700,000	\$11,841,000	+\$6,203,000	-\$6,859,000

TABLE B10: CONSTRUCTION AND EXPENDITURE SCHEDULE (DOLLARS) - OCT. 1986 PRICE LEVELS													
RECOMMENDED PLAN	Prior Years	1986	1987	1988	1989	1990	TOTALS						
		FY 1986	FY 1987	FY 1988	FY 1989	FY 1990							
Preparation of Final GDM		570,000	155,000										
Preparation of Plans & Specifications			33,000	42,000									
Review & Approval of Plans & Specifications													
Advertise, Open & Evaluate Bids													
Engineering During Construction													
Supervision, Inspection & Administration		176,000	12,000	12,000	375,000	218,000	823,000						
Construction of Deposition Basin/Channel Dredging at Fishing Facility													
Stone Construction - Rehabilitation of East and West Jetty & Revetment													
TOTAL EXPENDITURES		746,000	200,000	54,000	830,300	2,532,700	11,841,000						
TOTAL FEDERAL		746,000	200,000	54,000	6,282,700	1,920,300	3,203,000						
TOTAL NON-FEDERAL		0	0	0	2,020,600	617,400	2,638,000						

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APPENDIX C

ENGINEERING AND PROJECT DESIGN CONSIDERATIONS

APPENDIX C
ENGINEERING AND PROJECT DESIGN CONSIDERATIONS
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ENGINEERING AND PROJECT DESIGN CONSIDERATIONS

INTRODUCTION

Part I of this appendix presents a description of the characteristics of Shinnecock Inlet and Bay, and the adjacent shoreline along the barrier beach. Part II discusses the engineering and design of the alternative plans considered and a description of the selected plan. Part III describes the monitoring program.

PART I - ENGINEERING CONSIDERATIONS DESCRIPTION OF PROJECT AREA & VICINITY

C1. Shinnecock Inlet is one of the 6 openings through the narrow barrier island on the south shore of Long Island (see plate 1 of the main text) which separates the Atlantic ocean from the interior bays. It is located in the Township of Southampton, Long Island, New York, 95 miles by water east of the Battery, New York City, and 37 miles by water west of Montauk Point. Four other inlets along the barrier beach are Moriches, Fire Island, Jones and East Rockaway Inlets located 15, 45, 60, and 70 miles, by water respectively, west of Shinnecock Inlet. The sixth inlet, known as Rockaway Inlet, is located at the western tip of the barrier island and connects the Atlantic Ocean with Jamaica Bay. Seawater of varying salinity prevails in the inlets and bays, and therefore, these waters are not normally affected by ice conditions. No harbor lines have been established in the inlets and the bays.

C2. Shinnecock Bay, is about 9 miles long and has widths ranging from 0.4 to 2.8 miles. The total water surface area of Shinnecock Bay is 16 square miles. The bay drains about 20 square miles of land. Fresh water enters the bays from the drainage area mainly through groundwater seepage and river flow. The bay areas near mouths of tributary streams are more brackish than other parts of the bays where mixing with incoming ocean water through the inlets takes place more readily. The bay extends from the village of Southampton on the east to the village of Quogue on the west, where it connects with Moriches Bay through the Quantuck and Quogue Canals. The canals are about 200 feet wide and have a surface area including Quantuck Bay of 2 square miles. Quantuck Bay and the canals drain a land area of about 10 miles. Depths average about 6 feet, with maximum depths of 10 feet in Shinnecock Bay. Some locations in the Intercoastal Waterway have depths greater than 20 feet. Numerous tributaries indent the northern side of Shinnecock Bay, the largest of which are Tiana Bay and Weesuk Creek, located in the western portion. In the eastern portion, Shinnecock Canal which was constructed by local interests, cuts through a narrow neck of the mainland to Great Peconic Bay.

C3. Problem Identification

The development of the problems associated with the existing channel has been previously discussed in the Main Report. The problems and need for solution are reiterated here to indicate the objective of the design for the proposed dredging for the navigation channel at Shinnecock Inlet. The objective of the design is to stabilize the inlet system which includes the east and west jetties, the bay shoreline, a deposition basin as well as the navigation channel.

The presence of an offshore bar system at the oceanward entrance to the inlet (some locations of shoaling are at -8 feet MLW) forces all channel users to take a circuitous course, which runs in a southwestern direction from the inlet jetties, subjects vessels to broaching ocean waves. The shoal is migrating to the southwest across the inlet infringing on the deep channel causing an unstable condition of the channel including apparent width fluctuations. Continued shoaling across the bar has increased the occurrence of breaking waves, limiting access to the inlet.

Jetty rehabilitation and the need for a bayshore revetment are required for stability of the inlet system and are discussed further in following paragraphs.

Continued shoaling of the inlet without periodic maintenance will eliminate access to the inlet in the future due to the growth and movement of the offshore bar. Without repair and rehabilitation the jetties will continue to deteriorate and are expected to fail in 10 years. The proposed plan of improvement will address all aspects of the inlet system.

TIDES AND CURRENTS

C4. General. Astronomical tides along the study area are semidiurnal, flooding and ebbing twice a day. At the inlet entrance, the mean ocean tide range is 2.9 feet and the average spring tide range is 3.5 feet (Reference 1). These tides are primarily the result of the gravitational forces of the moon and sun, the centrifugal forces due to the movement of the earth in its orbit, the Coriolis forces due to the earth rotating about its axis, and frictional forces due to the movement of the water with respect to its boundaries. The theoretical astronomical tides are predictable; however, the effects of offshore/onshore winds and atmospheric pressure changes in depressing the theoretical high and low tide levels or causing tide set-up and/or tide cycle lag are not predictable. Mean Low Water is 1.27 feet below the National Geodetic Vertical Datum of 1929 (NGVD).

C5. Wind tides or set-up are local phenomena and occur most dramatically in shallow water. Wind set-up has a significant effect on seasonal and long-term shoreline erosion. During strong onshore winds, wind tides 2 to 3 feet are not uncommon. Extremely high wind velocities coupled with very low barometric pressures, tropical depressions or hurricane conditions, have caused tides as high as 8.3 feet above mean low water in Shinnecock Bay (9/12/60).

C6. Historical Bay and Ocean Tidal Changes. Tide observations at a number of locations in Shinnecock Bay and in the inlet have been made for varying periods since 1938 by the Suffolk County Department of Highways and by the Corps of Engineers. In January 1938, five gages were placed in the bays and operated until 17 September 1938, just prior to the hurricane of 21 September. In 1940, six tide gages were installed for periods up to 12 months, in 1949 twelve gages for a period of about 4 months, and in 1951 five gages for about 2 months. Gages were also installed in the bays in 1956 by the Corps of Engineers in connection with pending hurricane studies of this area and in 1967-68 to obtain baseline data for the inlet model study. These observations afford a record of the tidal characteristics and indicate the changed characteristics during the varying conditions of the inlets. Table C-1 excerpted from reference 2 gives a summary of these records; however, tidal data obtained in 1967-68 is continuous over only one tidal cycle and is not contained in the table.

C7. A gage operated by Suffolk County, New York Department of Public Works located in one of the public boat basins just west of Shinnecock Inlet has been in operation since 1951. Examination of records kept for a tide gage at the Shinnecock Inlet boat basin shows that a general rise in the tide range on the bay side of the inlet between 1953, when the jetties were constructed, and the early 1960's. This rise is indicative of increased bay tide range as the inlet stabilized. Beyond 1962, the bay tide range levels off, indicating the stable condition of the inlet. Average bay tide range is approximately 2.6 feet. Figure C-1 represents a history of the bay tide ranges recorded at the Shinnecock Inlet boat basin. The graph is a plot of mean quarterly tidal ranges.

C8. Currents. The tidal currents in Shinnecock Inlet have been measured by current meters and floats on a number of occasions before and after construction of the jetties at the Inlet. During recent years, there has generally been little change in the average maximum velocities in the inlet which range from about 3.9 feet per second to 4.2 feet per second through the tidal cycle. Float observations have shown maximum velocities as high as 8 feet per second. A more complete treatment of earlier tidal current investigations and flow determinations can be found in the documents listed

below. The findings of these investigations which are germane to the bay's circulation are discussed in paragraphs C9 to C11.

- (a) Survey Report, Moriches and Shinnecock Inlets 1958, (Reference 3).
- (b) Circulation Calculations in Shinnecock Inlet and Vicinity (Reference 4).

CIRCULATION IN THE BAY

C9. Circulation. The circulation of water in Shinnecock Bay is caused primarily by tidal currents. The ocean tide has a mean range of 2.9 feet at Shinnecock Inlet. In the inlet, the tidal wave has the character of a progressive wave, in which slack water occurs near half tide when the level inside and outside the bay is the same. Maximum flood and ebb currents occur at about the time of high and low waters in the ocean, when the difference in levels inside and outside the bay is greatest (Reference 5). Because of the relatively small size of the inlet and the shallowness of the bay, the tidal wave is dampened and delayed in its passage. The range of tide in the bay is consequently reduced (see figure C1), and high water occurs progressively later at points more remote from the inlet. The duration as well as the volume of the ebb tide through the inlet is greater than the flood tide, due to net inflow to the bays from adjacent bays. The bay circulation described in the following paragraphs generally describes the conditions which existed from 1958 to present, and from 1938 to about 1951.

C10. The tidal currents due to the flow of water into and out of the bay are strong in the restricted passages of the inlet where maximum velocities of over 6.8 feet per second occur. Within the bay velocities are lower. In general, the movement in the bay has an east-west direction paralleling the shores.

C11. Were Moriches and Shinnecock Bays and the adjoining Great South Bay of the same size, shape and subject to identical ocean tides, the tidal movement from each would meet in the connecting passages and little exchange between the bays would result. However, the bays are very different in size and shape and some exchange through the connecting passages occurs. At the Quantuck and Quogue Canals at the western end of Shinnecock Bay, the tidal currents results from differences in tide levels in Moriches and Shinnecock Bays at the different periods in the tidal cycle. There is a lag of 2 to 3 hours in the time of slack water as compared with that at the inlets. The greater tidal range and the earlier time of high water in Shinnecock Bay causes a westward flow during the flood tide. The ebb flow, normally

of greater volume than the flood flow, is toward the inlet. The canal which connects Moriches Bay and Shinnecock Bay is small and the quantity of water that is usually conveyed is consequently small when compared to the tidal prisms of either bay. This is shown by a series of observations made during 26 July to 4 August 1950 by the Woods Hole Oceanographic Institution.

WINDS

C12. A study of recorded and possible wind velocities, duration, and direction is necessary to determine their effect on the characteristics of waves likely to be experienced in the study area. Wind generated waves are the primary natural forces shaping the ocean shoreline in the study area. The design height of most shore structures is dictated to a great degree by the height and force of such waves likely to be experienced.

C13. Records of the United States Coast Guard and Suffolk County Highway Department for the South Shore of Long Island for the period of 1940-1959 were used in compiling the wind diagram shown on Figure C2. The diagram indicates the velocity in four velocity groups - the directions from which the winds blew, and the duration in days. The diagram indicates that the direction of the predominant onshore winds is southwest. Table C2 gives the percent of time and direction from which winds blow as indicated by those records.

C14. Winds from the eastern and southern quadrants, although not frequent, have an appreciable influence on the direction of littoral drift on the south shore of Long Island, since they blow over practically unlimited fetches of the open ocean.

C15. Diagrams showing prevailing winds as compiled from records of the U.S. Navy Hydrographic Office for the 5-degree squares nearest the shore of Long Island are shown on Plate 2. These diagrams indicate that winds from the westerly quadrants prevail, which is in agreement with the observations shown above. The monthly cumulative average winds over the North Atlantic, compiled from the records of the Hydrographic Office, United States Navy (reference 6) show the predominant direction of surface winds offshore to be from the northwest from October through April and from the southwest from May through September.

WAVES

C16. The wind waves that occur in the study area consist of "sea" and "swell". Local seas are waves generated by local winds and are observed as traveling with the wind. Swells

are waves generated from distant storms, as far away as 1,000 miles, that enter the study area independent of the local wind conditions.

C17. Existing Wave Climatology. There are about 27 months of local near shore wave data available from a pressure wave gage installed in about 30 feet of water at Southampton, New York, by U.S. Army Coastal Engineering Research Center (CERC). Although this data appears to be of remarkable quality, it does not provide information on wave direction, accordingly it cannot be used for this report.

C18. Visual surf observations were made from the Short Beach Lifeboat Station at the western end of Jones Beach for the period of October 1954 to December 1957 under a cooperative surf observation program between the U.S. Coast Guard and the Beach Erosion Board. The results, are published in Technical Memorandum No. 108 (reference 7), show that 98 percent of the waves were from the southern quadrant and the remaining 2 percent were from the east. The waves from the southeast and southwest predominated, with 41 percent and 40 percent of all the waves coming from these directions, respectively. During the period of observation, only 5 percent of the waves had a height of 4 feet or greater. Additionally, onshore visual wave observations of nearshore wave climatology are available from the CERC Beach Evaluation Program (reference 2), however, resolution of the observation into height and direction statistics is not yet published.

C19. There are 4 sets of deep water wave statistics available for the south shore of Long Island. These are the hindcast statistics published by Neuman and James (reference 8), the hindcast statistics published by T. Saville, Jr. (reference 9), and the Summary of Synoptic Meteorological Observations (SSMO, reference 6) which are in part water compilations of deep water wave observations for the entire offshore zone along the south shore of Long Island, and the U.S. Army Waterways Experiment Station, Wave Information Study, Shallow Water.

C20. The wave data statistics chosen for this study was taken from "Wave Information Study for the South Shore of Long Island - Phase III - Station 46" (see Tables C4) which is part of the Wave Information Studies of U.S. Coastlines (Reference 10). The wave data developed in this study consists of percent occurrence of significant wave heights and period ranges typical for each 30 degree of wave angle approach at a depth of 10m. gathered for 20 years of hindcast.

C21. Table C3 reveals that the predominant 30 degree sector of wave occurrence is for the wave angle sector between 60 and 89.9 degree. This sector corresponds to a compass direction of 159 to 189 degree from true north, with the

midpoint of the sector at 175 degree azimuth (S5 degree E). C22. The wave and swell conditions can also be described in terms of their affect on navigability and safe inlet usage. The existing conditions of wave and swell activity at Shinnecock Inlet have been provided by a consensus of the U.S. Coast Guard and local commercial inlet users. The variety of these conditions can be described as calm, normal and adverse in terms of navigability. In the recent past, the shoaling fronting the inlet has increased heights of breaking waves, limiting the access to the inlet for some vessels especially at times of low tide, during normal wave activity.

Continued shoaling without project improvements will increase breaker activity further limiting inlet navigation. A full description and the economic impact of these various conditions can be found in the Economic Appendix.

LITTORAL PROCESSES

C23. Littoral Materials. Evidence indicated that the material comprising the barrier beaches is derived from the erosion of the shore and headlands to the east, possibly supplemented by material seasonally moved shoreward by onshore waves and currents along the ocean bottom. Results of mechanical sieve analysis show that the largest grain size of beach material is at Montauk Point, where the median diameter, based on samples taken at various times from 1936 to 1956, was found to vary from about 1 to 4 millimeters. The median diameter decreases sharply, to about 0.4 millimeter, in the vicinity of Hither Hills State Park near East Hampton, and does not vary appreciably from that size as far westward as Fire Island Inlet, except in the areas somewhat to the west of Shinnecock and Moriches Inlets, where the median diameters of the 1955-56 samples increased abruptly to 1.2 to 0.8 millimeters, respectively, and probably show the effects of the heavy erosion that had taken place in these areas. Such abrupt increases are not indicated by the samples taken in prior years. In general, the materials in the offshore zone were found to be finer than the materials along the shore. The data show that, progressing westward, the sand loses its heavy granitic, feldspar and iron mineral content and becomes a purer quartz. Information on textural characteristics of the channel will be obtained during the proposed monitoring program. The results will be presented in the yearly monitoring reports (see para. C87).

C24. Littoral Drift. All available evidence indicates that along the south shore of Long Island the net littoral transport is from east to west. This is indicated by the observed westward migration of the inlets. Fire Island Inlet and Rockaway Inlet prior to stabilization, were reported by Beach Erosion Board (TM 128, reference 11) to have migrated

westward at annual rates of 201 and 222 feet, respectively. These rates as reported are based on a 100 year period of record. The littoral transport rate estimated from these inlet migrations is about 450,000 cubic yards per year to the west.

C25. The impounded materials on the beach side of the east jetty and the associated degradation of shoreline on the beach side of the west jetty at Shinnecock Inlet is further evidence that the littoral transport has a marked westward predominance.

C26. The net littoral transport rate adopted in the authorized survey report for Shinnecock Inlet is 300,000 cy/yr to the west. A sediment budget study conducted for the south shore of Long Island (Reference 12) was utilized to confirm this transport rate. Within the boundaries of the control volume used to analyze the amount of littoral movement in the area (see Paragraph C37-Sediment Budget) it is estimated that the gross (eastward and westward) transport volume is about 400,000 cy/yr. This is the volume of material which is expected to be available for entrapment in a sedimentation basin. This volume was used in the sedimentation analysis as stated in Paragraph C79.

INLET HISTORY, HYDROGRAPHY, SHORELINE AND VOLUMETRIC CHANGES, AND STABILITY CONSIDERATIONS

C27. History. Charts of Long Island dating since Colonial days indicate the existence from time to time of natural openings through the barrier beach into Shinnecock Bay. Although no continuous information is available, a map dated about 1770 shows an inlet into Shinnecock bay. A survey made by David H. Burr in 1829 records one inlet at the eastern end of Shinnecock Bay. However, another survey made by Burr 10 years later indicates that this inlet had closed. Openings into Shinnecock Bay appear on maps made during the period 1850 to 1890. No inlets are shown from 1890 to 1938, the year the existing inlet broke through.

C28. The present Shinnecock Inlet was formed as a result of wave action and extremely high water caused by the hurricane of 21 September 1938. In 1939 local interests constructed a bulkhead 1,470 feet long on the west side of the inlet consisting of two rows of closely driven timber piling with the intervening space filled with riprap and sand and cement-filled bags in galvanized wire cages. Twenty short spur jetties were built normal to the bulkhead. A revetment of the fill material was placed in front of the structure to prevent its being undermined. The structure acted as a brake to the tendency of the inlet to move westward. Subsequent storms caused damage to the works, and in 1947 local

interests repaired the stone revetment and added a 130 foot stone groin on its northerly end. In 1952-53 local interests constructed stone jetties on both sides of the inlet and in 1954 they extended the west jetty. In 1982, Suffolk County Department of Public Works reconstructed the pile crib revetment at the north end of the west jetty and part of the west jetty in the inlet. The pile crib revetment was replaced by a rubble mound jetty. Local interests constructed a bay channel 10 feet deep and 200 feet wide from a point inside the inlet to the Intracoastal Waterway in 1958, and widened it to 300 feet in 1963 and subsequently performed maintenance operations in 1973 and 1978. In 1966 local interests dredged through a shoal area northwest of the inlet and again in 1969 between the inlet and the Intracoastal Waterways.

C29. The storm of 6-8 March 1962 produced unusually high wind driven tides and high waves which continued to batter the south shore of Long Island for three successive days. A widespread pattern of waves travelling out of the storm eventually affected virtually the entire east coast of the United States. Because the storm was of such magnitude and covered a large area and because of the scarcity of observations over the ocean, it is difficult to plot a well-defined path or show the location at any particular time. Along the southern shoreline of Long Island between Fire Island Inlet and Montauk there was damage to beaches, dunes, groins, seawalls, paving and buildings as a result of high waves and flooding. At Shinnecock Inlet the 1962 storm caused bank erosion and jetty damage (stone displacement) on the east jetty. The south end of the east jetty suffered damage, and a jetty light was destroyed. The rehabilitation of the jetties will strengthen them, making them more resilient to storm damage.

C30. Hydrography. The physical changes at the inlet described in the preceding sections have resulted in changes in the hydrography of the inlet. It should be noted that the hydrography of the inlet is undergoing continual change and, particularly during storms, considerable changes may take place during very short periods.

C31. Based on Hydrographic information made available by the U.S.C. & G.S. over the period of years from 1930 through 1955 together with other survey information, an interpretation of historical hydrographic changes was made and is summarized below. Prior to the breakthrough of Shinnecock Inlet in 1939, the barrier beach between the bay and the ocean was continuous and a paved road crossed the present site of the inlet. A shoal area in the bay 1 to 2 feet deep and about 3,000 feet wide extended parallel to the beach except for a narrow channel which connected deep water in the bay with an indentation in the barrier beach, indicating the probable previous existence of a temporary inlet at this point. As

might be expected, the break through during the storm of 21 September 1938 occurred at this location. In 1939, the inlet was 700 feet wide. During that year works were constructed on the west side of the inlet which prevented its migration. In 1941 the inlet had widened to the east to about 1,000 feet, an inner and outer bar had formed and a tortuous channel connected the ocean with the bay. Although this channel was as deep as 23 feet at one point, the controlling navigable depth was only about 4 feet.

C32. During 1953-54, local interests constructed jetties on both sides of the inlet. As a result, the inlet openings which was perpendicular to the ocean shoreline rotated to conform with the alignment of the jetties which were constructed in a north-south direction. Just prior to construction of the jetties, the inlet was about 500 feet wide and had depths ranging from 3 to 6 feet. Two channels connected the inlet with deep water in the bay. One channel, dredged at the request of the U.S. Navy in 1943 to a depth of 6 feet and a width of 100 feet and which connected the inlet to the Long Island Intracoastal Waterway near Fonquogue Bridge, had shoaled to a controlling depth of about 5 feet. The second channel, located at the east side of the inner bar, had natural depths of 3 1/2 to 9 feet. After completion of the jetties, the width of the inlet was fixed at 800 feet, the distance between the jetties.

C32.1. Channel Scour History. Three inlet hydrographic surveys were evaluated for the channel scour history - 1955-56, June 1984, and June 1985. The 1955-6 survey can be considered representative of the inlet immediately after construction. Comparative cross sections were plotted at eight locations as shown in Figures C3-2 to C3-9. The inlet channel cross sectional areas at each location as well as information on the inlet throat characteristics are provided in Tables C4 and C5. The inlet has experienced significant scour since the jetty construction in 1952. Cross sectional areas have increased over 300% to achieve its current stable configuration. The minor variation in area between 1984-1985 indicates the inlet is within its stable configuration.

C33. Volumetric Shoreline Changes Near Shinnecock Inlet. An analysis was conducted to determine the existing conditions and historical trends of the shorelines both east and west of Shinnecock Inlet. Data used in this analysis consisted of beach profiles along a total of 12 ranges covering a distance of approximately 3,000 feet east of the inlet and 35,000 ft to the west of the inlet. The 3,000 feet eastern limit was chosen as the limit of beaches influenced by the east jetty. Surveys of these range lines were conducted in 1955, 1962, 1974 and 1984. However, all of the ranges were not surveyed in each of these years, thereby precluding analysis of the different reaches for all survey periods. Aerial photographs between 1953 and the present were used to supplement this

survey data, providing visual records of the shoreline movements throughout the history of the inlet. The quantity of sand was estimated for each record of survey using the average-end area method for computing volumes. Records of dredge and fill projects were also examined to determine the volume of material added to or removed from the project area in the periods of interest.

C34. Shoreline Changes Adjacent To Shinnecock Inlet. The information presented in this section consists of the following: an accretion/erosion shoreline analysis for the shorelines immediately east and west of the inlet, an accretion/erosion analysis along the bay shoreline and a review of the reported shoreline changes west of Shinnecock Inlet to Moriches Inlet.

a. Ocean Shoreline East of Shinnecock Inlet. A determination of the erosion/accretion changes on the ocean side of the barrier beach adjacent to east jetty was made for the periods following construction of the inlet in 1957. The beach to the east of the inlet has shown accretion in all periods examined. The results presented showed that the shoreline advanced oceanward while volumetrically gaining material. This accretion can be attributed to the trapping effect of the east jetty. Based on the growth of the offshore bar it is estimated that the east jetty has reached its trapping capacity and sand is now naturally passing around the tip of the jetty. It is concluded from the results of this analysis and from observation of aerial photographs and maps, that the ocean shoreline east of Shinnecock Inlet has accreted to its fullest and is expected to remain at a relatively stable configuration in the future.

Some erosion would occur along the beach face as a result of extraordinary high tides or northeast storms, but it is expected that this shoreline condition would quickly recover with the onset of favorable spring and summer season conditions. In the study area the littoral climate occurring during spring and summer season is usually responsible for the prograding or accretion of additional beach face area.

b. Ocean Shoreline Immediately West of Shinnecock Inlet As previously stated for the east shoreline, an erosion/accretion study of the shoreline was also accomplished for the shoreline immediately west of Shinnecock Inlet. The base survey (1955) was used for this analysis, and a recent survey (June 1984) was used to provide comparative coverage along with aerial photographs to supplement these surveys. The results of the comparative analysis indicates that the down-drift shoreline immediately west of the inlet exhibits a markedly different behavior than the shoreline east of the inlet. The shoreline west of the inlet is characterized by alternate patterns of erosion and

accretion. The net effect however, has been a long-term trend of erosion along approximately 6,000 feet of beach immediately adjacent the west jetty (see Table C-6). The beach area with the greatest erosion rate occurs within 3000 ft west of the Inlet. In the next 3000 ft westward a smaller amount of erosion occurs along with an adjacent accretion which balances the erosion. The erosion amounts to an average of approximately 10 cubic yards per year per foot of beach, or a total annual loss of approximately 61,000 cubic yards for the first 3000 foot section, and coincidentally for the entire 6000 ft section west of the inlet.

The western most range in this reach approximately 5000 ft. from the inlet, has exhibited accretion in the latest periods of examination indicating that this is the point at which natural by-passing is reaching the shore. (See Figure C5 and Paragraph C34e). This is evident in recent photography which shows a build-up of the beach at this location.

c. Ocean Shoreline Further West of Shinnecock Inlet.

An examination of the beaches further west of the inlet was also conducted. These beaches also exhibit a long-term trend of erosion, however, to much lesser degree. This erosion is observed for a distance of approximately 30,000 ft. further to the west, after which accretion has occurred in the eastern most compartments of the groin field along West Hampton Beach. The long term erosion in this reach has been calculated to be 2.3 cubic yards per year per foot of shoreline, or a total annual loss of approximately 69,000 cubic yards per year.

Shoreline recession rates were also calculated for these reaches, with an average recession of approximately 11.5 ft/year in the 6,000 ft. immediately west of the inlet and an average recession of approximately 3.3 ft/yr in the total distance of approximately 35,000 ft (7 miles). This corresponds to a yearly loss of 2.7 acres of beach-front property. These calculations are shown in Table C-6. It is expected that these shoreline loss rates would be representative of future without project conditions.

The existing condition long term erosion rates discussed above are considerably less than the long term erosion rate given in the Survey Report of 1957 (Reference 3, Table A2). The average annual highwater recession was given as 10.8 feet/year for 72,700 feet of shoreline between Shinnecock and Moriches Inlets (excluding approximately 5000 feet of shoreline adjacent to each inlet). The decrease in the erosion rates west of Shinnecock Inlet in the recent past is confirmed by the comparison of shoreline compartments unit volume changes for various time periods (1940-1955 and 1955-1979) given in the Sediment Budget Study of 1983 (Reference 12).

d. Bay Shoreline Erosion. The only bay shoreline which is subject to erosion is the shore adjacent to the east jetty. Based on an examination of aerial photographs and existing slopes it is estimated that approximately 6,000 cubic yards are lost from this shore each year. This sediment enters the inlet hydraulic system and may be deposited on the ebb delta/bar complex or continue as part of the longshore transport.

e. Ocean Shoreline Change Map. Mean High Water lines were extracted from aerial photos and compiled as a shoreline change map. (See Figures C4 and C5) Though these shoreline movements do not fully indicate volume changes occurring, the visual evidence of shoreline motion supports volume analysis results as described in Paragraphs C33 and C34a-c.

The reach 3000 ft. east of the jetty shows significant movement of the shoreline oceanward in the period immediately following construction. Examination of MHW lines for the last twenty years shows some oscillation about a stable configuration caused by occasional MHW erosion and subsequent recovery.

Shoreline changes west of the jetty support the erosion/accretion study results. Alternate patterns of erosion and accretion are observed, with a net tendency towards erosion in the 3000 ft. immediately west of the jetty. Proceeding further west, the oscillation of shoreline in the next 3000 ft. is shown to be less extreme. This again supports erosion/accretion study results. Long term erosion rates west of the inlet are tabulated in Table C6.

C35. Development of Offshore Bar and Ebb Tide Delta: Examination of the off-shore area in the vicinity of the inlet indicates that two distinct phenomena are taking place. These are the development of the ebb tide delta caused by deposition of sediments transported by ebb tidal currents, and the growth of an off-shore bar caused by sediments naturally by-passing the east jetty. Although the separate contributions of each of these processes is difficult to estimate, the combined effect is a general rise in the ocean bottom fronting the inlet. (See Figure C6) This rise was calculated by comparing bathymetric surveys for the year 1955, 1984 and 1985. This comparison indicates that approximately 100,000 cubic yards are deposited onto this complex each year, with an average rise in the ocean bottom of 0.5 ft/yr. in the vicinity of the existing thalweg and across the offshore bar.

C36. Development of Flood Tide Delta: Examination of aerial photographs has shown rapid development of the flood tide delta after construction of the jetties in 1952-53. This development slowed as the inlet stabilized. Current

estimates are that 20,000 cubic yards are lost annually to this delta. (See Figure C6)

C37. Sediment Budget: To provide better understanding of the ongoing processes and long-term trends at the inlet and adjacent shorelines and to estimate the magnitude of sediment available to shoal within a deepened entrance channel, a sediment budget for the inlet was developed. To create this budget, all possible sediment sources and sinks were investigated. These included deposition of drift on the offshore bar, deposition in the bay on the flood-tide delta, overwash losses to the bay, losses to the off-shore zone, transport from bay and inlet erosion, and the erosion of adjacent beaches. The effects of each of these budget components is incorporated in the following discussion.

A sediment budget control volume was established using the limits established by the survey range lines influenced by the inlet and jetties, and the area of any improved entrance channel. As shown in Figure C7 this volume extends approximately 3000 ft. to the east of the inlet and 6000 ft. to the west of the inlet. The -30 ft. MLW contour is used as the offshore boundary. The extent of the flood tide delta in the bay can be considered the northern boundary of the volume. Long-shore transport rates for this control volume were obtained from the sediment budget conducted for the south shore of Long Island (1983) (Reference 12). This report states that 300,000 cubic yards per year are entering the control volume from the eastern boundary, with approximately 247,000 cubic yards leaving the control volume from the western boundary. It is to be noted that these transport volumes are representatives of net sediment movement only. Gross transport volumes, which represent total sediment movement within the control volume, are estimated to be 400,000 cy/yr. This gross rate includes the drift from west to east into the deposition basin which can be estimated from this sediment budget as 100,000 cy/yr. The gross transport rate is used in the sedimentation analysis. It is noted that the control volume boundaries were established to estimate transport quantities which are available for entrapment into a deepened entrance channel.

Using these transport volumes and the data discussed above, a sediment budget for the inlet was formulated. This budget, shown in figure C7, shows that a total of 367,000 cubic yards enters the control volume each year from beach erosion sources and longshore transport, with 247,000 cubic yards leaving the volume due to net longshore transport across the western boundary. This leaves approximately 127,000 cubic yards distributed within the control volume of this total, it is estimated that 20,000 cubic yards per year are deposited on the bay shoal and 100,000 on the offshore bar and ebb tidal delta complex. The 100,000 cubic yards deposited annually offshore of the inlet will be available

for rehandling in a dredged sedimentation basin and for placement on the downdrift beaches.

It is noted that this sediment budget must be considered preliminary, as the lateral growth of the offshore bar and accretion rate of the ebb tide delta (0.5 ft/yr) was estimated from a comparison of three surveys. (See Figure C6) Examination of future monitoring surveys will give a better indication of the rates of deposition and shoal movement on this offshore complex during the next phase of studies.

STABILITY CONSIDERATIONS

C38. The stability of the inlet was estimated using the inlet analytical hydraulic model for the existing inlet configuration and subsequently for impacts of the proposed dredging on the inlet hydraulics based on the principles developed by Keulegan (reference 13). The model relates the maximum flow velocity in an inlet to the minimum cross-sectional area of the channel. Application of the model to Shinnecock Inlet is contingent upon the assumptions listed below. The results obtained are considered meaningful insofar as identifying possible inlet trends and not as a basis for design.

- a. the cross-sectional area is uniform over the length of the inlet,
- b. ocean tide can be represented by a sinusoidal function
- c. the bay water level rises and falls uniformly,
- d. there is no substantial inflow to the bay other than through the inlet,
- e. the bay area is constant over all bay tide ranges.

C39. A stability curve was developed which is representative of conditions at the inlet. The peak of the curve, known as the critical cross-sectional area, is interpreted to be the point of incipient stability. For inlets with minimum cross-section areas less than the critical area the flow is governed by frictional forces. This results in an inlet unstable to changes in flow area or maximum velocity. When the flow area is reduced by shoaling or if the velocity is reduced by changed flow characteristics, the inlet responds by further reducing area or velocity until the inlet closes. On the other hand, an unstable inlet which starts to scour by a reduction of sediment supply or an increase in velocity will continue to scour until the critical flow area is achieved. For inlets with cross-section areas greater than the critical area, the flow through the inlet is governed by

the continuity requirement resulting in an inlet stable to changes in flow area or velocity. In this condition, any change in cross-sectional area will cause the inlet to respond by compensating in such a way as to force its return toward the equilibrium position.

C40. A stability analysis, using surveys conducted in 1956 and 1984 shows that the inlet was unstable and in a scour mode in 1956. However, the 1984 survey shows that the inlet is now in a stable mode, with cross-sectional area greater than the critical area. Figure C8 shows the basis of this stability analysis in the form of a generalized hydraulic stability curve. Figure C9 shows the stability curves developed for Shinnecock Inlet for the 1956 and 1984 conditions. (See Computation C1 for details)

Once the stability of the inlet in its existing configuration was established, it was necessary to determine the effects of the proposed channel dredging on the inlet hydraulics. This was accomplished through the use of the "Inlet 2" Numerical model (Reference 14). This model, through solution of differential momentum and continuity equations, predicts inlet velocities and discharges, and bay tide levels, for a known tidal forcing function. Friction losses are determined by establishment of a flow net for the inlet, with a weighting function distributing flow at each cross-section so that friction is minimized. Using tide data obtained from gages at the inlet and throughout the bay, bay tide stages were successfully replicated indicating calibration of the model to existing conditions.

Examination of the bathymetry (see plate 4 of the main report) within the inlet reveals that there will be no dredging between the jetties to provide the -10 ft. MLW channel, as the existing bottom is much deeper. The most landward channel dredging for this project will be for construction of the deposition basin through the offshore bar. Although at initial construction the dredging will extend landward to the head section of the east jetty, the dredge cut will be outside the inlet throat cross sections that control the hydraulic flow characteristics and similarly outside the hydraulic flow net used for the hydraulic modeling. For this reason, there would be no impact on inlet and bay hydraulics caused by dredging through the bar.

C41. Recent Maintenance Dredging at Shinnecock Inlet. In April through May 1984, the Corps dredge "Currituck" was brought to Shinnecock Inlet for an emergency dredging operation. At that time approximately 160,000 c.y. of material was removed from various locations near the inlet from dredge depths to -14 ft MLW and disposed to the west of the inlet in the littoral system at depths of -10 MLW. The dredging operation was for emergency purposes only and

was not performed to specific channel dimensions. The dredge completed its operations by providing short term relief for the commercial channel users.

PART II - PROJECT DESIGN

INTRODUCTION

C42. The purpose of this section is to provide the engineering considerations and the design of the recommended plan. Two major features of the plan are the jetty rehabilitation and navigation channel with a deposition basin. Paragraphs C45 to C62 pertain to the jetty rehabilitation design, while paragraphs C63 to C89 are devoted to the navigation channel and deposition basin.

Basis of Design

C43. The design of coastal protective works constructed by Federal and non-Federal interests before development of the existing design criteria provided in general a level of protection commensurate within the given economic guidelines and rational engineering practices.

C44. Both the Corps design criteria and the as built design level of protection have been considered for the basis of the design of the proposed project improvements.

C45. Design Criteria. The design for the rehabilitation of the rubble-mound jetties and the repair of the revetments is in accordance with the provisions of the following memorandums and manuals:

- a. EM 1110-2-2904, dated 30 April 1963, Design of Breakwaters and Jetties (Reference 15).
- b. EM 1110-2-1607, dated 2 August 1965, Tidal Hydraulics (Reference 16).
- c. Shore Protection Manual, Volumes 1, and 2, dated 1984, fourth edition, CERC (Reference 17).
- d. ETL 1110-2-305, dated 16 November 1984, Determining Sheltered Water Wave Characteristics (Reference 18).
- e. EM 1110-2-1614, dated 30 April 1985, Design of Coastal Revetments, Seawalls and Bulkheads. (Reference 19).
- f. ER 1110-2-1457, dated 24 June 1985, Hydraulic Design of Small Boat Navigation Projects (Reference 20).
- g. EM 1110-2-1615, Hydraulic Design of Small Boat Harbors (Reference 21).

C46. Description of Proposed Structural Work. The proposed structural work includes the following major items: rehabilitation of the west and east jetties head sections including scour blankets, repair of isolated sections of the east jetty, replacement of north east revetment and construction of bay revetment behind the east jetty. The engineering considerations requisite to design and a brief description of the repair(s) work are summarily presented in the Project Design Section of this appendix and discussed in detail in the structural appendix with a summary of work given in Table B3 of the Cost Appendix, which is based on Plate No.3.

C47. Pertinent Data on Existing Structures.

(a) East jetty

- (1) Originally constructed to a length of about 1360 ft. in 1953 by the State of New York;
- (2) Crest width 12 feet;
- (3) Crest elevation +7.8 N.G.V.D. (+9 mlw);
- (4) Jetty Trunk - Side slopes one vertical on three-halves horizontal;
- (5) Original stone units in head portion 6 to 12 tons.
- (6) Stone revetment 700 ft long constructed in 1953 - 2 to 4 ton stone.

(b) West jetty

- (1) Originally constructed to a length of about 850 feet in 1953 by the State of New York;
- (2) West jetty extended to a total length of 950 feet in 1954;
- (3) Crest width 12 feet;
- (4) Crest elevation +7.8 N.G.V.D. (+9 mlw);
- (5) Jetty trunk - side slopes one vertical on three-halves horizontal;
- (6) Original stone units in head portion 6 to 12 tons;
- (7) Pile Crib revetment was constructed in 1939 at the north end of the west side of the inlet and replaced by armorstone revetment in 1982.

(c) Maximum breaking wave resisted by existing west jetty head section

(1) The existing jetty consists of one layers of cover stone placed on a stone core. A breaking wave that will require a 12 ton stone and slope of 1 on 1.5 is about a 11.8 ft. wave. Therefore, it is probable that the existing west jetty head section is capable of resisting up to a 11.8 ft. wave without significant damage. (See Computation C2 for details.)

(d) West and east jetty head sections - There has been a considerable loss of armor stones at the seaward end of both the east and west jetties. Comparison of hydrographic surveys of the inlet from 1955 through 1984 reveal that 50 ft. of the seaward end of the west jetty and 50 ft. of seaward end of the east jetty armor layer units have undergone severe displacement and between 150 ft. and 200 ft. of adjacent sections have undergone significant movement. The failure was probably caused by the undermining of the structure toe by the scouring action of the ebb currents since significant scour holes exist at both head sections. Another factor in the failure may have been the existence of only one layer of capstone at the head section and not the two layers recommended by Corps criteria. The stone for the head sections will not have to be any larger as waves higher than 12 ft. have occurred since construction of the jetties and the sections did not suffer significant loss of stability.

(e) Isolated east jetty sections in need of repair (see Appendix D for details)

(1) Along intermittent sections of the east jetty there has been partial washout of the jetty stones, crest settlement and loss of interlocking of the cap stones, for a total length along the jetty of approximately 700 ft.

(2) Two areas at the northern end of the jetty are completely deteriorated. Wave action in the inlet has eroded the sand on the beach side of the jetty at these washouts; continued loss of sand would further undermine the existing jetty.

(f) Bay Side Revetment - The original revetment north-east of the east jetty has completely washed away and the shoreline is receding. To control the erosion on the bay side of the inlet a blanket of stone will be placed along the bayside shoreline for a length of 1000 ft. to the east of the east jetty. The stone revetment is designed to stabilize

the bay shoreline affected by ebb-tidal current erosive forces and thereby reducing maintenance costs for the sand replenishment.

STRUCTURAL DESIGN

C48. General. The repairs required were determined based upon the findings of structural field surveys, and site inspections and are a feature of all the alternative plans considered.

C49. Rehabilitation of the West Jetty. The improvements will provide for stabilization of the ocean bottom fronting the jetty head section, and reconstruction of the seaward 200 feet of jetty head section .

C50. The ocean bottom fronting the structure will be stabilized by placement of a stone blanket within scour hole to an elevation of -30 ft. mlw. A design current velocity was used to select the bottom stone size.

C51. The maximum velocity of tidal current through inlets opening as stated in Chapter 7, Section IV. SPM, pg. 7-250 is a function of surface bay area, channel cross-sectional area, period of tide, and range of bay tide. A maximum current velocity of 10 ft./sec is estimated using equation 7-128, SPM, pg. 7-250. See computation sheet C3 for sample calculations.

C52. Selection of the armor stone size for the west jetty rehabilitation is a function of the design wave height, structure slope, unit stone weight, and stability coefficient. The existing head section armor stone sizes are considered stable for a breaking wave height of about 12 ft.

C53. The results of an existing condition design wave analysis (see computation sheet C4) indicates that the wave height is limited by the stillwater elevation above the offshore shoal fronting the inlet. The computations indicates that a 15.6 ft. breaking wave allows for maximum wave impact when the jetty is subjected to submersion by a storm surge. This surge of +12 MLW has an associated return period of about 70 years (see refer. 27). For the with project conditions (with deposition basin and channel improvement in place) the computations indicate that a 21 ft. breaking wave allows for maximum wave impact. However from review of the WIS wave climatology and a simplified refraction analysis the maximum expected breaking wave height is 16 ft. The estimated damage rate for the 12 ton armor units subjected to the expected 16 ft. breaking wave would be 25 percent (see calculation sheet-Appendix D).

C54. Proposed Revetment Along Bay Shoreline - To stabilize the bayside of the dune and prevent material losses estimated at up to 6,000 cu.yds. annually, a revetment was designed using Corps criteria.

C55. As previously discussed in paragraph C34d, the redistribution of the tidal currents resulted in shoreline recession and steepening of the adjacent bayshore contours. In order to evaluate the proposed revetment an analysis of the wave and current erosive forces was undertaken. The maximum probable current velocity estimated along the proposed revetment (see computation sheet C3) would be about 7 ft./sec although the measured average daily maximum velocities were reported (reference 22) to range from 2 to 4 ft./sec.

Although the shoreline in the vicinity of the proposed revetment is sheltered from the ocean waves it is not sheltered from waves generated within the bay and/or produced by passing boat traffic. Using the procedures published in the Shore Protection Manual (reference 17), and ETL 1110-2-305 (reference 18) for generation of shallow water waves, a maximum 3.3 ft. breaking wave was computed. (See Computation Sheet C5.)

C56. The revetment would extend from the existing channel bottom (el. -5 ft. mhw) to insure adequate toe stability, thence follow a 1 on 5 slope to elevation +7.7 NGVD. The top of this proposed revetment would tie into the top of the existing east jetty. (See Structural Appendix for further design details)

C57. Repair of East/West Jetty and Jetty Revetment - The jetties are in appreciably damaged condition in some sections; some rehabilitation has been applied to the structures since their construction in 1953/1954. For a detailed discussion on existing jetty condition see paragraph D4 of the structural Appendix D. Based on several field investigations, aerial photographs, and topographic study of the immediate vicinity of the jetty areas, the jetties have been effective in blocking sand movement through their interstices. Damage has been limited to isolated sections of the structures and does not warrant a complete redesign, however, the head section of both jetties will have two layers of armorstone. Although littoral materials appear to bypass around the seaward ends of the jetties along the ebb shoal fronting the inlet the jetties are structurally tight and continue to provide an effective barrier to sand movement through the interstices and into the existing channel. As part of the proposed monitoring program, quarterly site visits will be accomplished and include a visual inspection of both jetties and the results presented in annual reports. However, the structures do not meet Corps' criteria for layer thickness, stone weights, or crest height (reference 2). To

rehabilitate the structures to Corps' criteria would be very costly and in light of the structures past structural performance would not be justified. Therefore, it has been determined that repairing the structures to their "design dimensions" would be the basis for design.

C58. Repair of the east jetty would consist of the replacement of 420 ft. of the jetty where there has been complete washout of the stones. In other sections of the jetty which have experienced sloughing and settlement of stones (approximately 700 ft.) the original stones will be removed and reset to insure interlocking. The 250 ft. head section of the jetty will have to be totally repaired with some original stones and some new stones. A scour blanket will be placed at the head section for stability of the toe of the structure.

C59. Construction of the 1000 ft. bay revetment will consist of filter cloth and graded riprap.

C60. The oceanward 200 ft. section of the west jetty will be repaired similarly to the head section of the east jetty. New capstone and core stone will be needed to supplement the displaced stones of the existing jetty. A scour blanket will be placed at the head section of this jetty also.

CHANNEL DESIGN

C61. General. The purpose of this section is to present the engineering considerations necessary for design of the navigational elements of the plan considered. These elements are summarized in Tables 1 and 2 of the Cost Appendix and provide for a navigation channel, a sand deposition basin, and periodic maintenance dredging.

C62. Design Criteria. The design of the navigation channel, sand deposition basin and periodic maintenance dredging was based upon the provisions of the following memorandums and manuals:

- a. EM 1110-2-1615, Hydraulic Design of Small Boat Harbors (Reference 21).
- b. ER 110-2-1457, Hydraulic Design of Small Boat Navigation Projects (Reference 20).
- c. ETL 1110-2-293, Entrance Channel Infill Rates (Reference 24).
- d. Special Report No. 2, Small Craft Harbors: Design, Construction, and Operation, (Reference 25).

C63. Existing Navigation Conditions Fronting the Inlet. The waters fronting the inlet are characterized by crossing wave crest patterns. The complicated surface patterns are caused by refraction of ocean water waves at the inlet mouth with shallow water conditions over the inlet's shoals. Breaking waves due to these shallow water conditions and unpredictable inlet conditions resulting from the interaction of wave and tidal currents present additional navigation concerns.

C64. The inlet shoal typical of most sandy coast inlets is located just offshore of the inlet due south of the east jetty. As a result of increased shoaling, sections of the offshore outer bar are now at -8 ft. MLW. The presence of this shoal forces all channel users to take a southwestern course through the naturally deep area west of the shoal in the majority of sea conditions. The shoal is migrating to the west across the inlet infringing on the deep channel causing an unstable condition of the channel including apparent width fluctuations. Mariners navigating this channel take advantage of greater depths but expose their vessels to broaching ocean waves while steering to and from the inlet.

C65. Vessel Types and Sizes. Currently commercial fishing vessels, charterboats and private recreational boats use Shinnecock. A total of 48 commercial fishing vessels utilize the inlet with lengths varying from 40 to over 80 feet, beams varying from 12 to 23 ft, and drafts from 5 to 10.5 feet. For commercial fishing vessels the design dimensions of the 90th percentile vessel to be used in the channel design are as follows: 80 ft length, 22 ft beam and 10 foot draft. Approximately 700 recreational vessels use the inlet regularly. The design dimensions for the recreational vessels are as follows: 60 ft. length, 15 ft. beam, and 4 foot draft.

C66. Methodology of Channel Design - Design Requirements. With respect to channel dimensions, vessel safety and maneuverability are the paramount design criteria. As described above, navigation through the inlet entrance is a difficult and hazardous task that should only be undertaken by experienced sailors. The minimum width of channels necessary to provide for safe maneuvering lanes for the two-way traffic of small craft and fishing vessels in inlets has been developed in EM 1110-2-1615, Hydraulic Design of Small Boat Harbors (Reference 21). The width of a maneuvering lane varies with the relative maneuverability, of the design vessels. Both the commercial and recreational vessels can be considered to have very good maneuverability, therefore the minimum recommended maneuvering lane width was determined to be adequate for the design vessels. The dimensions of bank clearance and ship clearance lanes depend not only on the maneuverability of the design vessels, but also on the effects of the vessel motion on other vessels and adjacent

shorelines. Modifications to the design criteria were based on the maneuverability of the design vessel, on examination of site specific conditions such as wind, wave and current data, and communication, and recommendations of professional mariners in the area. A prudent application of engineering judgement resulted in the design of a safe and adequate navigation channel for the design vessels utilizing two-way traffic.

C67. Description of Parameters - Channel Width. Using the design vessels as described in Paragraph C65 the minimum allowable width two-way channel was designed to accommodate the fleet which uses Shinnecock Inlet. As described in Computation C6, the width of the navigation channel was calculated. For vessels with very good maneuverability, the dimensions as a percent of the vessel beam are as follows: maneuvering lane = 160%, ship clearance lane = 80% of larger vessels. The bank clearance percentage was increased to 150% of the vessel beam due to the existence to the rubble mound jetties and the adverse weather and hydraulic conditions at the inlet. An additional 70 ft. of channel width is necessary to provide sufficient allowances for the outriggers used at all times by the commercial fishing vessels while transiting the inlet channel. The required design channel width of 200 ft. has been presented to the Coast Guard and the channel users for concurrence. Channel widths larger than 200 feet are not required for the vessel fleet at Shinnecock Inlet. The authorized bay channel is 6 ft. deep MLW and 100 ft wide from Shinnecock Inlet to the Long Island Intracoastal Waterway and is adequate for the recreational vessels which are the primary users of the bay channel.

C68. Channel Depth. The channel depth was determined by economic analysis utilizing EC 1105-2-118 (NED Benefit Evaluation Procedures: Deep Draft Navigation Analysis and Design Underkeel Clearance Standards) and ER 1105-2-40 (Planning & Guidance for Navigation) which emphasizes the use of actual operating practices to determine most likely with and without project conditions over the project life, including the use of tides and light loading. The actual operating conditions were obtained from the users of the channel. Channel depths of -8, -10 and -12 feet MLW were considered. The -8 Ft. MLW channel is the same depth as the offshore sandbar which is not presently used by the vessels. The vessels have a choice to go over the -8 foot MLW sandbar or put their boat at a skewed angle to the waves and head for the natural channel. The vessels avoid the sandbar and choose to use the deeper natural channel even though it is on a skewed angle. The -10 ft. and -12 ft. MLW channel depths were evaluated in following paragraphs and Appendix B.

C69. Channel Alignment. An ocean entrance channel alignment parallel to the existing jetties and extending offshore on a compass direction of 176 degrees true north was investigated.

with a variety of considerations including safety, maneuverability, initial dredging, and maintenance requirements, in order to corroborate the previous study finding (ref.3). First, an investigation of the wave climate and bathymetry fronting the inlet was conducted to evaluate the location for the proposed channel and the predominant direction of wave approach. Based on this investigation and Table C4 from the Waterways Experiment Station W.I.S study (ref.10) it can be demonstrated that the predominant direction of wave approach is a 30 degree sector between compass azimuths 159 and 189 degrees. The recommended channel alignment which is on an azimuth of 176 degrees is well within this predominant wave group and runs straight through the inlet and parallel to the existing jetties and continuing oceanward over the sand bar fronting the inlet for a distance of approximately 2000 ft. This orientation would provide the only safe angle of approach out of the inlet, aligned perpendicular to the predominant direction of wave approach, thereby, reducing the incidence of broaching waves. Removal of the the offshore bar will reduce the height of breaking waves providing safer access into the inlet. The channel alignment was not varied since the straight channel is the only safe angle of approach and therefore the only channel alignment possible. Figure C10 shows the recommended channel alignment.

C70. Since unconstrained available bay area channel approaches would be available to mariners between the ocean entrance channel and the Intercoastal Waterway the minimum practicable bay channel is recommended. The dimensions of the inner channel, 6 feet deep mlw by 100 feet wide, are the minimum practicable and conform with the dimensions of the existing project for the Long Island Intracoastal Waterway with which they connect.

C71. The channel has been located in the deepest suitable areas in the inlet and bay to minimize the required initial dredging and future maintenance, while remaining consistent with safety of navigation under present hydrographic conditions.

C72. Deposition Basin. The channel design section can be viewed as consisting of two basic elements; the channel cross-sectional area required to carry vessel traffic, referred to as the project dimensions, and below it and to the sides a basin cross sectional area which is utilized for the storage, between maintenance operations, of littoral materials brought within the channel boundaries by tide and wave current action. This advance maintenance over depth zone will be referred to as the deposition basin.

C73. For the recommended channel alignment of 176 degree, the deposition basin design would provide for a dredged cut roughly trapezoidal in shape. For each combination basin bottom width and elevation of cut the basin bottom will slope upward (one vertical to five horizontal) to the existing bottom. The basin would encompass the channel through the offshore bar from the seaward end of the jetty extending oceanward about 2600 ft.

C74. Dredge Disposal Sites. All the alternative deposition basin plans require placement of the material obtained from dredging the project channels and deposition basin in a dedicated disposal area. The disposal area considered is as follows.

Ocean Shoreline West of Shinnecock Inlet. The excavated suitable material will be placed in various shoreline areas to a distance of approximately 5000 ft due west from the west jetty. For a distance of 3000 ft from the west jetty disposal sand will be placed on the existing beach face from elevation +10 MLW to approximately -10 ft. MLW. Downdrift of this section, 5000 ft from the west jetty and westward, disposal material will be placed in the littoral zone to -20 ft. MLW. These disposal areas have been located so as to place the dredged material that has been trapped at the inlet shoal back along its original path to the west, thus keeping it within the littoral regime, and available to nourish adjacent shores.

C75. Periodic Maintenance - Bay Channel. The authorized project also includes a bay channel, 6 feet deep (MLW) and 100 ft. wide, connecting the inlet with the Long Island Intracoastal Waterway in the vicinity of the Ponquogue Bridge. A hydrographic survey of the bay area shows depths from -15 to -20 feet MLW throughout the proposed channel area, allowing for the establishment of this channel, through the alignment authorized, with no initial construction dredging or periodic maintenance anticipated.

C76. Periodic Maintenance - Inlet Channel. The 1700 ft. section of entrance channel which is aligned between the existing jetties will not require the cutting of the existing natural channel bottom. Since the existing cross sectional areas naturally occurring between the jetties provide adequate depth and width for up to 450 ft. channel it is expected that no channel maintenance would be required for these channels. As previously discussed in para. C39, the inlet appears to be approaching an incipient stability point by naturally increasing its minimum cross sectional area; therefore, it is expected that any increase in area would probably maintain itself.

C77. Periodic Maintenance - Ocean Entrance Channel. The maintenance of the inlet entrance channel cross-sectional flow area is related to its hydraulic and sedimentation characteristics. Reliable estimates can be made where dredging records are available for inlets that are maintained and have similar sediment transport, textural and hydraulic characteristics.

C78. Of the six sandy coast inlets on the south shore of Long Island, only Moriches Inlet is similar in hydraulic and sedimentary characteristics. Since the ocean entrance is not maintained, there are no records available for estimating channel entrance shoaling rates.

C79. The method chosen to estimate the deposition changes that may occur and to estimate the probable maintenance requirements for the proposed channel dimensions in this study is the transport ratio method, also known as the Moriches Inlet Method (Reference 23 and 24). Application of this method requires an estimate of gross longshore littoral transport volume moving past the dredged channel each year, and the distribution of this sediment transport with depth. These quantities are required to determine the amount of sediment available to be trapped by basins dredged to various alternative depths. Based on the results of a sediment budget study and an examination of the wave climatology, a value of 400,000 cubic yards per year was determined for the gross transport at Shinnecock, available for entrapment into the channel cut.

The Shoaling Factor Method (see the Moriches Inlet GDM, Reference 23) was also used to evaluate the shoaling within the proposed deposition basin at Shinnecock Inlet. The results of these analyses predicted longer infill times than the Moriches Inlet (Transport Ratio) Method for more shallow dredge depths (-14, -17 ft. MLW). For the project design dredge depth of -20 ft MLW there was good agreement between the two methods, however the transport Ratio Method continued to provide more conservative estimates of maintenance dredging cycles which were utilized in the project design. The comparative surveys approach (Simplified Shoaling Rate) was not conducted due to the lack of sufficient survey data. Only three hydrographic surveys are available. The Lamble Method can not be utilized to study the Shinnecock Inlet deposition basin due to the flow characteristics at the basin which due to the longshore current are not normal to the channel. (More information on these modeling methods can be found in Reference 24).

C80. Application: To determine the optimum sedimentation basin design, a matrix of alternative basin dimensions was developed. The parameters that may be varied in the development of these alternatives include: basin width,

channel design depth and dredging depth. Basin lengths and existing natural depths are a function of channel alignment in that these values are determined by the dimensions of the off-shore bar where it is cut by the channel. For the recommended channel alignment, basins varying in width and depth were developed for analysis. Larger basins provide a greater trapping capacity at large initial cost, while the reverse is true for the smaller basins. Selection of the optimum is based on the results of an economic analysis. The matrix of basin alternatives was developed by varying the basin dimensions within these ranges.

Basin Widths:	Varying from 500 to 800 ft.
Channel Design Depth:	10 and 12 ft.
Basin Dredge Depth:	17 to 22 ft.

For all of the basin alternatives developed, a basin side slope value of 1 ft. vertical in 5 ft. horizontal was used. This slope was found to be stable in previous dredging projects at Long Island Inlets.

C81. Due to the large number of sedimentation basin alternatives, an analysis was conducted using a computer application of the transport ratio method. (See Computation Sheet C7 for sample calculations.) Use of this model requires that the dredged channel and basin cuts be represented as idealized trapezoidal sections. These sections were developed by examining the bathymetry in the area of the recommended alignment, and by spatially integrating, producing a representative cross-section through the off-shore bar. For the recommended channel, a section with a crest natural depth of -8.0 MLW and a crest length of 600 ft. was established. Slopes of 1 ft. vertical in 70 ft. horizontal were established for this section, as shown in Figure C10.

C82. Results: Results of this analysis as detailed in the Cost Appendix indicates that the most cost effective straight channel alternative will call for a channel design depth of -10 ft MLW and the maintenance of a basin approximately 800 ft. in width at -20 ft MLW. The results of the volumetric shoaling analysis are given in Table C7 for the various sedimentation basin alternatives. Dredging volumes are based on shoaling rates and are quantified in Table 4 of the Cost Appendix.

C83. Effects of Channel Design On Existing Inlet/Bay System. The tidal prism in Shinnecock Bay due to construction of the proposed navigation project should not change significantly. The tidal prism is dependent on the cross-sectional geometry of the inlet, specifically the minimum cross-sectional area and because no change in the historic minimum cross-sectional

area range of the inlet is expected to occur as a result of these plans, there should be no changes in the tidal prism. Accordingly, since normal tidal flooding is a function of the tidal prism, which is, in turn, a function of inlet throat cross-sectional area which is not expected to change, there should be no increase in normal tidal flooding of lowlying areas resulting from project implementation.

C84. The proposed work should not have any measurable impact on the tidal hydraulics of Moriches Bay. The hydraulics of Moriches Bay are predominantly related to the capacity of Moriches Inlet as the hydraulics of Shinnecock Bay are to the capacity of Shinnecock Inlet. However, the canals which connect Shinnecock Bay to the other bays are small and the quantity of water that may be conveyed is correspondingly small, when the conveyance of the canal is compared to the tidal prism of either bay. The proposed work should have no measurable effect on Shinnecock Bay. Therefore, there can be no effect on Moriches Bay.

C85. The proposed channel alignment and sedimentation basin will not impact the sediment budget in terms of net littoral movement to the west.

PART III - PROJECT MONITORING PROGRAM

C86. General. In order to estimate future channel maintenance requirements, and also document the results of the improvements, it is proposed to monitor the project for 6 years after construction. The monitoring survey will cover the inlet and ocean shores up to 10 miles east and west of the inlet. In addition to replicating past survey coverage, detailed coverage be obtained to monitor the proposed offshore disposal site and vicinity. The monitoring program is divided into four tasks as follows.

C87. Task I - Fill Placement. The beach fill will be monitored at selected intervals before and after initial fill placement and subsequent 1.5 year maintenance dredging fill placement along 15 profiles as scheduled in Table C8 and shown in Figure C11. The 15 profiles consist of 11 sites west of the inlet within the fill area (includes two control profiles, two and three miles west of the project limits). A higher density of profiles will be around the proposed nearshore fill area. Four profile sites will be east of the inlet. Specifically, the profile transect spacing is:

- Transect 1 - 4 1000 ft apart
- Transect 4 - 8 500 ft apart
- Transect 8 - 9 1000 ft apart
- Transect 10 & 11 are 2 and 3 miles west of inlet
- Transect 12 - 14 1000 ft apart
- Transect 15 is 1 mile east of inlet

Sediment samples will be collected during each profile survey, at three sample locations (Mean High Water - MHW, Mid-Tide level - MTL and Mean Low Water - MLW) per profile line. A total of 30 short cores will be collected (3 sampling locations on 10 selected profile lines) on the pre-fill placement sampling trip to characterize variability in native beach seasonal and storm related sediment distribution.

C88. A monitoring team will survey the 15 profiles once yearly, collecting both onshore and offshore data to identify the seaward depth of profile closure and to characterize the active envelope of fill response. Sediment redistribution across the entire profile will be monitored during this survey by collecting seven surface sediment grab samples (MHW, MTL, MLW, bar trough, offshore bar crest, offshore bar seaward slope, and at closure depth) with the assistance of a geologist. Profile lines 4 through 6 will monitor the nearshore fill placement area, with seven sediment samples collected during all profile sampling periods at MHW, MTL, MLW, bar trough, offshore bar crest, crest of fill placement mound, and at closure depth.

Beach Fill Area Sediment Sampling Scheme:

YEAR	TIMES/YR	NUMBER OF SAMPLES	TOTALS
Pre-	1	30 cores (3 cores x 10 profiles) + 75 surface (4 samples offshore at the 10 profiles and 7 samples x 5 profiles)	105
Post-	1	7 surface x 15 profiles	105
1	4	3 x 3 surface x 15 profiles + 4 surface offshore x 4 profiles + 1 x 7 surface x 15 profiles	256
2	4	3 x 3 surface x 15 profiles + 4 surface offshore x 4 profiles + 1 x 7 surface x 15 profiles	256
3	4	3 x 3 surface x 15 profiles + 4 surface offshore x 4 profiles + 1 x 7 surface x 15 profiles	256

Beach Fill Area Sediment Sampling Scheme (Cont.)

YEAR	TIMES/YR	NUMBER OF SAMPLES	TOTALS
4	4	3 x 3 surface x 15 profiles + 4 surface offshore x 4 profiles + 1 x 7 surface x 15 profiles	256
5	4	3 x 3 surface x 15 profiles + 4 surface offshore x 4 profiles + 1 x 7 surface x 15 profiles	256
6	4	3 x 3 surface x 15 profiles + 4 surface offshore x 4 profiles + 1 x 7 surface x 15 profiles	256
7	1	3 x 3 surface x 15 profiles + 4 surface offshore x 4 profiles + 1 x 7 surface x 15 profiles	256

Monitoring fill after major storm events (greater than 20 year return) would include sediment sampling at 3 surface x 15 profiles = 45 samples/storm event, and would be performed as an add-on cost to the scope of work.

C89. Data Analysis will include: profile volume change and shape readjustment, area of loss or gain on profile, volume of fill remaining on project, assessment of alongshore and cross shore fill movement from beach and nearshore fill placement area, and seasonal and storm response. Sediment analysis will include grain size statistics of native and fill material, with readjustment over monitoring period, seasonal and storm grain size response, and assessment of fill and renourishment factors to future fill requirements. Report writing will summarize behavior and response of beach fill to local and regional coastal and geomorphic processes.

C90. Task II - Borrow Area. Borrow area monitoring will include collection of cores before dredging and surface samples immediately after dredging to support biological monitoring and assessment of fill suitability. These tasks will be coordinated with a biologist for concurrent collection period. Table C8 also includes a summary of the borrow area sampling. During the seventh (last) year of monitoring, the monitoring team will collect 5 cores in the dredged area of the depositional basin. Sampling will include one control site outside of immediate borrow pit. About 6 samples will be taken per core (20 ft. long) for a total of 36 samples. This sampling will also be coordinated with biological sampling of the borrow area.

C91. Data analysis will include sediment statistics in tabular and graphic form for sediment fill suitability, borrow area sedimentology to support biological analysis and

usability of borrow area for future projects, and analysis of subcontractors bathymetric surveys for changes in borrow pits and calculation of infilling rates. Report writing will evaluate borrow changes, determine the rate of borrow area infilling, and identify current patterns in the immediate area of the channel and basin.

C92. Task III - Shoreline Change. A subcontractor will provide 15 rectified aerial photography overflights of the project area and construct a base map. Coverage will be a single flightline with 60% overlap stereo coverage of entire project area shoreline, including control profile locations one mile north and south of project limits. Black and White or Color Infrared film with a 9x9 inch film format will be specified. The scale of the photographs will be sufficient to identify shoreline features. A scale of 1:500 is suggested for the base map and aerial photography. Proposed aerial flight times are listed on Table C8 and should be coordinated to occur during ground surveys.

C93. Data analysis done will include shoreline changes and profile changes from pre- and immediately post-construction, and bi-annually as in Table C8 to cover post maintenance dredging. Products provided will be tables and maps on shoreline change rates and volume calculations of fill remaining at each flight time. Report will augment the acquired data base of historic shoreline and inlet shoaling to determine the readjusted rates of accretion and erosion along the shoreline and changes to the ebb shoal/dredged basin area. This is important to assess inlet shoal and beach fill changes.

C94. Task IV - Biological Assessment. Biological surveys of both beach and borrow areas will be conducted. One biologist and technician will join the field team for the proposed field trips listed in Task I and II. Field collection will consist of grab samples offshore and quadrat of beach areas to assess presence of infauna.

C95. Data Analysis will evaluate changes in infauna located in the beach fill and nearshore fill deposition area, effects of turbidity on fauna of the beach and borrow area and the effects of dredging activities on borrow area infauna. Report will describe and quantify the changes to or the reestablishment of the biological community in the fill placement area and borrow and compare to control sites.

References

1. U.S. Department of Commerce, National Oceanic & Atmospheric Administration, National Ocean Survey, "Tide Tables 1985, East Coast of North and South America Including Greenland."
2. Dewal, A.E., - Beach Changes at Westhampton Beach, New York, 1962-73, U.S. Army Corps of Engineers, CERC, Misc. Report No. 79-5, August 1979.
3. U.S. Army Corps of Engineers, New York District Moriches and Shinnecock Inlets, Long Island, New York, September 1957, Revised 11 July 1958, Survey Report.
4. Tetra Tech "Circulation Calculations in Shinnecock Inlet and Vicinity" January 12, 1981.
5. U.S. Department of Commerce, National Oceanic & Atmospheric Administration, National Ocean Survey "Tide Current Tables 1985, Atlantic Coast of North America."
6. U.S. Naval Weather Service Command, Summary of Synoptic Meteorological Observations, North American Coastal Marine Areas, Vol. 2.
7. Helle, J.R., - Surf Statistics For the Coasts of The United States, Beach Erosion Board, Technical Memorandum 108, November 1958.
8. Neuman, G. and James - North Atlantic Coast wave Statistics Hindcast by Wave Spectrum Method, Beach Erosion Board Technical Memorandum No. 57.
9. PRC Harris, Inc., Moriches Inlet, New York Current and Tide Observations, Contract DACW51-79-C-0005.
10. U.S. Army Engineers Waterways Experiment Station WIS Report 9, Atlantic Coast Hindcast, Shallow Water Significant Wave Information, January 1983
11. Taney, N.E., Geomorphology of the South Shore of Long Island, New York; Beach Erosion Board, Technical Memorandum No. 128, September 1961.
12. Research Planning Institute, Inc. Sediment Budget Analysis, Fire Island Inlet to Montauk Point, Long Island, New York -Reformulation Study, Revised December 1983.
13. Keulegan, G.H., Tidal Flow in Entrances Water Level Fluctuations of Basins in communication with SEAS, Corps of Engineers, U.S. Army June 1967.

14. U.S. Army Engineers "A Simple Computer Model for Evaluating Coastal Inlet Hydraulics" CETA 77-1.
15. U.S. Army Engineers "Design of Breakwaters and Jetties", EM 1110-2-2904, 30 April 1963.
16. U.S. Army Engineers "Tidal Hydraulics", EM 1110-2-1607, 2 August 1965.
17. U.S. Army Engineers Coastal Engineering Research Center, "Shore Protection Manual", 1984.
18. U.S. Army Engineers "Determining Sheltered Water Wave Characteristics." ETL 1110-2-305, 16 February 1984.
19. U.S. Army Engineers "Design of Coastal Revetments, Seawalls and Bulkheads" EM 1110-2-1614, 30 April 1985.
20. U.S. Army Engineers "Hydraulic Design of Small Boat Navigation Projects" ER 1110-2-1457, 24 June 1985.
21. U.S. Army Engineers "Hydraulic Design of Small Boat Harbors" EM 1110-2-1615.
22. House Document No. 126, 86th Congress, 1st Session, Moriches and Shinnecock Inlets, Long Island, New York.
23. U.S. Army Engineers, New York District, General Design Memorandum, Moriches Inlet, Long Island, New York, April 1983.
24. U.S. Army Engineers "Entrance Channel Infill Rates", ETL 1110-2-293, 15 March 1984.
25. U.S. Army Engineers Coastal Engineering Research Center, Small Craft Harbors: Design, Construction, and operation" Special Report No. 2, December 1974.
26. U.S. Army Engineers Coastal Engineering Research Center, Simplified Method for Estimating Refraction and Shoaling Effects on Ocean Waves, TM-59, November 1975
27. U.S. Army Corps of Engineers, Atlantic Coastal of Long Island, N.Y., Fire Island Inlet to Montauk Point. Cooperative Beach Erosion Control and Interim Hurricane Study (Survey) -Appendices and Main Report, July 1952.

TABLE C - 1

SHINNECOCK INLET AND BAY TIDE RECORDS

Location of gage	Elevation (ft. NGVD) Mean High Water	Mean Low Water	Mean Range of tide (ft.)	Period of Record (mo.)	Remark
East Quogue	0.64	-0.06	0.70	3 1/2 (1949)	
	0.49	0.00	0.49	2 1/2 (1951)	
	0.65	0.23	0.88	12 (1956)	
Ponquogue Bridge	0.08	-0.02	0.10	1/2 (1938)	Prior to opening of Shinnecock Inlet
	0.93	0.07	0.86	12 (1939-40)	
Boat Basin just West of Inlet	0.79	-0.84	1.63	5 (1939)	
	0.90	-0.37	1.27	3 1/2 (1949)	
	0.59	-0.17	0.76	2 (1951)	
	0.82	-0.09	0.91	7 (1951-2)	After dredging in Inlet
	0.74	-0.46	1.20	15 (1952-3)	After start of construction of East jetty
	0.90	-0.61	1.51	16 (1953-4)	After Construction of West jetty
	1.01	0.87	1.88	12 (1956)	
Shinnecock Inlet (ocean)	1.23	-1.10	2.33	12 (1939-40)	
	1.40	-1.49	2.89	3 (1953)	
	1.89	-1.21	3.10	2/3 (1955-6)	

TABLE C-2

ESTIMATED ANNUAL AVERAGE WINDS
(From Observations 1940-1959)

<u>Direction</u>	<u>Percent of Time</u>
N	10
NE	9
E	9
SE	6
S	9
SW	22
W	17
NW	17
Calms	1

TABLE C-3.1 WAVE DATA

(219° - 244°) 21

STATION 46 20 YEARS WAVE APPROACH ANGLE(DEGREES)= 0. - 29.9
 SHORELINE ANGLE = 69.0 DEGREES AZIMUTH
 WATER DEPTH = 10.00 METRES
 PERCENT OCCURRENCE(X1000) OF HEIGHT AND PERIOD BY DIRECTION

HEIGHT(METRES)	PERIOD(SECONDS)										TOTAL
	0.0-2.9	3.0-3.9	4.0-4.9	5.0-5.9	6.0-6.9	7.0-7.9	8.0-8.9	9.0-9.9	10.0-10.9	11.0- LONGER	
0.0-0.49	1497	3446	2000	1471	443	39	.	.	.	.	8896
0.5-0.99	.	559	3050	1998	124	10	.	.	.	.	5745
1.0-1.49	.	.	42	331	75	.	.	.	.	.	4505
1.5-1.99	.	.	.	.	.	.	.	.	.	.	0
2.0-2.49	.	.	.	.	.	.	.	.	.	.	0
2.5-2.99	.	.	.	.	.	.	.	.	.	.	0
3.0-3.49	.	.	.	.	.	.	.	.	.	.	0
3.5-3.99	.	.	.	.	.	.	.	.	.	.	0
4.0-4.49	.	.	.	.	.	.	.	.	.	.	0
4.5-4.99	.	.	.	.	.	.	.	.	.	.	0
5.0-5.49	.	.	.	.	.	.	.	.	.	.	0
5.5-5.99	.	.	.	.	.	.	.	.	.	.	0
6.0-6.49	.	.	.	.	.	.	.	.	.	.	0
6.5-6.99	.	.	.	.	.	.	.	.	.	.	0
7.0-7.49	.	.	.	.	.	.	.	.	.	.	0
7.5-7.99	.	.	.	.	.	.	.	.	.	.	0
8.0-8.49	.	.	.	.	.	.	.	.	.	.	0
8.5-8.99	.	.	.	.	.	.	.	.	.	.	0
9.0-9.49	.	.	.	.	.	.	.	.	.	.	0
9.5-9.99	.	.	.	.	.	.	.	.	.	.	0
10.0-10.49	.	.	.	.	.	.	.	.	.	.	0
10.5-10.99	.	.	.	.	.	.	.	.	.	.	0
11.0-11.49	.	.	.	.	.	.	.	.	.	.	0
11.5-11.99	.	.	.	.	.	.	.	.	.	.	0
12.0-12.49	.	.	.	.	.	.	.	.	.	.	0
12.5-12.99	.	.	.	.	.	.	.	.	.	.	0
13.0-13.49	.	.	.	.	.	.	.	.	.	.	0
13.5-13.99	.	.	.	.	.	.	.	.	.	.	0
14.0-14.49	.	.	.	.	.	.	.	.	.	.	0
14.5-14.99	.	.	.	.	.	.	.	.	.	.	0
15.0-15.49	.	.	.	.	.	.	.	.	.	.	0
15.5-15.99	.	.	.	.	.	.	.	.	.	.	0
16.0-16.49	.	.	.	.	.	.	.	.	.	.	0
16.5-16.99	.	.	.	.	.	.	.	.	.	.	0
17.0-17.49	.	.	.	.	.	.	.	.	.	.	0
17.5-17.99	.	.	.	.	.	.	.	.	.	.	0
18.0-18.49	.	.	.	.	.	.	.	.	.	.	0
18.5-18.99	.	.	.	.	.	.	.	.	.	.	0
19.0-19.49	.	.	.	.	.	.	.	.	.	.	0
19.5-19.99	.	.	.	.	.	.	.	.	.	.	0
20.0-20.49	.	.	.	.	.	.	.	.	.	.	0
20.5-20.99	.	.	.	.	.	.	.	.	.	.	0
21.0-21.49	.	.	.	.	.	.	.	.	.	.	0
21.5-21.99	.	.	.	.	.	.	.	.	.	.	0
22.0-22.49	.	.	.	.	.	.	.	.	.	.	0
22.5-22.99	.	.	.	.	.	.	.	.	.	.	0
23.0-23.49	.	.	.	.	.	.	.	.	.	.	0
23.5-23.99	.	.	.	.	.	.	.	.	.	.	0
24.0-24.49	.	.	.	.	.	.	.	.	.	.	0
24.5-24.99	.	.	.	.	.	.	.	.	.	.	0
25.0-25.49	.	.	.	.	.	.	.	.	.	.	0
25.5-25.99	.	.	.	.	.	.	.	.	.	.	0
26.0-26.49	.	.	.	.	.	.	.	.	.	.	0
26.5-26.99	.	.	.	.	.	.	.	.	.	.	0
27.0-27.49	.	.	.	.	.	.	.	.	.	.	0
27.5-27.99	.	.	.	.	.	.	.	.	.	.	0
28.0-28.49	.	.	.	.	.	.	.	.	.	.	0
28.5-28.99	.	.	.	.	.	.	.	.	.	.	0
29.0-29.49	.	.	.	.	.	.	.	.	.	.	0
29.5-29.99	.	.	.	.	.	.	.	.	.	.	0
30.0-30.49	.	.	.	.	.	.	.	.	.	.	0
30.5-30.99	.	.	.	.	.	.	.	.	.	.	0
31.0-31.49	.	.	.	.	.	.	.	.	.	.	0
31.5-31.99	.	.	.	.	.	.	.	.	.	.	0
32.0-32.49	.	.	.	.	.	.	.	.	.	.	0
32.5-32.99	.	.	.	.	.	.	.	.	.	.	0
33.0-33.49	.	.	.	.	.	.	.	.	.	.	0
33.5-33.99	.	.	.	.	.	.	.	.	.	.	0
34.0-34.49	.	.	.	.	.	.	.	.	.	.	0
34.5-34.99	.	.	.	.	.	.	.	.	.	.	0
35.0-35.49	.	.	.	.	.	.	.	.	.	.	0
35.5-35.99	.	.	.	.	.	.	.	.	.	.	0
36.0-36.49	.	.	.	.	.	.	.	.	.	.	0
36.5-36.99	.	.	.	.	.	.	.	.	.	.	0
37.0-37.49	.	.	.	.	.	.	.	.	.	.	0
37.5-37.99	.	.	.	.	.	.	.	.	.	.	0
38.0-38.49	.	.	.	.	.	.	.	.	.	.	0
38.5-38.99	.	.	.	.	.	.	.	.	.	.	0
39.0-39.49	.	.	.	.	.	.	.	.	.	.	0
39.5-39.99	.	.	.	.	.	.	.	.	.	.	0
40.0-40.49	.	.	.	.	.	.	.	.	.	.	0
40.5-40.99	.	.	.	.	.	.	.	.	.	.	0
41.0-41.49	.	.	.	.	.	.	.	.	.	.	0
41.5-41.99	.	.	.	.	.	.	.	.	.	.	0
42.0-42.49	.	.	.	.	.	.	.	.	.	.	0
42.5-42.99	.	.	.	.	.	.	.	.	.	.	0
43.0-43.49	.	.	.	.	.	.	.	.	.	.	0
43.5-43.99	.	.	.	.	.	.	.	.	.	.	0
44.0-44.49	.	.	.	.	.	.	.	.	.	.	0
44.5-44.99	.	.	.	.	.	.	.	.	.	.	0
45.0-45.49	.	.	.	.	.	.	.	.	.	.	0
45.5-45.99	.	.	.	.	.	.	.	.	.	.	0
46.0-46.49	.	.	.	.	.	.	.	.	.	.	0
46.5-46.99	.	.	.	.	.	.	.	.	.	.	0
47.0-47.49	.	.	.	.	.	.	.	.	.	.	0
47.5-47.99	.	.	.	.	.	.	.	.	.	.	0
48.0-48.49	.	.	.	.	.	.	.	.	.	.	0
48.5-48.99	.	.	.	.	.	.	.	.	.	.	0
49.0-49.49	.	.	.	.	.	.	.	.	.	.	0
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50.5-50.99	.	.	.	.	.	.	.	.	.	.	0
51.0-51.49	.	.	.	.	.	.	.	.	.	.	0
51.5-51.99	.	.	.	.	.	.	.	.	.	.	0
52.0-52.49	.	.	.	.	.	.	.	.	.	.	0
52.5-52.99	.	.	.	.	.	.	.	.	.	.	0
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56.0-56.49	.	.	.	.	.	.	.	.	.	.	0
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57.5-57.99	.	.	.	.	.	.	.	.	.	.	0
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58.5-58.99	.	.	.	.	.	.	.	.	.	.	0
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61.5-61.99	.	.	.	.	.	.	.	.	.	.	0
62.0-62.49	.	.	.	.	.	.	.	.	.	.	0
62.5-62.99	.	.	.	.	.	.	.	.	.	.	0
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63.5-63.99	.	.	.	.	.	.	.	.	.	.	0
64.0-64.49	.	.	.	.	.	.	.	.	.	.	0
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68.0-68.49	.	.	.	.	.	.	.	.	.	.	0
68.5-68.99	.	.	.	.	.	.	.	.	.	.	0
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69.5-69.99	.	.	.	.	.	.	.	.	.	.	0
70.0-70.49	.	.	.	.	.	.	.	.	.	.	0
70.5-70.99	.	.	.	.	.	.	.	.	.	.	0
71.0-71.49	.	.	.	.	.	.	.	.	.	.	0
71.5-71.99	.	.	.	.	.	.	.	.	.	.	0
72.0-72.49	.	.	.	.	.	.	.	.	.	.	0
72.5-72.99	.	.	.	.	.	.	.	.	.	.	0
73.0-73.49	.	.	.	.	.	.	.	.	.	.	0
73.5-73.99	.	.	.	.	.	.	.	.	.	.	0
74.0-74.49	.	.	.	.	.	.	.	.	.	.	0
74.5-74.99	.	.	.	.	.						

$(129^\circ - 158.9^\circ)$ [illegible]

(99° - 123.7°)

[illegible]
$$= (69^\circ - 98.7^\circ)$$

HEIGHT(METRES)		PERIOD(SECONDS)											TOTAL
		0.0-2.9	3.0-3.9	4.0-4.9	5.0-5.9	6.0-6.9	7.0-7.9	8.0-8.9	9.0-9.9	10.0-10.9	11.0-LONGER		
5.0-5.9	0000000000	557	1273	1064	1112	311	50	.	.	.	.	4375	
4.0-4.9	0000000000	.	76	766	853	215	1	.	.	.	.	1934	
3.0-3.9	0000000000	.	.	3	49	1	.	.	.	.	.	76	
2.0-2.9	0000000000	.	.	.	.	.	.	.	.	.	.	0000000000	
1.0-1.9	0000000000	.	.	.	.	.	.	.	.	.	.	0000000000	
0.0-0.9	0000000000	.	.	.	.	.	.	.	.	.	.	0000000000	
TOTAL		557	1351	1833	2014	553	61	0	0	0	0		
AVERAGE HS(M) = 0.37		LARGEST HS(M) = 2.09		ANGLE CLASS % = 6.4									

TABLE C4

INLET CHANNEL CROSS - SECTIONAL
AREA (BELOW MLW) CHANGES

	1955-56	14-15 JUNE 84	JUNE 85
<u>STATION</u>	<u>AREA (FT²)</u>	<u>AREA (FT²)</u>	<u>AREA (FT²)</u>
0+00	4520*	16060	14840
2+00	4200*	17640	18220
4+00	4440	25380	25400
6+00	5700	17940	19500
8+00	5680	15860	14860
10+00	5220	16620	14890
12+00	4400	17020	14420
14+00	4200*	19220	17010

*Not within Inlet Channel, area calculated within jetty boundaries

TABLE C-5

SHINNECOCK INLET THROAT CROSS - SECTIONAL
AREA AND HYDRAULIC CHANGES

<u>SURVEY DATE</u>	<u>A AREA BELOW MSL (FT²)</u>	<u>R HYDRAULIC RADIUS FT.</u>	<u>* DAV AVERAGE CHANNEL DEPTH (FT. MSL)</u>
1955-56	5,500	6.76	6.9
JUNE 84	16,600	19.72	20.8
JUNE 85	15,440	19.60	19.3

*DAV = A/T , Where T = Top width of channel
A = Cross Sectional Area

TABLE C-6

Shinnecock Inlet
Shoreline Erosion West of the Inlet
 (Long Term Rates)

Range No.	Loss Rate (Ft./Yr.)	Equivalent Length (Ft.)	Land Lost (Sq.Ft/Yr.)	Land Lost (Acres/Yr.)
047	-14.6	500	-7,300	-0.17
047+500	-17.3	500	-8,650	-0.20
047+1000	-26.4	485	-12,804	-0.29
046B	-24.9	972.5	-24,215	-0.56
046A	-18.0	1,462.5	-26,325	-0.60
046	+ 8.0	2,173	+17,384	+0.40
045	- 3.8	12,123.5	-46,069	-1.06
043	- 0.6	17,349.5	-10,410	-0.24
		-----	-----	-----
		35,566.0	-118,389	-2.70

Average Recession = -118,389/35,566
 = -3.3 Ft./Yr.

TABLE C-7

Shinnecock Inlet Deposition Basin Shoaling Rate

Straight Channel Alignment

Channel Design Depth of -10 ft. MLW

Depth of Basin (MLW)	Depth Of Natural Bottom (MLW)	Deposition Basin Width (FT)	Time to Shoal to Design Depth (DAYS)	Volume Shoaled in Basin to Design Depth (1000 CY)
18	8	500	276	212.8
		700	378	292.0
		800	429	331.7
20	8	500	361	293.6
		700	493	401.8
		800	559	455.9
22	8	500	455	386.2
		700	619	526.7
		800	701	596.9

Channel Design Depth of -12 ft. MLW

18	8	500	210	174.9
		700	287	239.5
		800	327	272.9
20	8	500	293	254.2
		700	402	349.1
		800	457	396.8
22	8	500	387	346.6
		700	529	474.3
		800	600	538.1

TABLE CB

SAMPLING SCHEDULE FOR BEACH FILL MONITORING

Beach Fill and Nearshore Fill	Prefill Place- ment	Postfill As- Built	1st 3-mo	Thru 6-mo	6th Yr 9-mo	12-mo	Seventh Yr 6-mo
--	---------------------------	--------------------------	-------------	--------------	----------------	-------	-----------------------

Profiles
Sediment

X X X
X X X

Profile
Sediment

X X X X
X X X X

Air Photos

X X X X X

Biological
Samples

X X X X X X X

Borrow
Area

Pre-Fill Placement Postfill As-Built After Each Dredging Seventh Yr. 6 mo

Sediment
Cores

X X X

Surface
Samples

X

Biological
Samples

X X X X

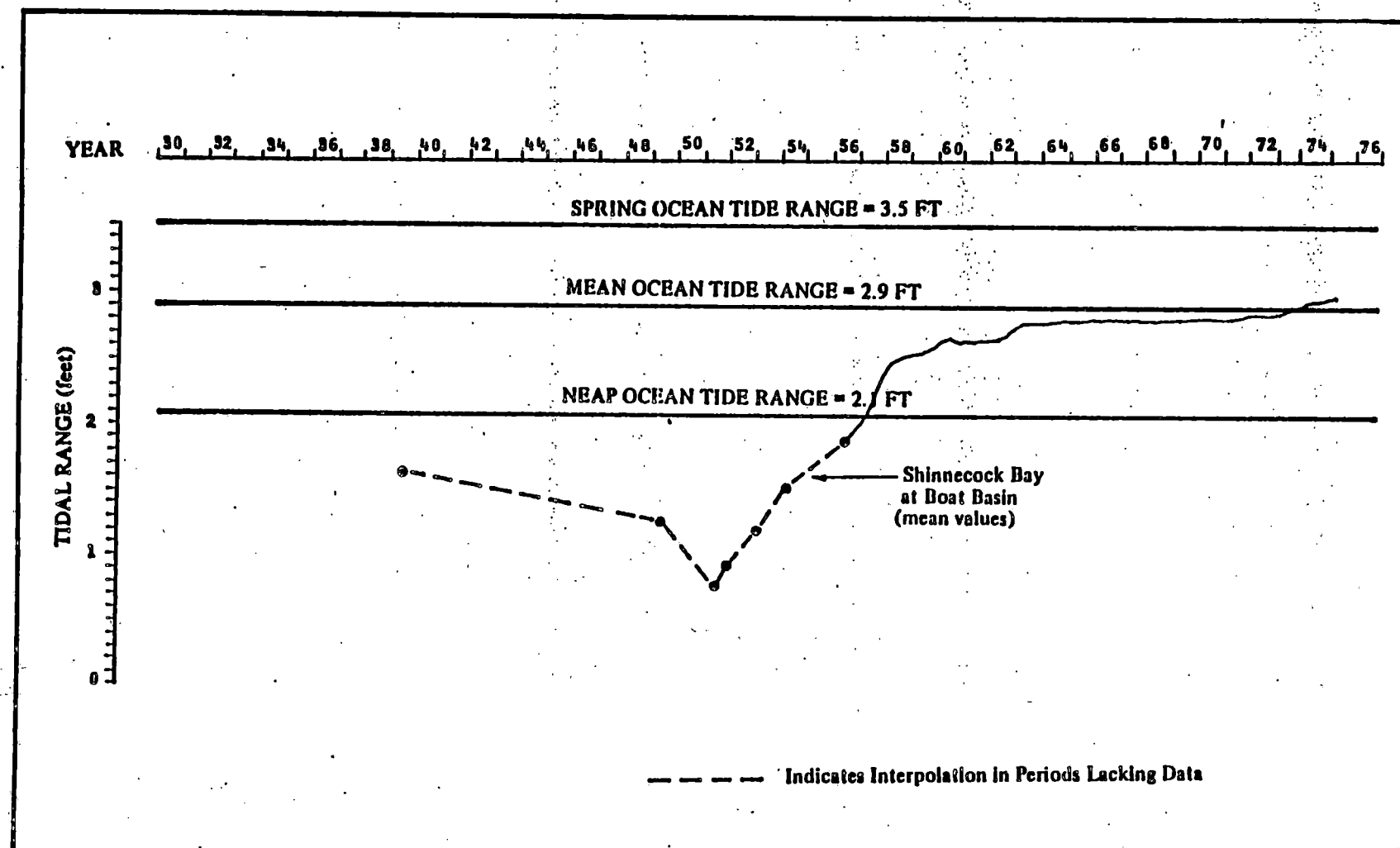
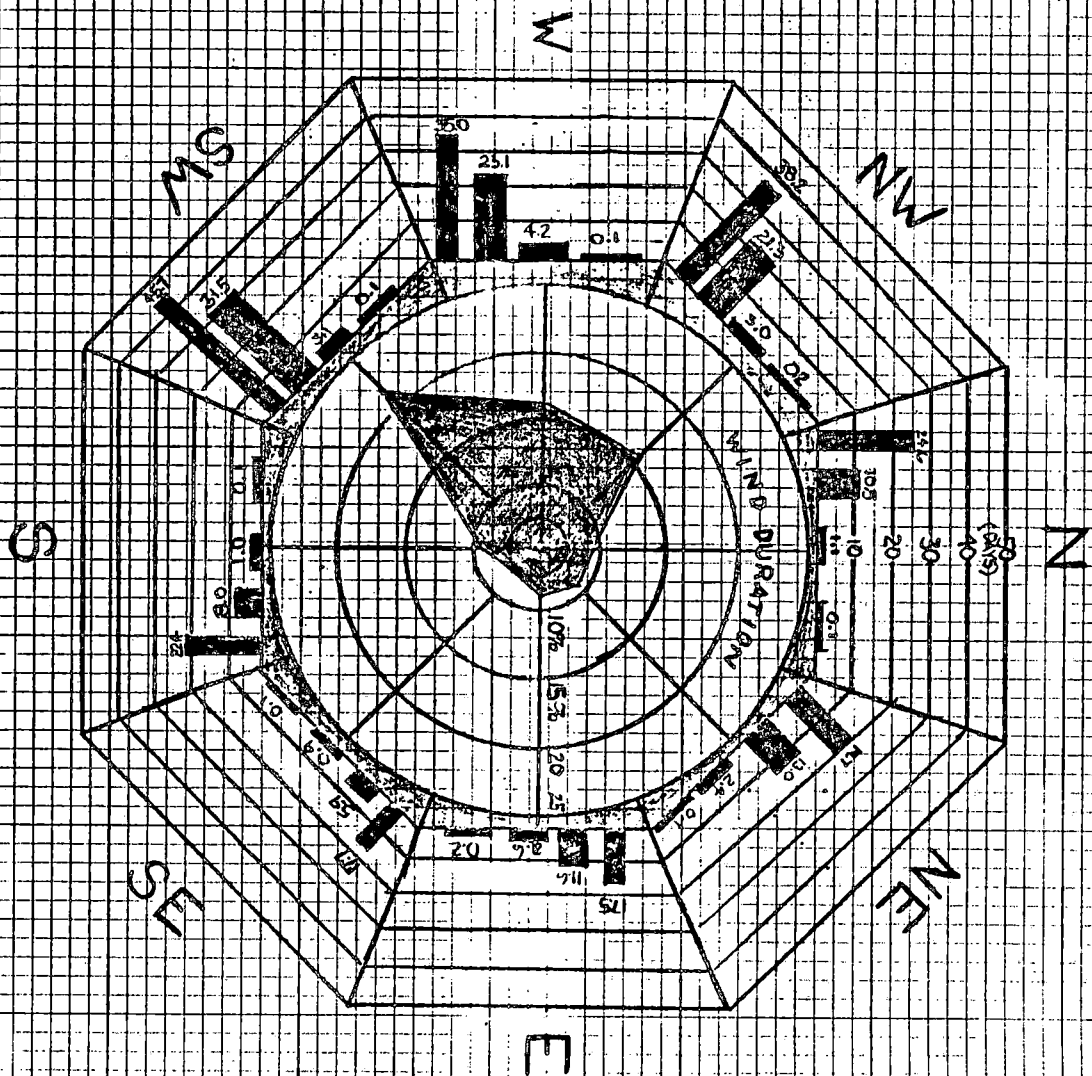


FIGURE C1 HISTORY OF BAY TIDE RANGE IN SHINNECOCK BAY

(FROM REFERENCE 4)

WIND DIAGRAM

SOUTH SHORE OF LONG ISLAND
20 YR. AVERAGE (1940-1959)



LEGEND

VELOCITY RANGE (MPH)

0 TO 12

OVER 12 TO 24

OVER 24 TO 38

OVER 38

FIGURE C2

JAM
6/29/84

SHINNECOCK INLET
CROSS SECTION STATIONING

REVISED

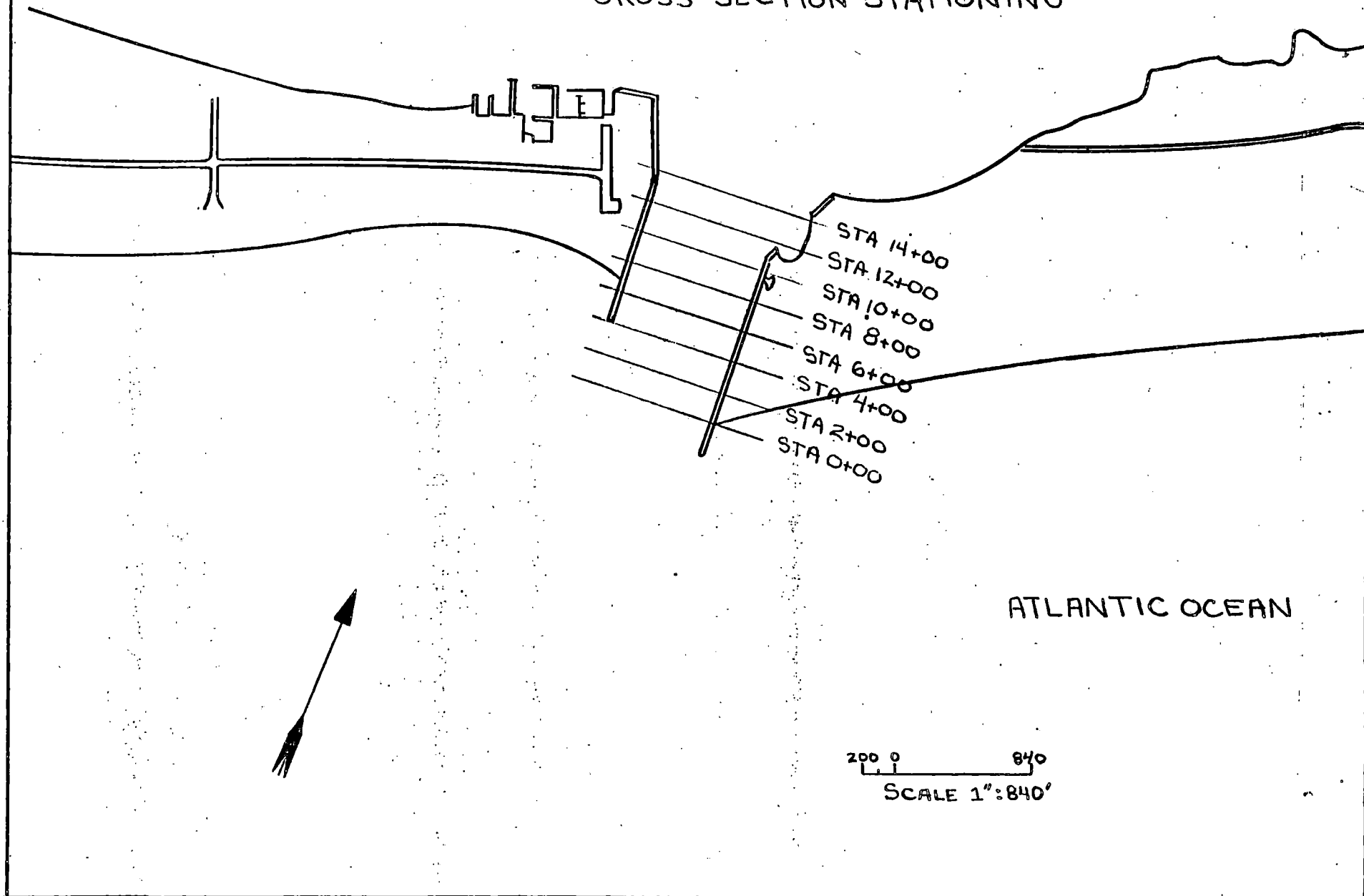


FIGURE C3-1

SHINNECOCK INLET COMPARATIVE CHANNEL CROSS SECTIONS

STA 0+00

WEST
JETTY

EAST
JETTY

0

0 FT. (MLW)

-10

10

-20

-20

-30

-30

-40

-40

1855-56
JUNE 84
JUNE 85

0 200 400 600 800 1000 FT.

REVISED

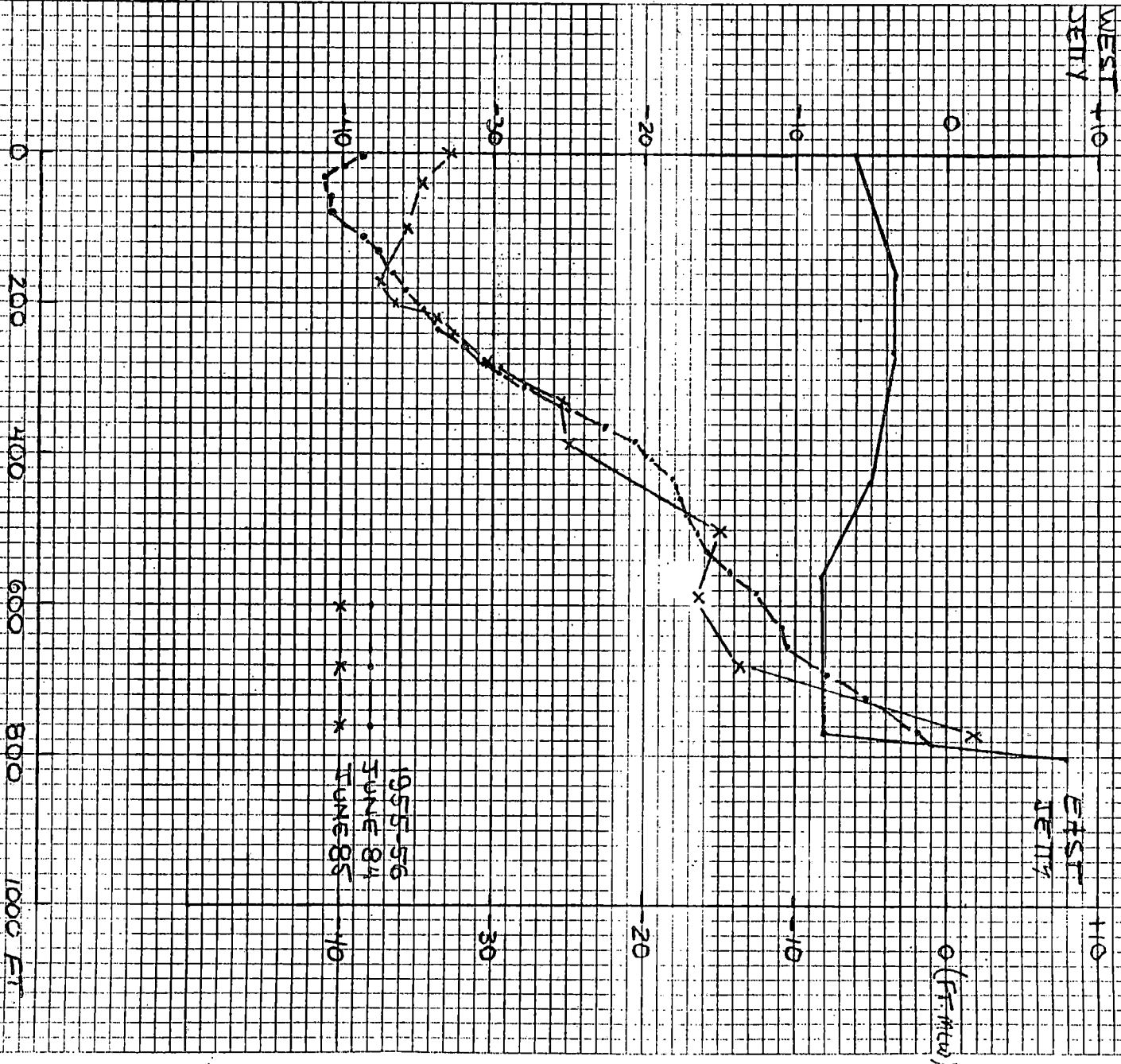
FIGURE C3-2

46 0703

10 X 10 TO THE INCH, 7 X 10 INCHES
NEUFFEL & ESSER CO. MADE IN U.S.A.

STA 2+00

SHINNECOCK INLET
COMPARATIVE CHANNEL
CROSS SECTIONS



REVERSE

FIGURE C3-3

SHUNNECOCK INLET
COMPARATIVE CHANNEL
CROSS SECTIONS

STA 4+00

WEST HO
JETTY



46 0703

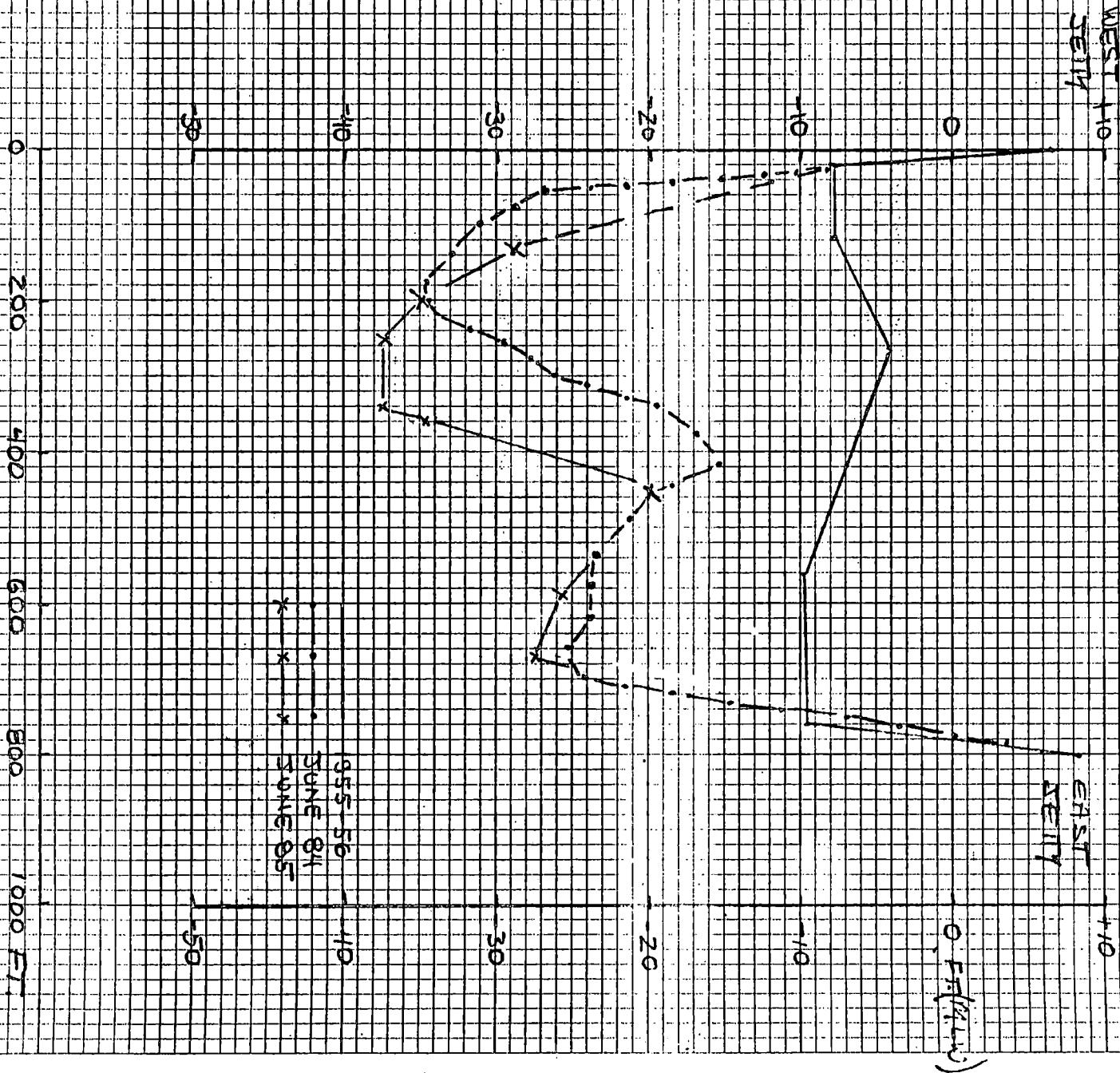
K&M 10 X 10 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.

REVISED

FIGURE C3-4

SHINNECOCK INLET
COMPARATIVE CHANNEL
CROSS SECTIONS

STA 6+00

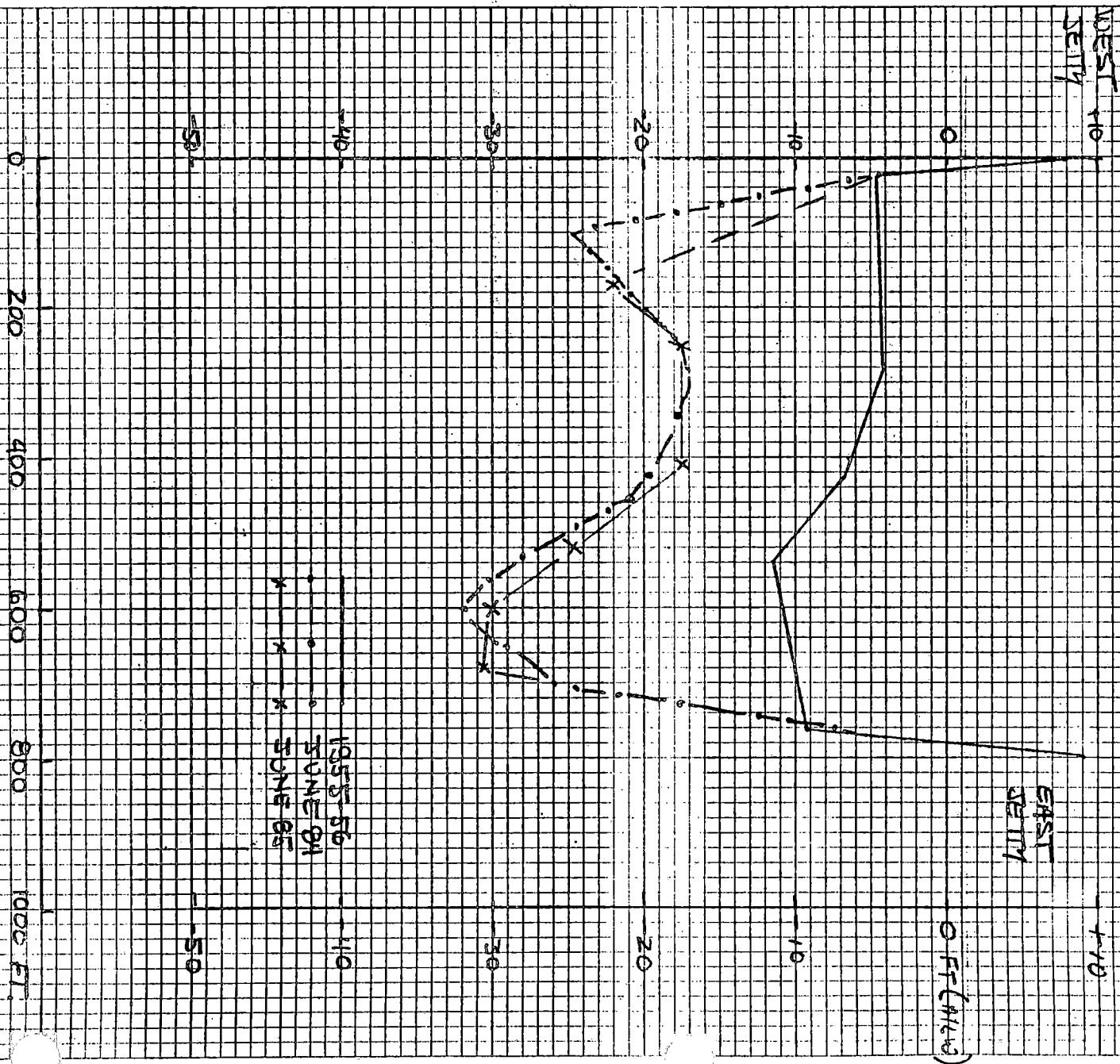


REMOVED

FIGURE C3-5

SHINNECOCK INLET
COMPARATIVE CHANNEL
CROSS SECTIONS

STA. 8+00



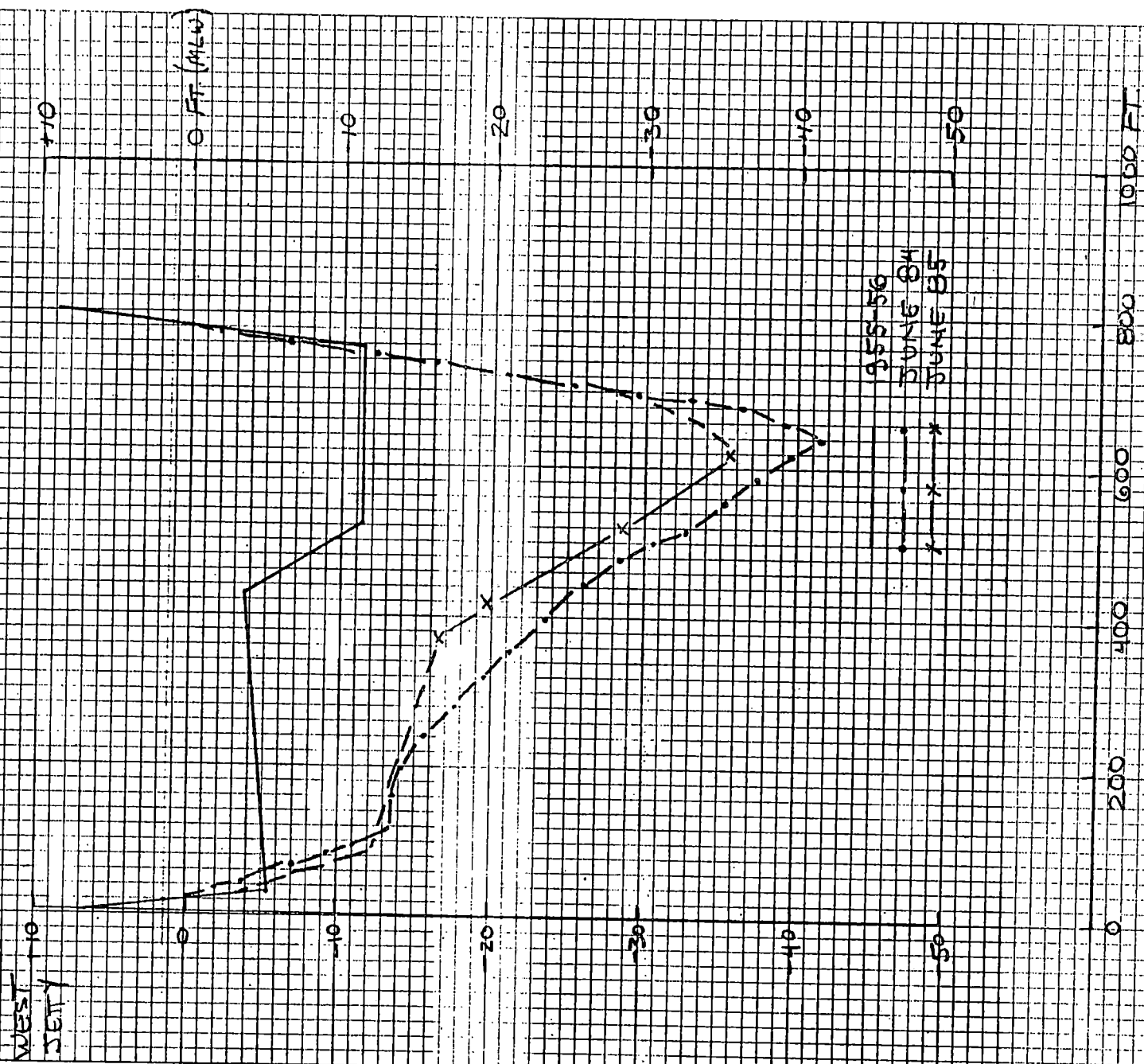
REVISED

FIGURE C3-6

SHINNECOCK INLET COMPARATIVE CHANNEL CROSS SECTIONS

STA. 10+00

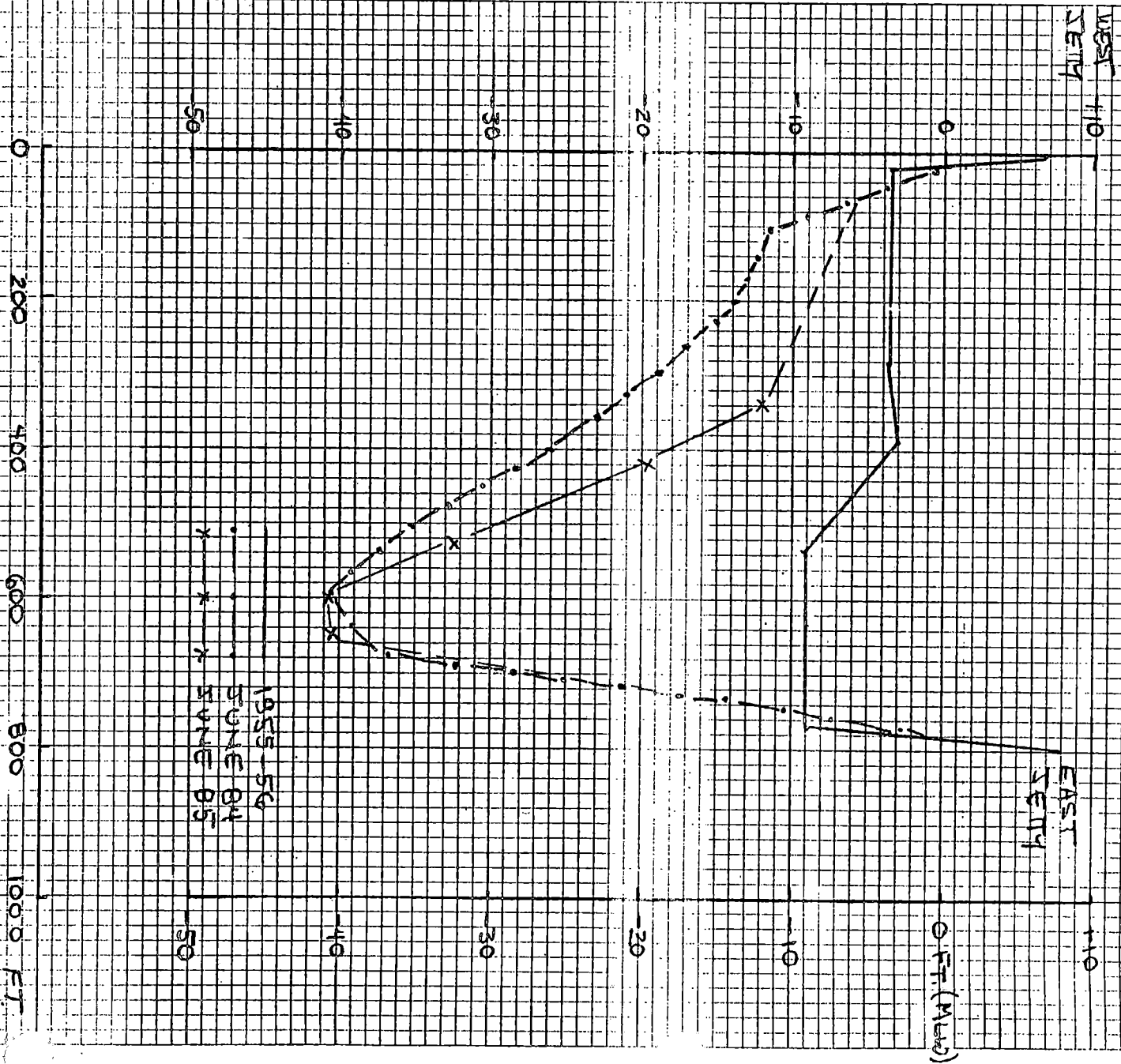
WEST
JETTY



1955-56
JUNE 56
JUNE 55

STA 12+00

SHINNEDOCK INLET
COMPARATIVE CHANNEL
CROSS SECTIONS

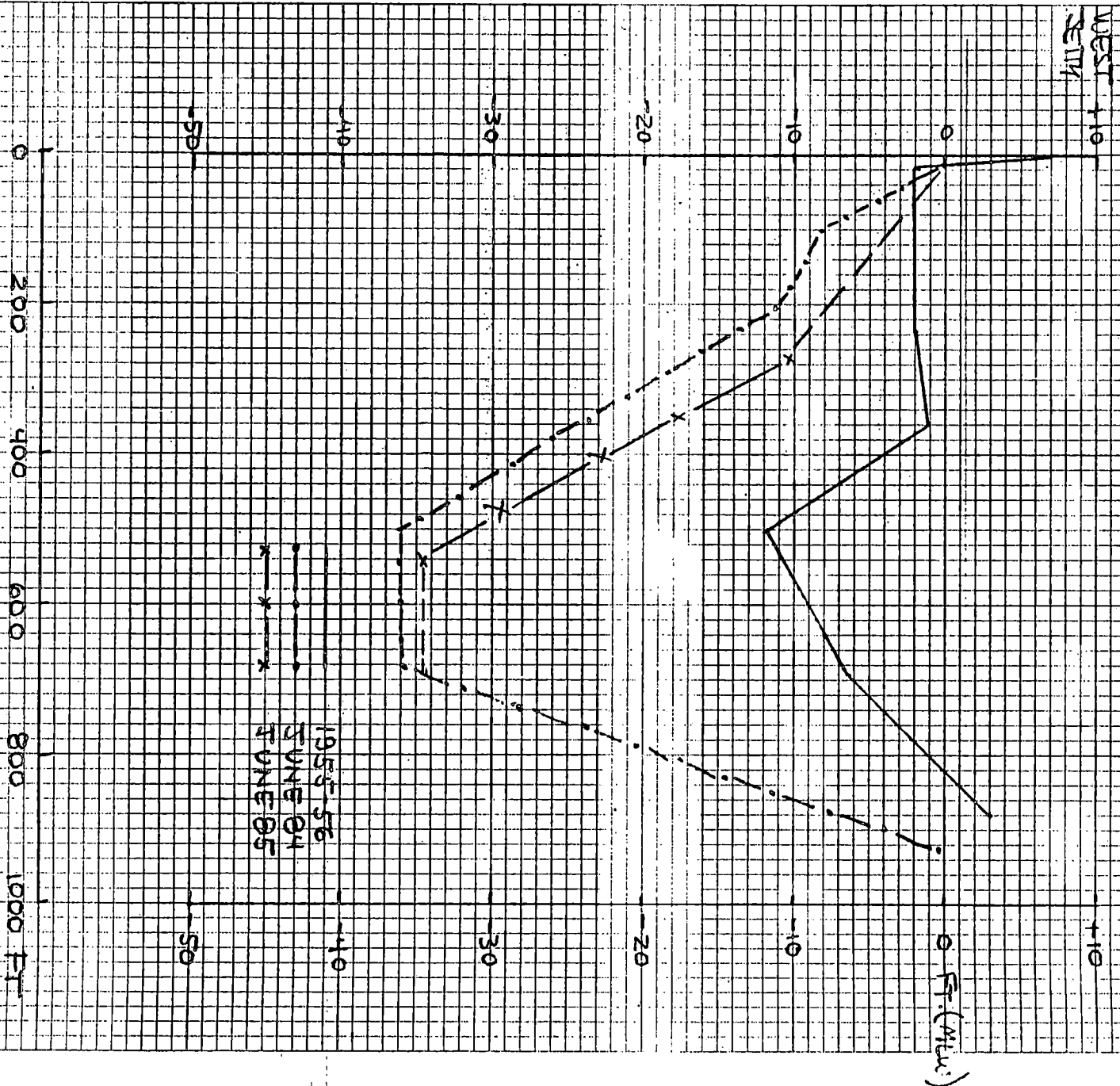


REVISED

FIGURE C3-8

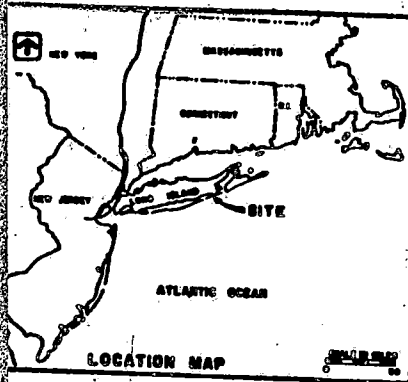
STA 14+00

SHINNECOCK INLET
COMPARATIVE CHANNEL
CROSS SECTIONS

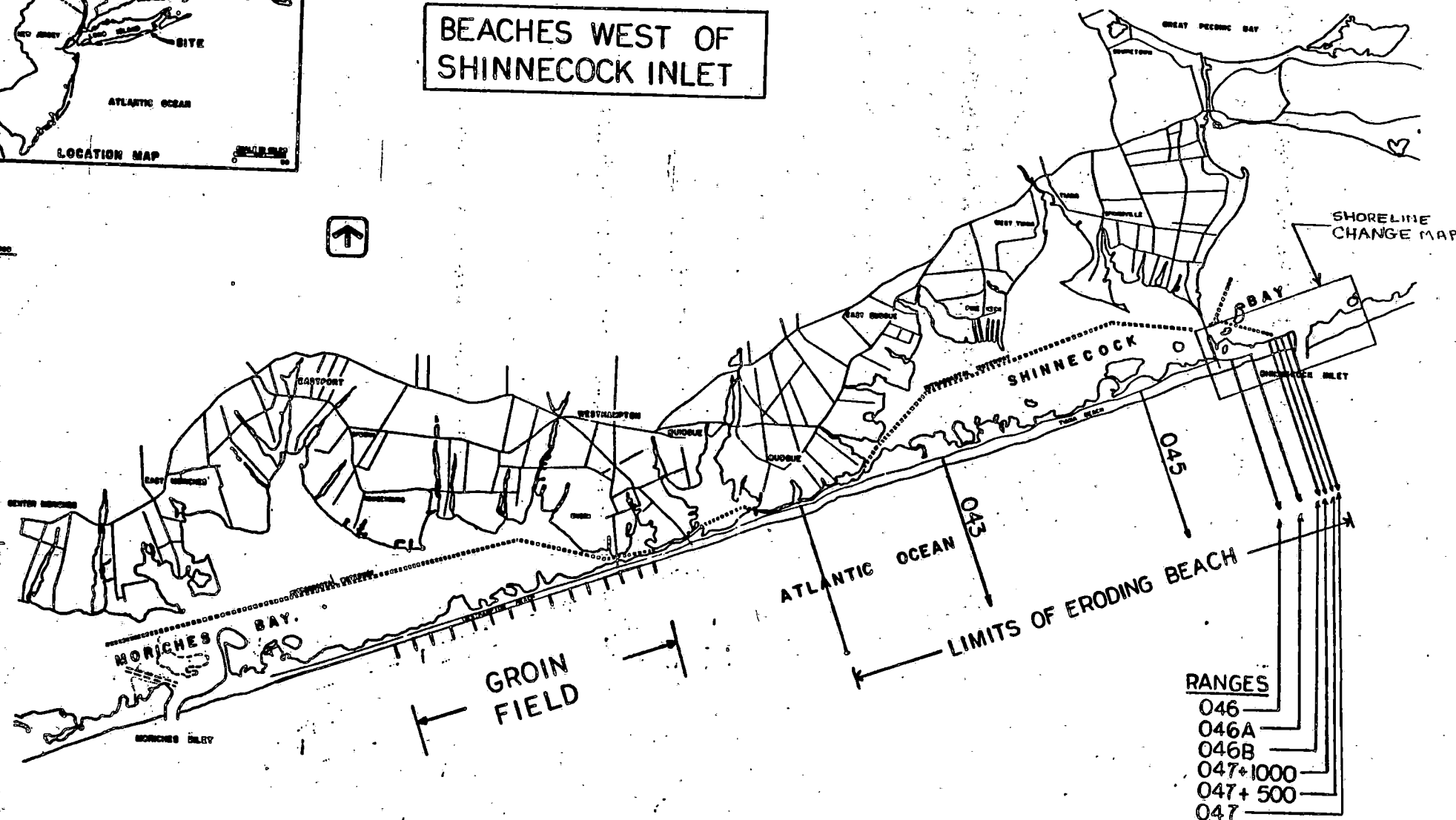


REVISED

FIGURE C3-9



BEACHES WEST OF SHINNECOCK INLET



SCALE IN FEET

US ARMY CORPS OF ENGINEERS, NEW YORK DISTRICT	
CHIEF OF DISTRICT	
DATE: 10/1/50	
PROJECT: BEACH EROSION CONTROL AND RECREATION PROTECTION PROJECT	
FOR PLANS WEST TO SHINNECOCK POINT	
SHEET NO. 10	
DESIGNED BY	NEW YORK
DRAWN BY	NEW YORK
CHECKED BY	NEW YORK
APPROVED BY	NEW YORK

REVIS

FIGURE C4

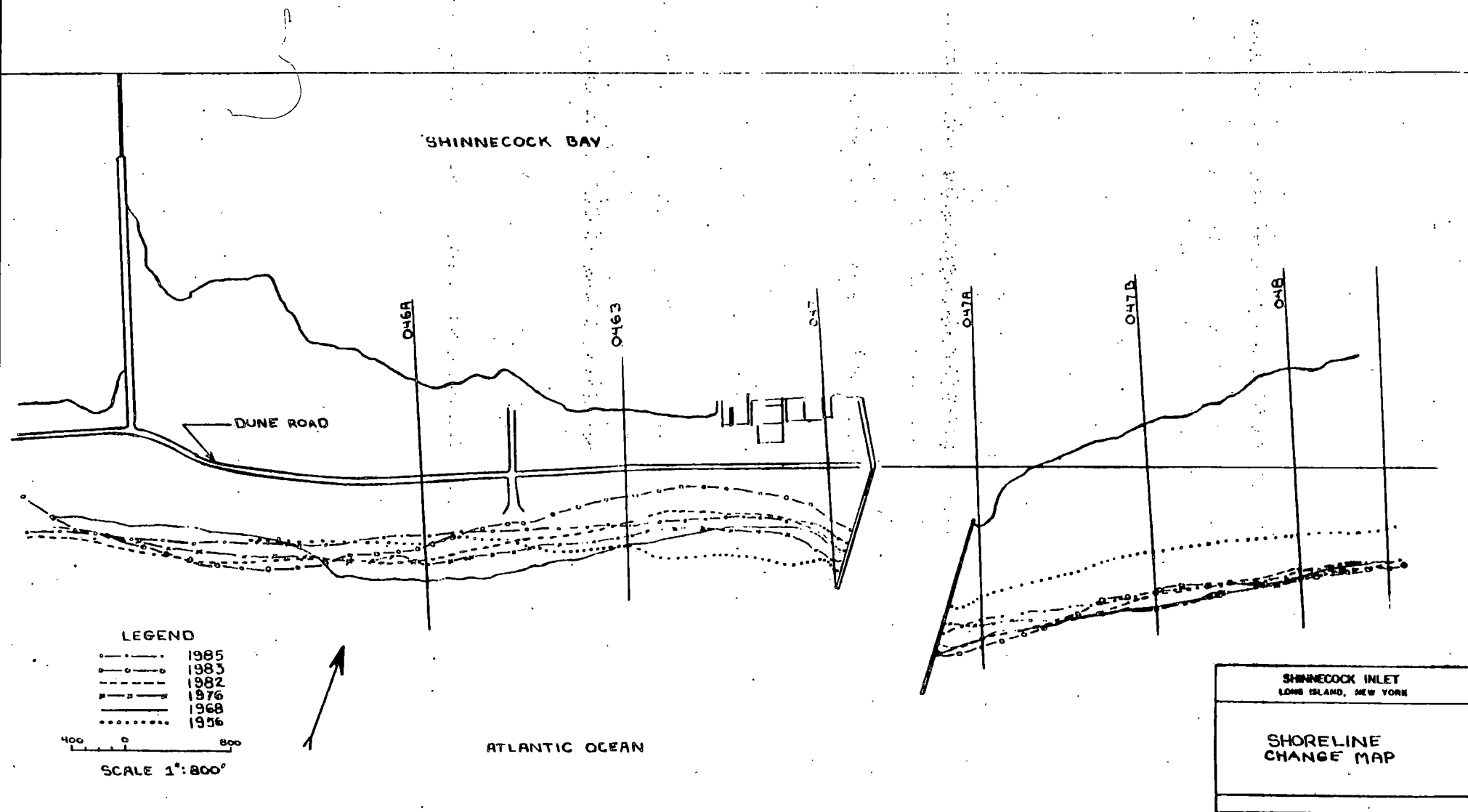


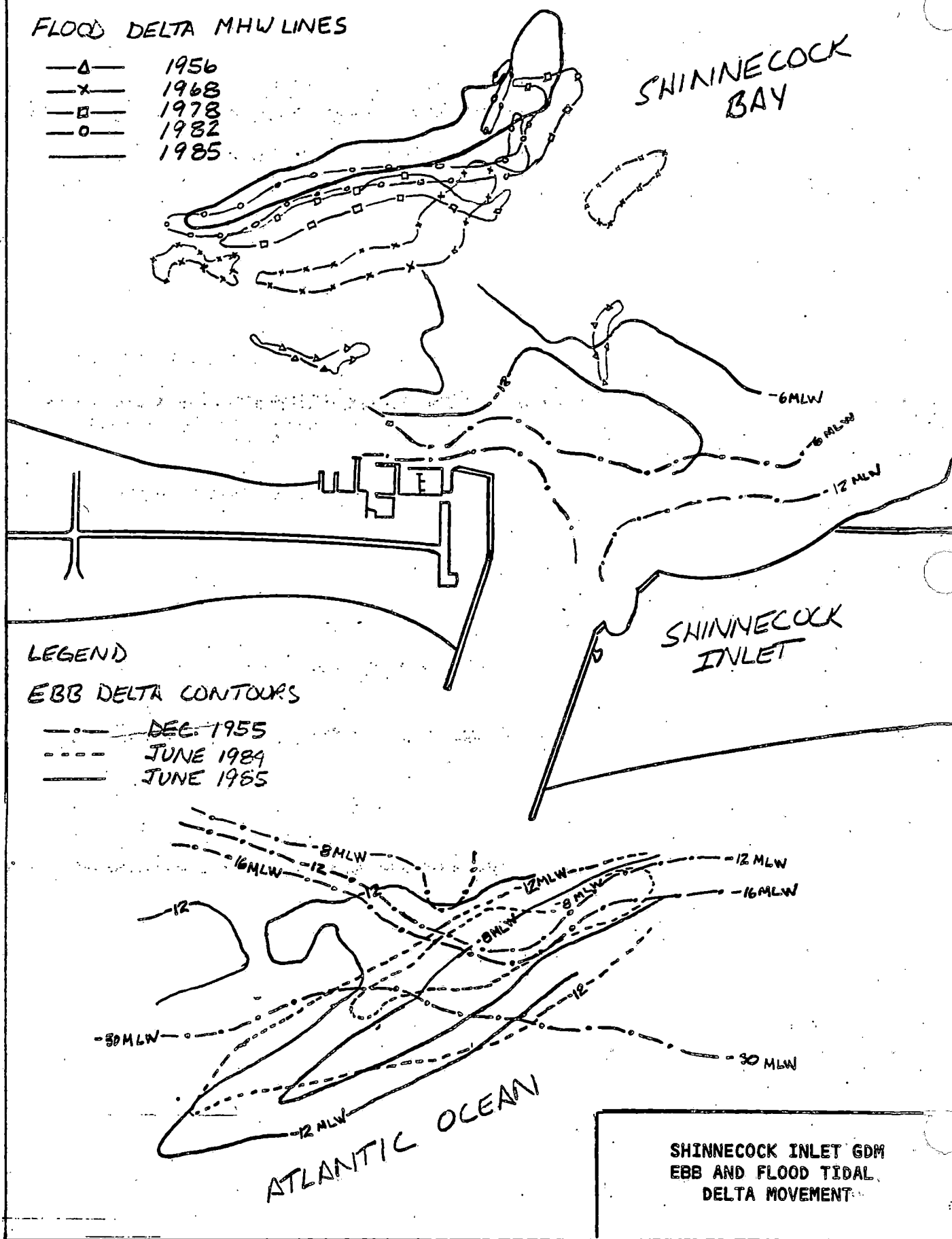
FIGURE C5

REVISED

LEGEND

FLOOD DELTA MHW LINES

- Δ— 1956
- x— 1968
- 1978
- o— 1982
- 1985



REVISED

FIGURE C6

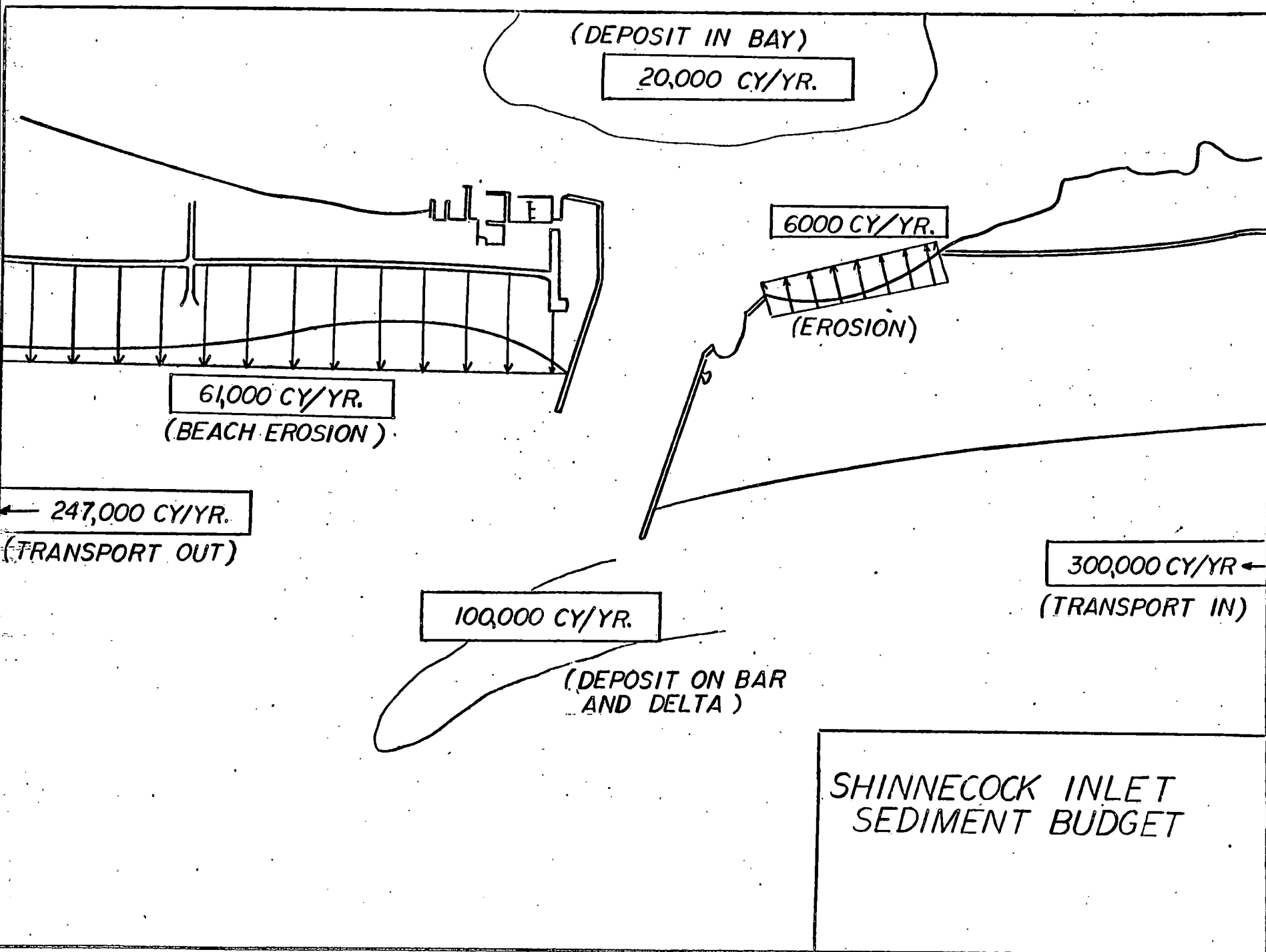


FIGURE C7

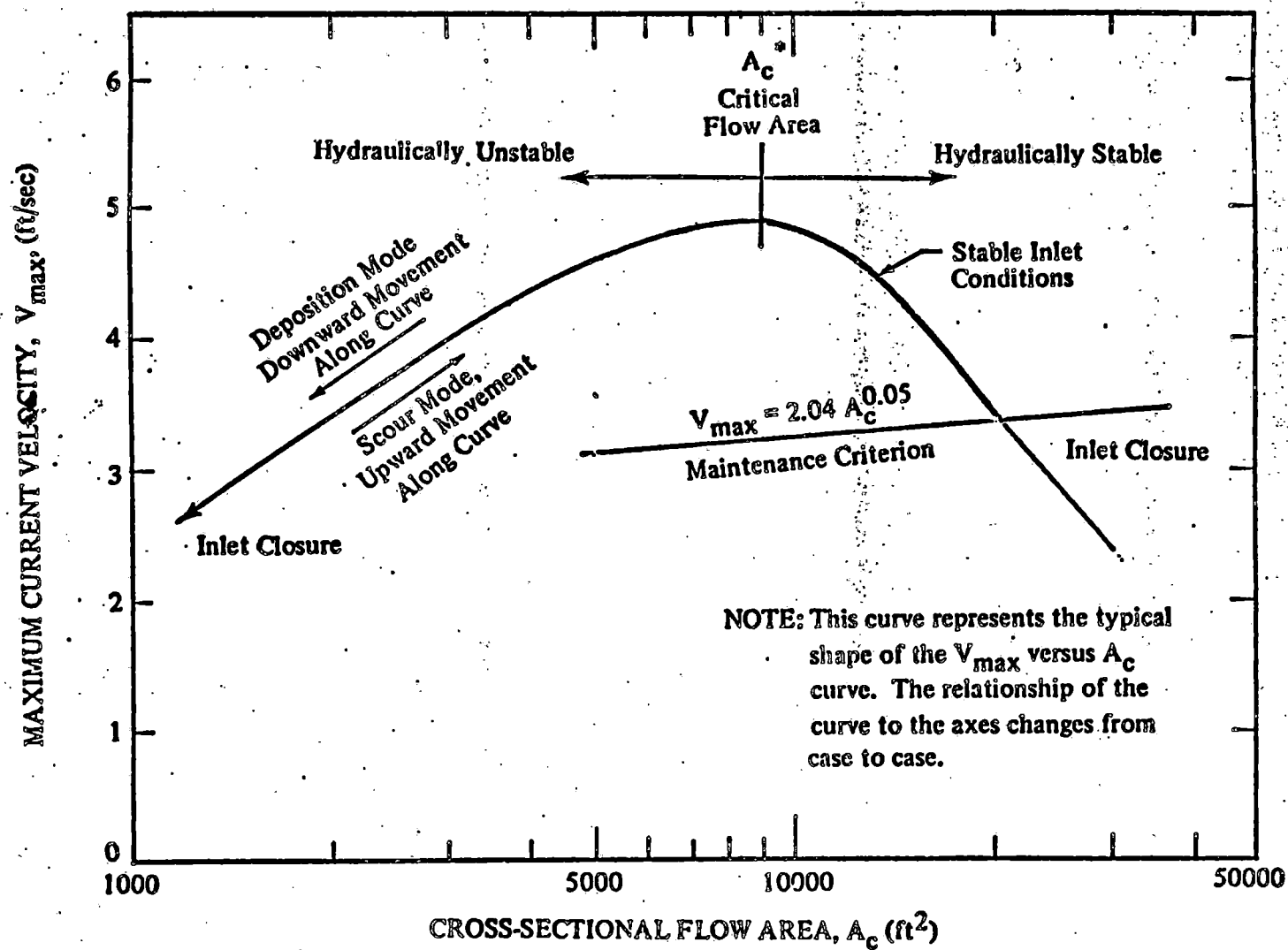


FIGURE C8 Typical Hydraulic Stability Curve Showing Various Inlet Stability Conditions.

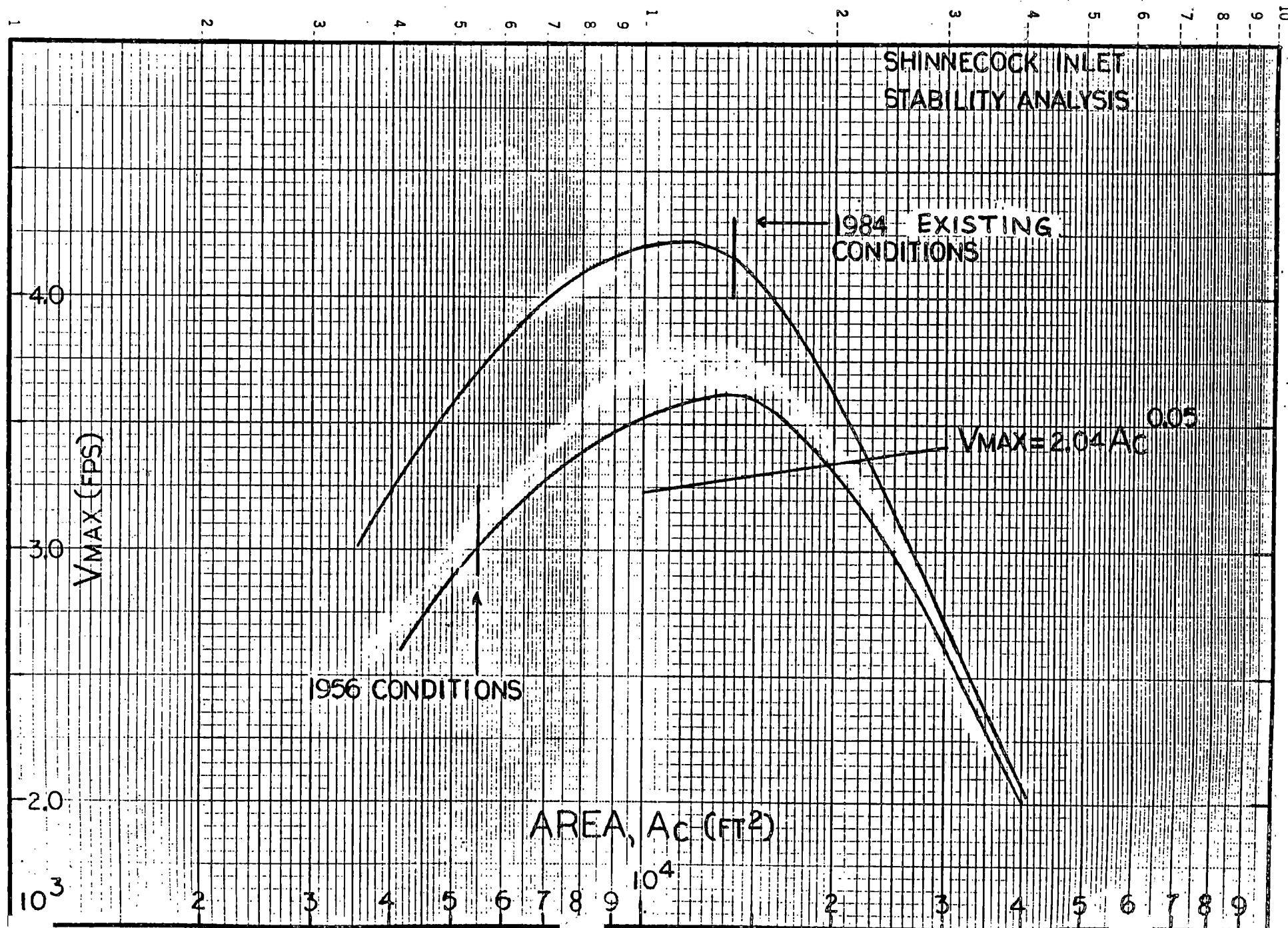
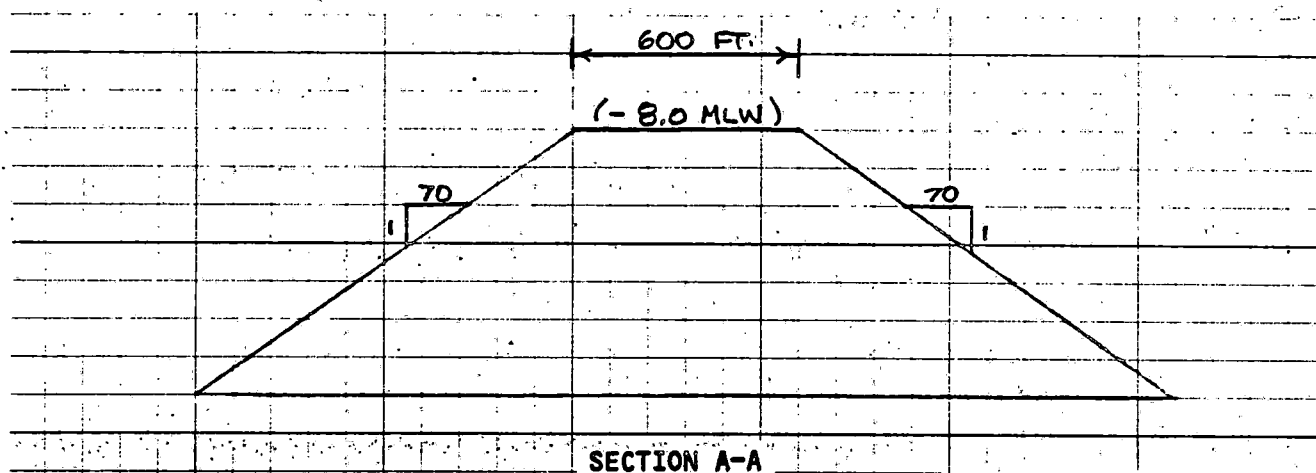
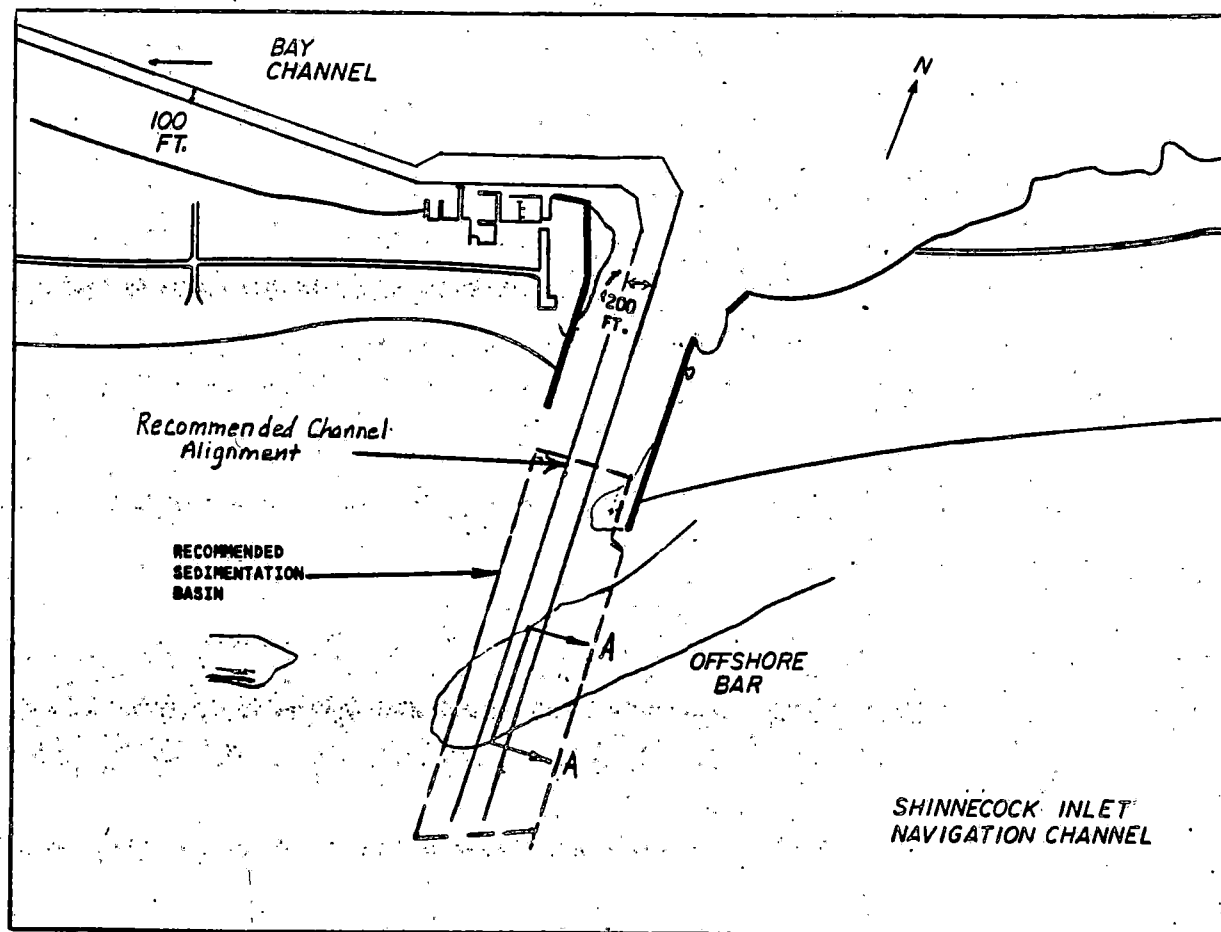
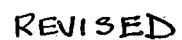


FIGURE C9



RECOMMENDED CHANNEL ALIGNMENT
AND SEDIMENTATION BASIN



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Subject STABILITY ANALYSIS		Project SHINNECOCK INLET	
Computed by:	Date	Checked by	Date

STABILITY CONSIDERATIONS

1. The stability of Shinnecock Inlet was estimated using the inlet analytical hydraulic model (Reference 1) based on principles developed by Keulegan (Reference 2). The model relates the maximum flow velocity in an inlet to the minimum cross-sectional area of the channel. Application of the model to Shinnecock Inlet is contingent upon the assumptions listed below.

- a. The inlet cross-sectional area is uniform over the length of the inlet,
- b. The ocean tide can be represented by a sinusoidal function,
- c. The bay water level rises and falls uniformly,
- d. There is no substantial inflow to the bay other than through the inlet,
- e. and the bay area is constant over all tide ranges.

The results obtained are considered meaningful in the identification of possible inlet trends, and not as a basis for design.

2. The stability analysis is based on the development of a stability curve representative of conditions at a particular inlet. The peak of this curve, which plots a relationship between inlet minimum cross-sectional area and average maximum current velocity, is known as the critical cross-sectional area and is interpreted to be the point of incipient stability. For minimum cross-sectional areas less than the critical area the flow is governed by frictional forces. This results in an inlet unstable to changes in flow area or maximum velocity. When the flow area is reduced by shoaling, or if the velocity is reduced by changed flow characteristics the inlet responds by further reducing area or velocity until the inlet closes. Conversely, an unstable inlet which starts to scour, by either a reduction in sediment supply or an increase in velocity, will continue to scour until the critical flow area is achieved. For cross-sectional areas greater than the critical area, the flow through the inlet is governed by the continuity requirement resulting in an inlet stable to changes in flow area or velocity. In this condition, any change in cross-sectional area will cause the inlet to respond by compensating in such a way as to force its return toward the equilibrium position. A stable inlet can close, however, if the velocity does not exceed the maintenance criterion defined as the velocity needed to scour sand deposits from the inlet channel. This velocity is given by the equation:

$$V_{max} = 2.04 A_c^{0.05}$$

These characteristics are shown on the generalized inlet hydraulic stability curve of Figure 1.

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Computed by	Date	Checked by	Date

3. Using all available hydrographic survey, bay and ocean tide data, and a measured bay area of $4.07 \times 10^8 \text{ ft}^2$, the stability curves of Figure 2 were developed. The lower curve in this figure was developed from 1956 hydrographic and tidal conditions at Shinnecock Inlet. The minimum inlet cross-sectional area of 5500 ft^2 , as determined from the Nov/Dec 1955-Jan 1956 survey, indicates that the inlet was hydraulically unstable at that point in time. This is due to the fact that the minimum area plots on the 'scour' side of the stability curve. The upper curve of Figure 2 was developed from hydrographic survey and tidal data obtained after the Federal emergency dredging of June 1984. A minimum cross-sectional area of $16,600 \text{ ft}^2$ was determined for the inlet using the hydrographic survey of 16 June 1984. This area plots well in the stable range of the 1984 stability curve, indicating that the inlet is currently in a hydraulically stable condition.

4. Information presented in earlier sections of this report supports the conclusion that the inlet is hydraulically stable at the present time. Figure C1 shows that the tide range in Shinnecock Bay, immediately inside the inlet, continually increased from the time the inlet jetties were constructed in 1952 until about 1964. After 1964 the rate of increase appears to level off and fluctuate about an approximate tide range of 3.0 ft. This value is consistent with the 2.9 mean ocean tide range reported by NOAA for Shinnecock Inlet. The tidal prism, defined as the volume of water entering the bay, is the product of the bay tide range and effective bay surface area. An increase in bay tide range is indicative of an increase in tidal prism, which in turn by hydraulic continuity is proportional to an increase in conveyance through the inlet entrance, provided the volume of water exchanged at the other entrances is relatively small and can be neglected. Therefore it is expected that inlet minimum cross-sectional area data should show similar trends to those exhibited by tide range data. It appears that bay tidal data, and consequently inlet cross-sectional areas, support the conclusion that the inlet is in a stable mode.

References Cited:

- 1) O'Brien, M.P. and Dean, R.G. (1972) Hydraulics and Sedimentary Stability of Coastal Inlets, Proceedings: 13th Coastal Engineering Conference.
- 2) Keulegan, G.H., Tidal Flow in Entrances, Water Level Fluctuations of Basins in Communications with SEAS, Corps of Engineers, U.S. Army, June 1967.
- 3) Czerniak, M.T., (Tetra Tech, Inc.) Engineering and Environmental Assessment for the Stabilization and Sand Bypassing of Moriches Inlet, Prepared for NY District Corps of Engineers, Contract DACW-51-75-C-0015, Jan 1976.

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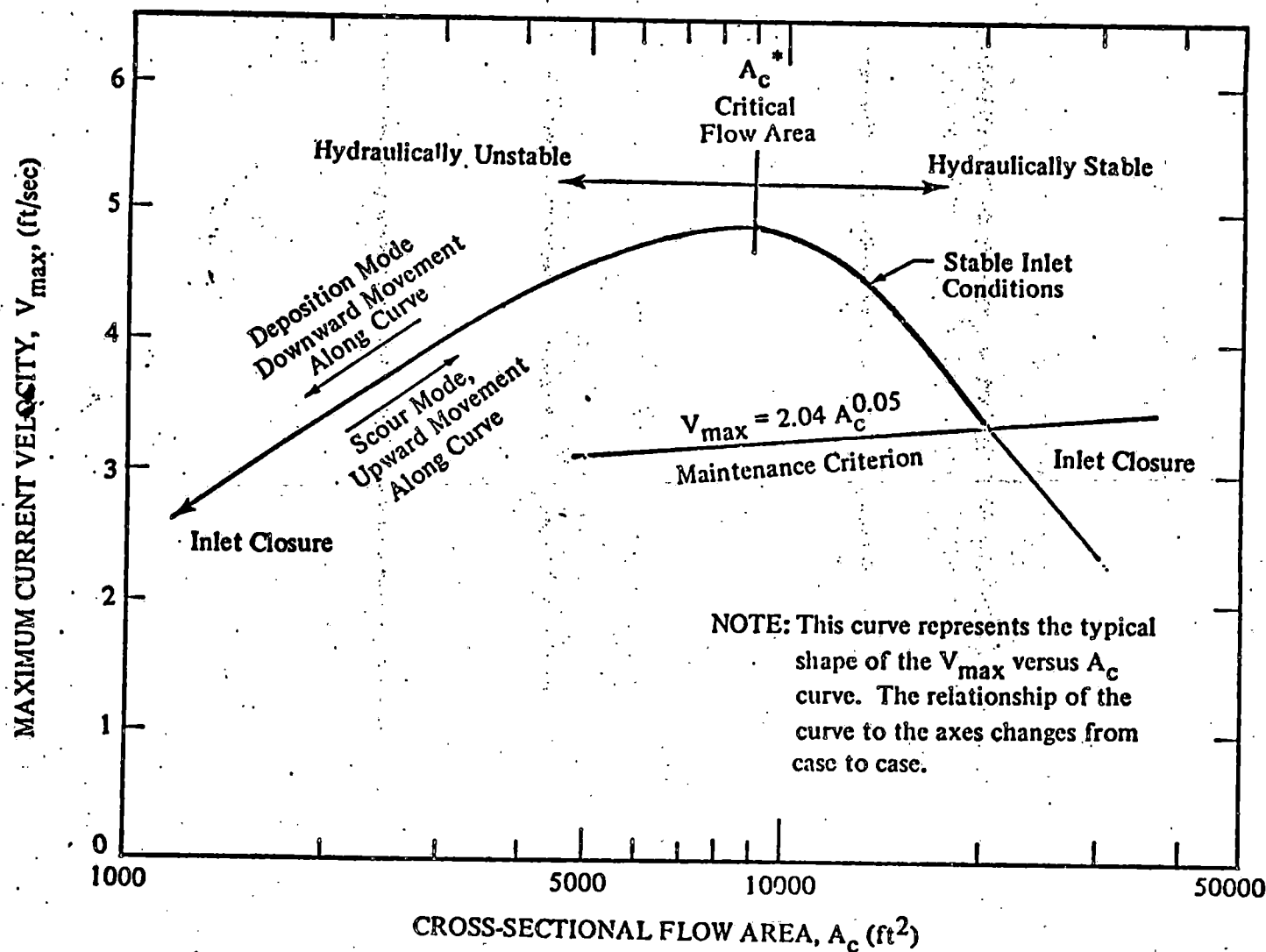
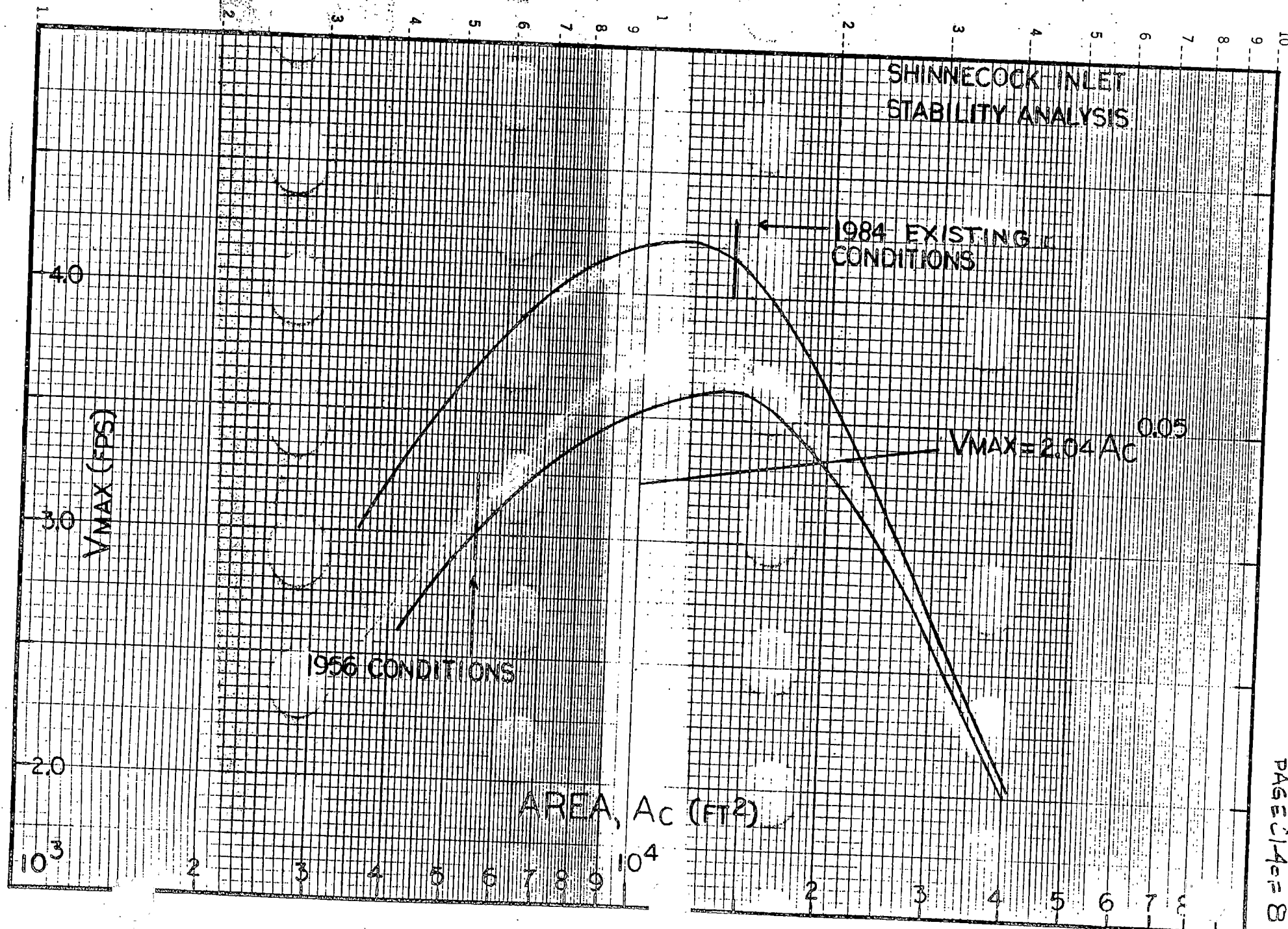


FIGURE 1. Typical Hydraulic Stability Curve Showing Various Inlet Stability Conditions.

SHINNECOCK INLET STABILITY ANALYSIS



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STABILITY ANALYSIS USING O'BRIEN AND DEAN METHOD

$$\text{REPLETION COEFFICIENT } K = \frac{T}{2\pi a_0} \frac{A_c}{A_b} \sqrt{\frac{2g a_0}{K_{en} + K_{ex} + fl/4R}} \quad (\text{EQ. 1})$$

FOR 15 JUNE '84 (POST EMERGENCY DREDGING) CONDITIONS:

$$A_c (\text{FROM FIG. 4}) = 16,600 \text{ FT}^2$$

$$R_H = 19.72 \text{ FT.}$$

$$(\text{USING } R_H = A_c / (W + 2D))$$

$$A_b = 4.07 \times 10^8 \text{ FT}^2 (\text{MEASURED})$$

$$K_{en} + K_{ex} = 1.3 (\text{O'BRIEN + DEAN})$$

$$a_0 = 1.45 \text{ FT. (NOAA)}$$

$$a_b = 1.30 \text{ FT. (TIDE GAGES)}$$

$$T = 12.42 \text{ HRS (44,700 SEC.)}$$

$$f = 0.03$$

FROM FIG. 4 O'BRIEN + DEAN; USING $a_b/a_0 = 0.9$, $K_E = 1.13$

RE-ARRANGING EQ. 1:

$$l_E = \left[\left(\frac{T A_c}{2\pi K A_b} \right)^2 \frac{2g}{a_0} - (K_{en} + K_{ex}) \right] \frac{4R}{f}$$

$$= \left[\frac{(44700(16600))^2 (64.4)}{2\pi (1.13) 4.07 \times 10^8 \cdot 1.45} - 1.3 \right] \frac{4(19.72)}{0.03}$$

$$l_E = 4282$$

USING CONSTANT l_E ,

$$K = \frac{44700}{2\pi (1.45)} \frac{A_c}{4.07 \times 10^8} \sqrt{\frac{64.4 (1.45)}{1.3 + (0.03 (4282))/4R}}$$

$$K = \frac{1.165 \times 10^{-4} A_c}{\sqrt{1.3 + 32.1/R}}; \quad (\text{EQ. 2})$$

$$V_{MAX} = \frac{2\pi a_0}{T} \frac{A_b}{A_c} V'_{MAX}$$

$$= 8.295 \times 10^4 \frac{V'_{MAX}}{A_c}; \quad (\text{EQ. 3})$$

$$P = 2 a_b A_b = 2 a_0 A_b (a_b/a_0); \quad (\text{EQ. 4})$$

$$= 1.1803 \times 10^9 (a_b/a_0)$$

COMPUTATION SHEET			
Subject	STABILITY ANALYSIS	Project	SHINNECOCK INLET
Computed by	DMM	Date	
		Checked by	
		Date	

15 JUNE 1984, STABILITY CALCULATIONS:

STABILITY CALCULATIONS:

TO THE INT.
SQUARE

		(1)	(2)	(3)	(4)	(5)	(6)
A_c (Ft ²)	RH (Ft.)	K	V'_{MAX}	V_{MAX}	Q_{MAX}	a_b/a_o	P (Ft ³)
2000	2.48	0.062	—	—	—	—	—
3000	3.72	0.111	0.105	2.90	8700	0.121	1.428×10^8
4000	4.94	0.167	0.150	3.11	12440	0.185	2.183×10^8
5000	6.15	0.228	0.210	3.48	17400	0.255	3.010×10^8
6000	7.36	0.294	0.270	3.73	22380	0.335	3.954×10^8
7000	8.56	0.363	0.330	3.91	27370	0.405	4.780×10^8
8000	9.76	0.435	0.385	3.99	31920	0.470	5.550×10^8
9000	10.94	0.510	0.445	4.10	36900	0.545	6.433×10^8
10000	12.12	0.586	0.500	4.15	41500	0.610	7.200×10^8
12000	14.46	0.745	0.610	4.22	50640	0.735	8.675×10^8
14000	16.77	0.910	0.690	4.08	57120	0.820	9.678×10^8
16000	19.05	1.079	0.760	3.94	63040	0.885	1.045×10^9
18000	21.30	1.252	0.815	3.76	67680	0.930	1.098×10^9
20000	23.53	1.421	0.865	3.59	71800	0.955	1.127×10^9
25000	29.99	1.892	0.945	3.14	78500	0.985	1.163×10^9
30000	34.29	2.337	0.980	2.71	81300	0.990	1.168×10^9
35000	39.44	2.804	0.990	2.35	82250	0.995	1.174×10^9
40000	44.44	3.277	1.0	2.07	82800	1.0	1.1803×10^9

(1) K FROM (EQ.2)

(2) V'_{MAX} FROM FIG. 3, O'BRIEN + DEAN

(3) V_{MAX} FROM (EQ.3)

(4) $Q_{MAX} = V_{MAX} \times A_c$

(5) a_b/a_o FROM FIG. 4, O'BRIEN + DEAN

(6) P FROM (EQ.4)

FOR MAINTENANCE VELOCITY:

$$V_{MAX} > 2.04 A_c^{0.05}$$

COMPUTATION SHEET			
Subject STABILITY ANALYSIS		Page 1-7 of 8	
Project SHINNECOCK INLET			
Computed by DMM	Date	Checked by	Date

STABILITY ANALYSIS USING O'BRIEN AND DEAN METHOD :

FOR 1955 - JAN 1956 CONDITIONS:

$$A_c = (\text{FROM FIG. }) 5500 \text{ FT}^2$$

$$R_H = 6.76 \text{ FT}$$

$$(\text{USING } R_H = A_c / (W + 2D))$$

$$A_B = 4.07 \times 10^8 \text{ FT}^2 (\text{MEASURED})$$

$$K_{en} + K_{ex} = 1.3 (\text{O'BRIEN} + \text{DEAN})$$

$$a_o = 1.4 \text{ FT. (NOAA)}$$

$$a_b = 0.35 \text{ FT. (SURVEY REPORT)}$$

$$T = 12.42 \text{ HRS (44700 SEC.)}$$

$$f = 0.03$$

FROM FIG. 4 O'BRIEN AND DEAN, USING $a_b/a_o = 0.25$, $K_E = 0.22$

RE-ARRANGING EQUATION 1:

$$L_E = \left[\left(\frac{T A_c}{2\pi K A_B} \right)^2 \frac{2g}{a_o} - (K_{en} + K_{ex}) \right] \frac{4R}{f}$$

$$= \left[\left(\frac{44700 (5500)}{2\pi (0.22) 4.07 \times 10^8} \right)^2 \frac{64.4}{1.4} - (1.3) \right] \frac{4(6.76)}{0.03}$$

$$L_E = 6746 \text{ FT.}$$

USING CONSTANT L_E ,

$$K = \frac{T}{2\pi a_o} \frac{A_c}{A_B} \sqrt{\frac{2g a_o}{K_{en} + K_{ex} + f L_E / 4R}} \quad ; \quad (\text{EQ. 1})$$

$$K = \frac{44700}{2\pi (1.4)} \frac{A_c}{4.07 \times 10^8} \sqrt{\frac{64.4 (1.4)}{1.3 + 50.6/R}}$$

$$K = \frac{1.185 \times 10^{-4} A_c}{\sqrt{1.3 + 50.6/R}} \quad ; \quad (\text{EQ. 2})$$

$$V_{MAX} = 80093 \frac{V'_{MAX}}{A_c} \quad ; \quad (\text{EQ. 3})$$

$$P = 2 a_b A_B = 2 a_o A_B (a_b/a_o)$$

$$P = 1.1396 \times 10^9 (a_b/a_o) \quad ; \quad (\text{EQ. 4})$$

COMPUTATION SHEET			
Subject	STABILITY ANALYSIS	Project	SHINNECOCK INLET
Computed by	DM	Date	
		Checked by	Date

1955 - JAN 1956 STABILITY CALCULATIONS

	(1)	(2)	(3)	(4)	(5)	(6)	
A_c (FT ²)	R_H (FT)	K	V'_{MAX}	V_{MAX}	Q_{MAX}	ab/a_0	P (FT ³)
2000	2.48	0.051	-	-	-	-	-
3000	3.72	0.092	-	-	-	-	-
4000	4.94	0.139	0.125	-	-	-	-
5000	6.15	0.192	0.182	2.50	10,000	0.160	1.823×10^8
6000	7.36	0.249	0.230	2.92	14,600	0.210	2.393×10^8
7000	8.56	0.309	0.285	3.07	18,420	0.280	3.191×10^8
8000	9.76	0.372	0.330	3.26	22,820	0.350	3.989×10^8
9000	10.94	0.438	0.390	3.30	26,400	0.410	4.672×10^8
10000	12.12	0.506	0.435	3.47	31,230	0.480	5.470×10^8
12000	14.46	0.649	0.540	3.48	34,800	0.540	6.154×10^8
14000	16.77	0.798	0.635	3.60	43,200	0.660	7.521×10^8
16000	19.05	0.953	0.710	3.63	50,820	0.760	8.661×10^8
18000	21.30	1.113	0.775	3.55	56,800	0.830	9.459×10^8
20,000	23.53	1.276	0.830	3.45	62,100	0.890	1.014×10^9
25000	29.99	1.714	0.920	3.32	66,400	0.930	1.059×10^9
30,000	34.29	2.134	0.970	2.95	73,750	0.975	1.111×10^9
35000	39.44	2.581	0.990	2.59	77,700	0.990	1.128×10^9
40,000	44.44	3.035	0.995	2.27	79,450	0.995	1.134×10^9
				1.99	79,600	1.0	1.1396×10^9

(1) K FROM (EQ. 2)

(2) V'_{MAX} FROM FIG. 3, O'BRIEN + DEAN

(3) V_{MAX} FROM (EQ. 3)

(4) $Q_{MAX} = V_{MAX} \times A_c$

(5) ab/a_0 FROM FIG. 4, O'BRIEN + DEAN

(6) P FROM (EQ. 4)

FOR MAINTENANCE VELOCITY:

$$V_{MAX} > 2.04 A_c^{0.05}$$

(O'BRIEN + DEAN)

COMPUTATION SHEET

Page 21 of 1Subject Design Wave Analysis - West Jetty
Head Section - Existing Design

Project SHINNECOCK INLET

Computed by

Date 9/86

Checked by

Date

To determine the maximum wave resisted by existing west jetty head section equation 7-116 SPM pg. 205 will be used as follows:

$$W = \frac{w_r H^3}{K_D (S_r - 1)^3 \cot \theta}$$

Where

W = weight in pounds of an individual armor unit in the primary cover layer.

Maximum size of existing head armor units is 12 tons.

w_r = unit weight (sat. surf. dry) of armor unit
lbs/ft³ - use 165 lbs/ft³

H = maximum design wave height at the structure in ft.

S_r = specific gravity of armor relative to water at the structure $S_r = w_r / w_w$
 $S_r = 165 / 64.0 = 2.58$

w_w = unit weight of water, 64.0 lbs/ft³

θ = angle of structure slope
 $\cot \theta = 1.5$

K_D = stability coefficient, for rough angular quarry stone head section, on a 1V on 1.5 H for a breaking wave
use $K_D = 1.9$

Substituting

$$H_{max}^3 = \frac{(24,000)(2.58 - 1)^3 (1.5) (1.9)}{(165)} = 1635.1$$

$$H_{max} = 11.8 \text{ feet}$$

TO THE INCH

5 X 5

SQUARE

COMPUTATION SHEET

Page 5-1 of 2

Subject Design Current Velocity

Project SHINNECOCK INLET

Computed by

Date 9/86

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The maximum velocity of tidal currents in mid channel through a navigation opening can be approximated by Eq 7-12B pg 7-250, SPM:

$$V = \frac{4\pi Ah}{3TS} \quad (7-12B)$$

where:

V = maximum velocity at center of opening

T = Period of Tide (12.4 hrs = 44,640 sec)

A = Surface area of bay ($16 \text{ mi}^2 = 446,054,400 \text{ sq ft}$)

S = Cross-sectional area of opening (16,600 sq ft)

h = range of tides in bay (ft.)

$$V = \frac{4\pi(446,054,400)h}{3(44,650)(16,600)}$$

$$V = 2.52 h$$

For the estimated bay tidal range resulting from a 1938 Hurricane (Recurring) of 4.0 feet (from Fire Island to Montauk BEC, HP Survey Report) to velocity is given

$$V = 2.52(4.0) = 10.1 \text{ ft/sec}$$

$\therefore$ 10 fps is design current velocity at jetty head section

COMPUTATION SHEET

Page C3-2 of 2

Subject Design Current Velocity

Project SHINNECOCK INLET

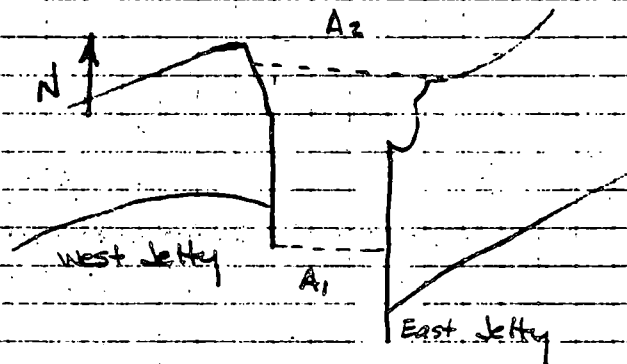
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Date

To estimate a maximum probable design current velocity at the bay shoreline east of the inlet, the Continuity Equation was utilized.



$$Q = VA$$

$Q_1 \equiv Q_2$ where Q_1 and Q_2 are the discharges at the cross sections 1 and 2

$$V_1 A_1 = V_2 A_2$$

$$A_2 \approx 24,000 \text{ ft}^2$$

$$V_2 = V_1 \frac{A_1}{A_2}$$

Substituting in computed maximum probable velocity at the inlet throat and measured cross-sectional areas

$$V_2 = 10 \text{ fps} \times \frac{16,600 \text{ ft}^2}{24,000 \text{ ft}^2} = 6.9 \text{ fps}$$

$$V_2 \approx 7.0 \text{ ft/sec.}$$

This velocity will not however control the revetment design. The revetment design is controlled by wind generated bay waves shown in computation C5. The revetment design is detailed in Computation D1.

COMPUTATION SHEET

Page CA-1 of 4Subject DESIGN WAVE ANALYSIS
WEST/EAST JETTY HEAD SECTProject Shinnecock Inlet GDM

Computed by

Date 9/86

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1. The wave climatology selected for use in this study was available by the U.S. Army Corps Waterways Experiment Station and titled "Atlantic Coast Hindcast, Shallow Water Significant Wave Information" (Ref. 10). The tables used were for station #46. See Tables C-4.1 & C-4.2
2. Refraction and Shoaling coefficients were estimated using a simplified method (Ref. 26). The following assumptions are implicit in this approach:
- a. effects of currents are precluded
 - b. wave-wave interaction precluded
 - c. effects of wave energy reflection on shoals precluded
 - d. attenuation by friction precluded
 - e. assumed straight and 1/ contours

DIRECTION OF WAVE APPROACH	SIGNIF. $\frac{1}{2}$ WAVE HGT @ 30' depth (FT)	WAVE $\frac{1}{2}$ PERIOD (SEC)	REFRACTION $\frac{1}{2}$ SHOALING COEFF K _R K _S		REFRACT SHOALING WAVE HGT (FT)	
			@ 30'	@ 20'	@ 30'	@ 20'
30° - 59.9° (187° - 217°) [45°]	12.5	9.5	0.85	0.89	10.6	11.1
60° - 89.9° (157° - 187°) [15°]	14.2	11	1.06	1.12	15	15.9
90° - 119.9° (127° - 157°) [15°]	14.2	11	1.06	1.12	15	15.9
120° - 149.9° 97° - 127° [45°]	10.8	9.5	0.85	0.89	9.2	9.6

TO THE HCD
S 11
SUNWAY

COMPUTATION SHEET

Page C4-201 4Subject DESIGN WAVE HEIGHT
WEST/EAST JETTY HEAD SECTProject Shinnecock Inlet GDM

Computed by

Date 9/86

Checked by

Date

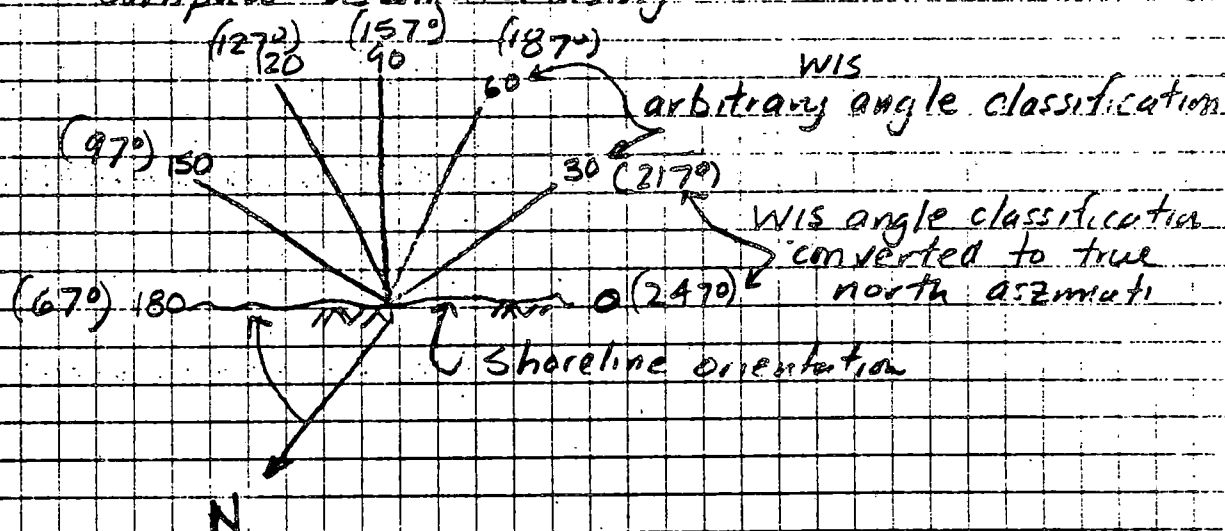
MAXIMUM
WAVE HEIGHT TABLE (CONT'D):DIRECTION OF
WAVE APPROACHSIGNIFICANT
WAVE HGT. λ
30' depth
(FT)WAVE
PERIOD
(sec)K_r's REFRACTED
SHOAL
WAVE HGT
(FT)150-179°
(67°-97°)
[75°]

7.5

6.5

30' 20' @ 20' @ 30'
0.6 0.55 4.5 3.6∴ Maximum Wave Height Expected = 1.6 ft.

NOTES:

1/ Wave direction, height and period obtained
from WIS tables C-4.1, C-4.22/ Wave direction converted to true north
compass azimuth using3/ Average of WIS wave angle section measured
from the shore normal for use in
refraction analysis (Ref 26)4/ Refraction and shoaling coefficient K_r 's
obtain from Ref. 26

COMPUTATION SHEET

Page 64-3 of 7

Subject DESIGN WAVE ANALYSIS -
WEST JETTY HEAD SECTION

Project

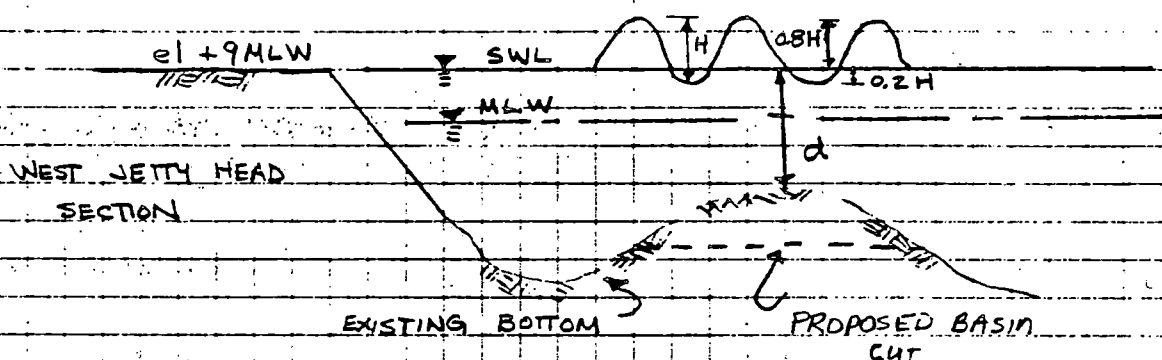
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Date 9 / 86

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Date

The design wave which allows for the full impact of a breaking wave upon the structure (see Chap. 7 Section 7.9, pg. 7-202, SPM) and is limited by the depth of water above the existing bottom ($H = 0.78d$, Eq 2-91, pg 2-130, SPM) is computed assuming a non-linear surface profile as shown below.



TRY SWL = +8 FT MLW

Depth at bar (d_s) = 8 + 14 = 22 ft.

Depth limited wave height = $0.78/22 = 17.16$ ft

Depth of trough below SWL = $0.2(17.16) = 3.43$ ft

elevation of trough = +8 MLW - 3.4 = 4.6 ft MLW

Full Impact Is Not Achieved

IMPROVED

+4.6 ft MLW < +9.0 ft MLW

SWL	d_s	Depth limited wave height	Depth of trough below SWL	Elevation of trough	Full Impact Achieved
+ 8.0 MLW	22	17.16	3.43	4.6	NO
+ 10.0	24	18.7	3.7	6.3	NO
+ 12.0	26	20.3	4.1	7.9	NO
+ 13.0	27	21.1	4.2	8.78	NO
+ 14.0	28	21.8	4.4	9.6	NO

∴ Full IMPACT is achieved for design SWL between +13 MLW and +14 MLW

TRY SWL = +13.2

13.2 27.2 21.2 4.24 8.95 YES

Depth Limited Wave Height = 21.2 ft.
(Improved Condition)

COMPUTATION SHEET

Page C4-4 of 4Subject DESIGN WAVE ANALYSIS
WEST/EAST JETTY HEADProject SHINNECOCK INLET BDM

Computed by

Date 9/86

Checked by

Date

SQUAD 5 X 5 TO THE INCH

EXISTING CONDITION Waves Breaking on Existing Bar

<u>SWL</u>	<u>ds</u>	<u>Depth Limited</u> <u>Wave Height</u>	<u>Depth of Trough</u> <u>below SWL</u>	<u>EL. of</u> <u>Trough</u>	<u>Full Impact</u> <u>Achieved</u>
+8.0 MLW	16'	12.5'	2.5'	+5.5 MLW	NO
+10.0	19'	14.0'	2.8'	+7.2 MLW	NO
+12.0	20'	15.6'	3.1'	+8.9 MLW	YES
+12.5	20.5'	16.0'	3.2'	+9.3 MLW	NO

0. FULL IMPACT IS ACHIEVED FOR EXISTING COND.
SWL = +12 FT MLW

DEPTH LIMITED WAVE HEIGHT = 15.6 FT.
(EXISTING CONDITION)

Design Wave Height for Jetty Head Section = 16 ft.

Based on N.I.S. Hindcast
and Refraction-Shallowing Analysis.

COMPUTATION SHEET

Page C5-1 of 1Subject Design Wave Height for
Proposed RevetmentProject SHINNECOCK INLET

Computed by

Date 9/86

Checked by

Date

To stabilize the bayside of the dune and prevent material losses, a revetment was designed using Corps criteria. Although the shoreline in the vicinity of the proposed revetment is sheltered from the ocean waves it is not sheltered from waves generated within the bay. Using the procedures published in the SPM and ETL 1110-2-221 for generation of shallow water waves, a breaking wave was computed.

Estimated bay depth = -8.0 ft. MLWSurge + Tide level = +7.3 ft MLW(+6.0 ft NGVD)Fetch length = 14,500 ftWind Velocity U_A = 79 mphusing procedures in
ETL 1110-2-221

h (water depth)	H (wave height)	T (wave period)	Figure (SPM)
----------------------	----------------------	----------------------	-----------------

153.33.23-29Assume wave height = 3.3 ftwave period = 3.2 sec

COMPUTATION SHEET

Page 661 of 1

Subject CHANNEL WIDTH DESIGN

Project SHINNECOCK INLET

Computed by LMK

Date 9/86

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Date

TO THE INCH

5 X 5

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The width of the navigation channel at Shinnecock Inlet was determined by the procedure given in EM 1110-2-1615, Hydraulic Design of Small Boat Harbors. Two design vessels, one fishing vessel and one recreational vessel, were chosen for the two-way traffic. The beam width of the design recreational vessel is 15 ft., and the beam width of the design commercial vessel is 22 ft. Allowances for outriggers used by the commercial fishing vessels was included in the channel width.

CHANNEL WIDTH (VESSELS WITH VERY GOOD MANEUVERABILITY)BANK CLEARANCE LANE (COMMERCIAL) $150\% \times 22' = 33 \text{ ft.} *$ MANEUVERING LANE (COMMERCIAL) $160\% \times 22' = 35 \text{ ft.}$ 70 ft. for Outriggers $= 70 \text{ ft.}$ SHIP CLEARANCE LANE (COMMERCIAL) $80\% \times 22' = 13 \text{ ft.}$ MANEUVERING LANE (RECREATIONAL) $160\% \times 15' = 24 \text{ ft.}$ BANK CLEARANCE (RECREATIONAL) $150\% \times 15' = 23 \text{ ft.} *$

203 ft.

The Design Channel Width will be 200 ft.

* Bank Clearance as Per Cent of the vessel beam were increased due to existence of the rubble mound jetties and the adverse weather conditions.

COMPUTATION SHEET			
Subject <i>Shoaling Analysis for a Channel Basin Cut Through An Offshore Bar-Transport Ratio</i>		Page <i>7-1</i> of <i>3</i>	
Project SHINNECOCK INLET			
Computed by	Date <i>9/86</i>	Checked by	Date

TRANSPORT RATIO METHOD
FOR
SHOALING OF A DREDGED CUT
THROUGH THE BAR SEAWARD OF AN INLET

This method was developed by Dr. Cyril Galvin, under contract DACW51-79-C-0046 for the New York District, specifically with reference to Moriches Inlet.

Assumptions. This is an analysis of the shoaling likely to occur in a cut through a typical ocean bar around the mouth of an inlet. The analysis depends on the following assumptions:

1. Sand is set in motion by the shoaling and breaking of waves.
2. Once set in motion, the sand is transported by whatever net currents exist at the site. For the dredged channel, these currents are assumed to be mostly due to the ebb flow of the tidal prism coming out of the inlet.
3. Wave motion is adequately described by linear theory.
4. Sediment motion depends on the bottom shear which is primarily due to the bottom water motion under shoaling and breaking waves.

General Equation. The purpose of this analysis is to compare the sediment transport potential in the dredged cut with the sediment transport on the bar before dredging. The general equation relates sediment transport to the bottom shear which initiates sediment motion and the ambient current which moves the sediment whose motion has been initiated.

$$\text{Sediment Transport Rate} = \text{Coefficient} \times \text{Bottom Shear} \times \text{Ambient Current (1)}$$

Since this analysis compares two conditions in the same environment, it is assumed that the coefficients for pre and post dredging conditions are the same. Thus, the ratio of post dredging to pre-dredging sediment transport is:

$$\text{Transport ratio} = \text{Bottom Shear Ratio} \times \text{Ambient Current Ratio (2)}$$

Bottom Shear Ratio. Shear is proportional to the bottom velocity squared.

$$\tau = \text{constant} \times U^2 \quad (3)$$

COMPUTATION SHEET			
Subject <i>Transport Ratio Method</i>		Project <i>SHINNECOCK INLET</i>	
Computed by	Date <i>9/86</i>	Checked by	Date

Page *7-2* of *8*

The bottom water velocity under linear waves is sinusoidal, and the peak velocity, U , will be used to represent this bottom velocity. In shallow water, for linear theory,

$$U^2 = g H^2 / (4d) \quad (4)$$

If we use a subscript 1 to indicate the condition before dredging and subscript 2 to indicate the condition after dredging, then the bottom shear ratio is

$$\frac{\tau_2}{\tau_1} = \frac{U_2^2}{U_1^2} \quad (4)$$

$$= \frac{H_2^2}{H_1^2} \frac{d_1}{d_2} \quad (5)$$

From conservation of energy flux for linear waves in shallow water,

$$\frac{H_2^2}{H_1^2} = \left(\frac{d_1}{d_2} \right)^{1/2} \quad (6)$$

So the bottom shear ratio turns out to depend entirely on the ratio of pre to post dredging depths.

$$\frac{\tau_2}{\tau_1} = \left(\frac{d_1}{d_2} \right)^{3/2} \quad (7)$$

Ambient Current Ratio. The general equation (1) is blind to whatever causes the ambient current on the bar and dredged cut. For the case of the dredged cut in the bar opposite an inlet, it is assumed that the dominant current is due to the ebb tide. The general relation for the current velocity is

$$V = Q/A \quad (8)$$

where Q is the discharge and A is the channel area. For the two-dimensional unit channel, A equals depth times 1 foot. So the ambient current ratio is,

$$\frac{V_2}{V_1} = \frac{Q_2}{Q_1} \frac{d_1}{d_2} \quad (9)$$

assuming that the discharge will remain the same after dredging and the ambient current ratio is

$$\frac{V_2}{V_1} = \frac{d_1}{d_2} \quad (10)$$

TO THE INLET

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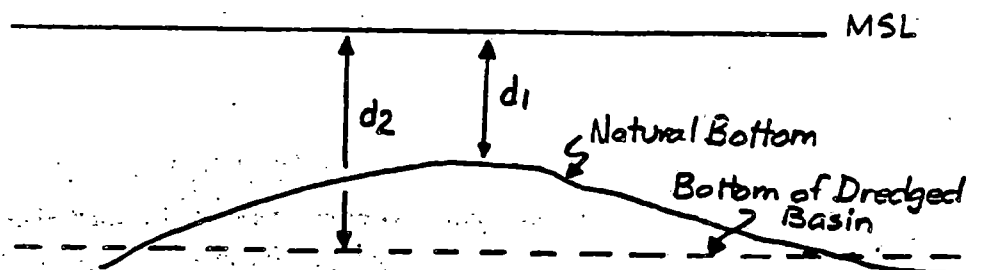
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COMPUTATION SHEET		Page <u>73</u> of <u>8</u>	
Subject <u>Transport Ratio Method</u>		Project <u>SHINNECOCK INLET</u>	
Computed by	Date <u>9/86</u>	Checked by	Date

Transport Ratio. It is now possible to combine the bottom shear ratio with the ambient current ratio to get the transport ratio, post dredging to pre dredging conditions. For the case where $Q_1 = Q_2$ in (10),

$$\text{Transport Ratio} = (d_1/d_2)^{5/2} \quad (11)$$



This ratio may be interpreted as follows, where d_1 and d_2 are defined by the above figure. The table evaluates equation (11) for given values of d_1/d_2 , the ratio of pre to post dredging depth, measured from Mean Sea Level.

$\frac{d_1}{d_2}$	Transport Ratio
0.25	0.031
0.5	0.18
0.7	0.41
0.8	0.57
0.9	0.77
0.95	0.88

The transport ratio is a measure of potential for transporting sediment in the cut after dredging, relative to sediment transport before dredging. For example, if the ratio is 1.0, then as much sand will be taken away by the tidal flow as is brought to the channel. However, as can be seen from equation (11), the only time the transport ratio will be 1.0, equation is when $d_1 = d_2$, that is, the channel is not deepened at all.

If the dredged depth is double the natural depth, d_1/d_2 equals 0.5, then the table indicates the transport ratio is 0.18, or roughly the potential to transport out one cubic yard for every 6 cubic yards carried in from the sides of the channel (which are assumed to remain at pre dredging depth, d_1).

The following is an example calculation for a 500 ft wide deposition basin.
 The natural depth of the shipal is -8.0 ft MLW
 channel design depth is -12.0 ft MLW
 dredge depth is -18.0 ft MLW

Gross Longshore Transport Volume 400,000 cy/yr
 Transport By Passing the Inlet Below -18.0 ft MLW = 2.8 %

SI SHOALING COMPUTATION FOR 1986
 FOR A 500. FOOT WIDE BASIN
 TRANSPORT RATIO METHOD

DEPTH RATIO	INFLUX TRANSPORT VOLUME (CU.YDS./DAY)	TRANSPORT RATIO	CUT OF CHANNEL TRANSPORT VOLUME (CU.YDS./DAY)	CHANNEL SHOAL VOLUME (CU. YDS.)	CHANNEL DEPTH SHOAL (FT./DAY)	NEW CHANNEL DEPTH (FT. MLW)	DAY	CUMULATIVE VOLUME SHOAL (CU.YDS.)	
DEPTH (FT. MLW)									
18.00	0.445	1065.3	0.132	140.3	925.0	0.0263	17.98	1.	925.0
17.98	0.446	1065.3	0.133	140.8	924.5	0.0264	17.95	2.	1849.4
17.95	0.446	1065.3	0.133	141.4	924.0	0.0264	17.93	3.	2773.3
17.93	0.447	1065.3	0.134	141.9	923.4	0.0264	17.90	4.	3696.7
17.90	0.448	1065.3	0.134	142.4	922.9	0.0264	17.87	5.	4619.5
17.87	0.448	1065.3	0.135	142.7	922.4	0.0265	17.85	6.	5541.9
17.85	0.445	1065.3	0.135	143.5	921.9	0.0265	17.82	7.	6463.7
17.82	0.450	1065.3	0.136	144.0	921.3	0.0265	17.79	8.	7385.0
17.79	0.450	1065.3	0.136	144.5	920.8	0.0265	17.77	9.	8305.7
17.77	0.451	1065.3	0.137	145.1	920.2	0.0265	17.74	10.	9225.9
17.74	0.452	1065.3	0.137	145.6	919.7	0.0266	17.71	11.	10145.5
17.71	0.452	1065.3	0.138	146.1	919.2	0.0266	17.69	12.	11064.6
17.69	0.453	1065.3	0.138	146.7	918.6	0.0266	17.66	13.	11983.2
17.66	0.454	1065.3	0.139	147.2	918.1	0.0266	17.63	14.	12901.2
17.63	0.454	1065.3	0.139	147.8	917.5	0.0267	17.61	15.	13818.7
17.61	0.455	1065.3	0.140	148.4	916.9	0.0267	17.58	16.	14735.6
17.58	0.456	1065.3	0.140	148.9	916.4	0.0267	17.56	17.	15651.9
17.56	0.456	1065.3	0.141	149.5	915.8	0.0267	17.53	18.	16567.7
17.53	0.457	1065.3	0.141	150.1	915.2	0.0268	17.50	19.	17482.9
17.50	0.458	1065.3	0.142	150.6	914.7	0.0268	17.47	20.	18397.5
17.47	0.459	1065.3	0.142	151.2	914.1	0.0268	17.45	21.	19311.5
17.45	0.455	1065.3	0.143	151.8	913.5	0.0268	17.42	22.	20225.0
17.42	0.460	1065.3	0.143	152.4	912.9	0.0268	17.39	23.	21137.9
17.39	0.461	1065.3	0.144	153.0	912.3	0.0269	17.37	24.	22050.2
17.37	0.461	1065.3	0.145	153.6	911.8	0.0269	17.34	25.	22961.9
17.34	0.462	1065.3	0.145	154.1	911.2	0.0269	17.31	26.	23873.0
17.31	0.463	1065.3	0.146	154.7	910.6	0.0269	17.29	27.	24783.5
17.29	0.463	1065.3	0.146	155.3	910.0	0.0270	17.26	28.	25693.4
17.26	0.464	1065.3	0.147	156.0	909.4	0.0270	17.23	29.	26602.7

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Subject TRANSPORT RATIO METHOD

Project SHINNECOCK INLET

COMPUTATION SHEET

Page 74 of 8

SI SHCALING COMPUTATION FOR 1986
FOR A 500. FOOT WIDE BASIN
TRANSPORT RATIO METHOD
CONTINUED

DEPTH (FT. MLW)	DEPTH RATIO	INFLOW TRANSPORT VOLUME (CU. YDS./DAY)	TRANSPORT RATIO	CUT OF CHANNEL TRANSPORT VOLUME (CU. YDS./DAY)	CHANNEL SHCAL VOLUME (CU. YDS.)	CHANNEL DEPTH SHOALED (FT./DAY)	NEW CHANNEL DEPTH (FT. MLW)	DAY	CUMULATIVE VOLUME SHOALED (CU. YDS.)
17.23	0.465	1065.3	0.147	156.6	908.7	0.0270	17.21	30.	27511.4
17.21	0.466	1065.3	0.148	157.2	908.1	0.0270	17.18	31.	28419.5
17.18	0.466	1065.3	0.149	157.8	907.5	0.0271	17.15	32.	29326.9
17.15	0.467	1065.3	0.149	158.4	906.9	0.0271	17.13	33.	30233.8
17.13	0.468	1065.3	0.150	159.0	906.3	0.0271	17.10	34.	31140.0
17.10	0.469	1065.3	0.150	159.7	905.6	0.0271	17.07	35.	32045.6
17.07	0.469	1065.3	0.151	160.3	905.0	0.0272	17.04	36.	32950.5
17.04	0.470	1065.3	0.152	160.5	904.4	0.0272	17.02	37.	33854.8
17.02	0.471	1065.3	0.152	161.6	903.7	0.0272	16.99	38.	34758.5
16.99	0.472	1065.3	0.153	162.2	903.1	0.0272	16.96	39.	35661.5
16.96	0.472	1065.3	0.153	162.9	902.4	0.0273	16.94	40.	36563.9
16.94	0.473	1065.3	0.154	163.5	901.8	0.0273	16.91	41.	37465.6
16.91	0.474	1065.3	0.155	164.2	901.1	0.0273	16.88	42.	38366.6
16.88	0.475	1065.3	0.155	164.9	900.4	0.0273	16.85	43.	39267.0
16.85	0.475	1065.3	0.156	165.5	899.8	0.0274	16.83	44.	40166.8
16.83	0.476	1065.3	0.156	166.2	899.1	0.0274	16.80	45.	41065.8
16.80	0.477	1065.3	0.157	166.9	898.4	0.0274	16.77	46.	41964.2
16.77	0.478	1065.3	0.158	167.6	897.7	0.0274	16.74	47.	42861.9
16.74	0.478	1065.3	0.158	168.3	897.1	0.0275	16.72	48.	43758.9
16.72	0.479	1065.3	0.159	168.9	896.4	0.0275	16.69	49.	44655.2
16.69	0.480	1065.3	0.160	169.4	895.7	0.0275	16.66	50.	45550.8
16.66	0.481	1065.3	0.160	170.3	895.0	0.0275	16.63	51.	46445.7
16.63	0.482	1065.3	0.161	171.0	894.3	0.0276	16.61	52.	47339.9
16.61	0.482	1065.3	0.162	171.8	893.6	0.0276	16.58	53.	48233.4
16.58	0.483	1065.3	0.162	172.5	892.8	0.0276	16.55	54.	49126.2
16.55	0.484	1065.3	0.163	173.2	892.1	0.0276	16.52	55.	50018.3
16.52	0.485	1065.3	0.164	173.9	891.4	0.0277	16.50	56.	50909.7
16.50	0.486	1065.3	0.164	174.6	890.7	0.0277	16.47	57.	51800.3
16.47	0.486	1065.3	0.165	175.4	889.9	0.0277	16.44	58.	52690.2
16.44	0.487	1065.3	0.166	176.1	889.2	0.0277	16.41	59.	53579.3
16.41	0.488	1065.3	0.166	176.9	888.5	0.0278	16.39	60.	54467.7
16.39	0.489	1065.3	0.167	177.6	887.7	0.0278	16.36	61.	55355.4
16.36	0.490	1065.3	0.168	178.4	886.9	0.0278	16.33	62.	56242.3
16.33	0.491	1065.3	0.169	179.1	886.2	0.0278	16.30	63.	57128.4
16.30	0.491	1065.3	0.169	179.9	885.4	0.0279	16.27	64.	58013.8
16.27	0.492	1065.3	0.170	180.6	884.7	0.0279	16.25	65.	58898.4
16.25	0.493	1065.3	0.171	181.4	883.9	0.0279	16.22	66.	59782.2
16.22	0.494	1065.3	0.172	182.2	883.1	0.0280	16.19	67.	60665.3
16.19	0.495	1065.3	0.172	183.0	882.3	0.0280	16.16	68.	61547.5
16.16	0.496	1065.3	0.173	183.8	881.5	0.0280	16.14	69.	62429.0
16.14	0.496	1065.3	0.174	184.6	880.7	0.0280	16.11	70.	63309.7
16.11	0.497	1065.3	0.174	185.4	879.9	0.0281	16.08	71.	64189.5
16.08	0.498	1065.3	0.175	186.2	879.1	0.0281	16.05	72.	65068.6
16.05	0.499	1065.3	0.176	187.0	878.3	0.0281	16.02	73.	65946.9
16.02	0.500	1065.3	0.177	187.9	877.5	0.0281	15.99	74.	66824.3
15.99	0.501	1065.3	0.178	188.7	876.7	0.0282	15.97	75.	67700.9
15.97	0.502	1065.3	0.178	189.5	875.8	0.0282	15.94	76.	68576.7
15.94	0.503	1065.3	0.179	190.3	875.0	0.0282	15.91	77.	69451.6
15.91	0.503	1065.3	0.180	191.2	874.1	0.0282	15.88	78.	70325.7
15.88	0.504	1065.3	0.181	192.0	873.3	0.0283	15.85	79.	71198.9
15.85	0.505	1065.3	0.182	192.9	872.4	0.0283	15.83	80.	72071.3

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SI
FOR A 500. FOOT WIDE EASIA
TRANSPORT RATIO METHOD
CONTINUED

DEPTH (FT. MLW)	DEPTH RATIO	INFLOW TRANSPORT VOLUME (CU. YDS./DAY)	TRANSPORT RATIO	CUT OF CHANNEL TRANSPORT VOLUME (CU. YDS./DAY)	CHANNEL SHOAL VOLUME (CU. YDS.)	CHANNEL DEPTH SHOAL (FT./DAY)	NEW CHANNEL DEPTH (FT. MLW)	DAY	CUMULATIVE VOLUME SHOAL (CU. YDS.)
15.83	0.506	1065.3	0.182	193.7	878.6	0.0283	15.80	81.	72942.8
15.80	0.507	1065.3	0.183	194.6	870.7	0.0264	15.77	82.	73613.5
15.77	0.508	1065.3	0.184	195.5	869.8	0.0284	15.74	83.	74683.3
15.74	0.509	1065.3	0.185	196.4	869.0	0.0284	15.71	84.	75552.2
15.71	0.510	1065.3	0.186	197.2	868.1	0.0284	15.68	85.	76420.2
15.68	0.511	1065.3	0.186	198.1	867.2	0.0285	15.66	86.	77287.3
15.66	0.512	1065.3	0.187	199.0	866.3	0.0285	15.63	87.	78153.5
15.63	0.513	1065.3	0.188	199.9	865.4	0.0285	15.60	88.	79018.8
15.60	0.514	1065.3	0.189	200.9	864.4	0.0285	15.57	89.	79883.2
15.57	0.514	1065.3	0.190	201.8	863.5	0.0286	15.54	90.	80746.7
15.54	0.515	1065.3	0.191	202.7	862.6	0.0286	15.51	91.	81609.3
15.51	0.516	1065.3	0.192	203.6	861.7	0.0286	15.48	92.	82470.9
15.48	0.517	1065.3	0.193	204.6	860.7	0.0286	15.46	93.	83331.6
15.46	0.518	1065.3	0.193	205.5	859.8	0.0287	15.43	94.	84191.3
15.43	0.519	1065.3	0.194	206.5	858.8	0.0287	15.40	95.	85050.1
15.40	0.520	1065.3	0.195	207.4	857.9	0.0287	15.37	96.	85907.9
15.37	0.521	1065.3	0.196	208.4	856.9	0.0288	15.34	97.	86764.7
15.34	0.522	1065.3	0.197	209.4	855.9	0.0288	15.31	98.	87620.6
15.31	0.523	1065.3	0.198	210.4	854.9	0.0288	15.28	99.	88475.5
15.28	0.524	1065.3	0.199	211.4	853.9	0.0288	15.26	100.	89329.4
15.26	0.525	1065.3	0.200	212.4	852.9	0.0289	15.23	101.	90182.3
15.23	0.526	1065.3	0.201	213.4	851.9	0.0289	15.20	102.	91034.2
15.20	0.527	1065.3	0.202	214.4	850.9	0.0289	15.17	103.	91885.0
15.17	0.528	1065.3	0.203	215.4	849.9	0.0289	15.14	104.	92734.9
15.14	0.529	1065.3	0.204	216.4	848.9	0.0290	15.11	105.	93583.7
15.11	0.530	1065.3	0.205	217.5	847.8	0.0290	15.08	106.	94431.5
15.08	0.531	1065.3	0.206	218.5	846.8	0.0290	15.05	107.	95278.3
15.05	0.532	1065.3	0.207	219.6	845.7	0.0291	15.02	108.	96123.9
15.02	0.533	1065.3	0.208	220.6	844.7	0.0291	14.99	109.	96968.6
14.99	0.534	1065.3	0.209	221.7	843.6	0.0291	14.97	110.	97812.1
14.97	0.535	1065.3	0.210	222.8	842.5	0.0291	14.94	111.	98654.6
14.94	0.536	1065.3	0.211	223.9	841.4	0.0292	14.91	112.	99496.0
14.91	0.537	1065.3	0.212	225.0	840.3	0.0292	14.88	113.	100336.3
14.88	0.538	1065.3	0.213	226.1	839.2	0.0292	14.85	114.	101175.5
14.85	0.539	1065.3	0.214	227.2	838.1	0.0292	14.82	115.	102013.6
14.82	0.540	1065.3	0.215	228.3	837.0	0.0293	14.79	116.	102850.5
14.79	0.542	1065.3	0.216	229.4	835.9	0.0293	14.76	117.	103686.4
14.76	0.543	1065.3	0.217	230.6	834.7	0.0293	14.73	118.	104521.1
14.73	0.544	1065.3	0.218	231.7	833.6	0.0294	14.70	119.	105354.6
14.70	0.545	1065.3	0.219	232.9	832.4	0.0294	14.67	120.	106187.0
14.67	0.546	1065.3	0.220	234.0	831.3	0.0294	14.64	121.	107018.2
14.64	0.547	1065.3	0.221	235.2	830.1	0.0294	14.62	122.	107848.3
14.62	0.548	1065.3	0.222	236.4	828.9	0.0295	14.59	123.	108677.2
14.59	0.549	1065.3	0.223	237.6	827.7	0.0295	14.56	124.	109504.8
14.56	0.550	1065.3	0.225	238.8	826.5	0.0295	14.53	125.	110331.3
14.53	0.551	1065.3	0.226	240.0	825.3	0.0295	14.50	126.	111156.6
14.50	0.553	1065.3	0.227	241.2	824.1	0.0296	14.47	127.	111980.6
14.47	0.554	1065.3	0.228	242.5	822.9	0.0296	14.44	128.	112803.4
14.44	0.555	1065.3	0.229	243.7	821.6	0.0296	14.41	129.	113625.0
14.41	0.556	1065.3	0.230	244.9	820.4	0.0296	14.38	130.	114445.3

COMPUTATION SHEET

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Checked by _____ Date _____

SI SHCALING COMPUTATION FOR 1986
FOR A 500. FOOT WIDE BASIN
TRANSPORT RATIO METHOD

CONTINUED

DEPTH (FT.-MLW)	DEPTH RATIO	INFLGW TRANSPORT VOLUME (CU. YDS./DAY)	TRANSPORT RATIO	CUT OF CHANNEL TRANSPORT VOLUME (CU. YDS./DAY)	CHANNEL SHCAL VOLUME (CU. YDS.)	CHANNEL DEPTH SHOALED (FT./DAY)	NEW CHANNEL DEPTH (FT.-MLW)	DAY	CUMULATIVE VOLUME SHOALED (CU. YDS.)
14.38	0.557	1065.3	0.232	246.2	819.1	0.0297	14.35	131.	115264.3
14.35	0.558	1065.3	0.233	247.5	817.8	0.0297	14.32	132.	116082.1
14.32	0.559	1065.3	0.234	248.9	816.5	0.0297	14.29	133.	116898.6
14.29	0.561	1065.3	0.235	250.1	815.2	0.0297	14.26	134.	117713.8
14.26	0.562	1065.3	0.236	251.4	813.9	0.0298	14.23	135.	118527.7
14.23	0.563	1065.3	0.238	252.7	812.6	0.0298	14.20	136.	119340.3
14.20	0.564	1065.3	0.239	254.0	811.3	0.0298	14.17	137.	120151.5
14.17	0.565	1065.3	0.240	255.3	810.0	0.0298	14.14	138.	120961.4
14.14	0.566	1065.3	0.241	256.7	808.6	0.0299	14.11	139.	121770.0
14.11	0.568	1065.3	0.243	258.0	807.3	0.0299	14.08	140.	122577.2
14.08	0.569	1065.3	0.244	259.4	805.9	0.0299	14.05	141.	123383.1
14.05	0.570	1065.3	0.245	260.8	804.5	0.0299	14.02	142.	124187.5
14.02	0.571	1065.3	0.247	262.2	803.1	0.0300	13.99	143.	124990.6
13.99	0.572	1065.3	0.248	263.6	801.7	0.0300	13.96	144.	125792.3
13.96	0.574	1065.3	0.249	265.0	800.3	0.0300	13.93	145.	126592.5
13.93	0.575	1065.3	0.251	266.4	798.9	0.0300	13.90	146.	127391.3
13.90	0.576	1065.3	0.252	267.9	797.4	0.0301	13.87	147.	128188.7
13.87	0.577	1065.3	0.253	269.3	796.0	0.0301	13.84	148.	128984.6
13.84	0.578	1065.3	0.255	270.8	794.5	0.0301	13.81	149.	129779.1
13.81	0.580	1065.3	0.256	272.3	793.0	0.0301	13.78	150.	130572.1
13.78	0.581	1065.3	0.257	273.8	791.6	0.0302	13.75	151.	131363.6
13.75	0.582	1065.3	0.258	275.3	790.0	0.0302	13.72	152.	132153.6
13.72	0.584	1065.3	0.260	276.9	788.5	0.0302	13.69	153.	132942.1
13.69	0.585	1065.3	0.262	278.3	787.0	0.0302	13.66	154.	133729.0
13.66	0.586	1065.3	0.263	279.8	785.5	0.0303	13.63	155.	134514.4
13.63	0.588	1065.3	0.265	281.4	783.9	0.0303	13.60	156.	135298.3
13.60	0.589	1065.3	0.266	283.0	782.3	0.0303	13.57	157.	136080.6
13.57	0.590	1065.3	0.268	284.5	780.8	0.0303	13.54	158.	136861.3
13.54	0.592	1065.3	0.269	286.1	779.2	0.0303	13.51	159.	137640.4
13.51	0.593	1065.3	0.271	287.7	777.6	0.0304	13.48	160.	138418.0
13.48	0.594	1065.3	0.272	289.4	775.9	0.0304	13.45	161.	139193.9
13.45	0.596	1065.3	0.274	291.0	774.3	0.0304	13.42	162.	139968.1
13.42	0.597	1065.3	0.275	292.6	772.7	0.0304	13.39	163.	140740.7
13.39	0.598	1065.3	0.277	294.3	771.0	0.0304	13.36	164.	141511.7
13.36	0.600	1065.3	0.278	296.0	769.3	0.0305	13.33	165.	142281.0
13.33	0.601	1065.3	0.280	297.7	767.6	0.0305	13.30	166.	143048.5
13.30	0.602	1065.3	0.282	299.4	765.9	0.0305	13.27	167.	143814.4
13.27	0.604	1065.3	0.283	301.1	764.2	0.0305	13.24	168.	144578.6
13.24	0.605	1065.3	0.285	302.8	762.5	0.0305	13.21	169.	145341.0
13.21	0.607	1065.3	0.286	304.6	760.7	0.0306	13.18	170.	146101.6
13.18	0.608	1065.3	0.288	306.4	758.9	0.0306	13.14	171.	146860.5
13.14	0.609	1065.3	0.290	308.1	757.2	0.0306	13.11	172.	147617.7
13.11	0.611	1065.3	0.291	309.9	755.4	0.0306	13.08	173.	148373.0
13.08	0.612	1065.3	0.293	311.4	753.6	0.0306	13.05	174.	149126.5
13.05	0.614	1065.3	0.295	313.6	751.7	0.0307	13.02	175.	149878.1
13.02	0.615	1065.3	0.297	315.4	749.9	0.0307	12.99	176.	150628.0
12.99	0.617	1065.3	0.298	317.3	748.0	0.0307	12.96	177.	151375.9
12.96	0.618	1065.3	0.300	319.2	746.1	0.0307	12.93	178.	152122.0
12.93	0.619	1065.3	0.302	321.1	744.2	0.0307	12.90	179.	152866.2

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Project SHINNECOCK INLET

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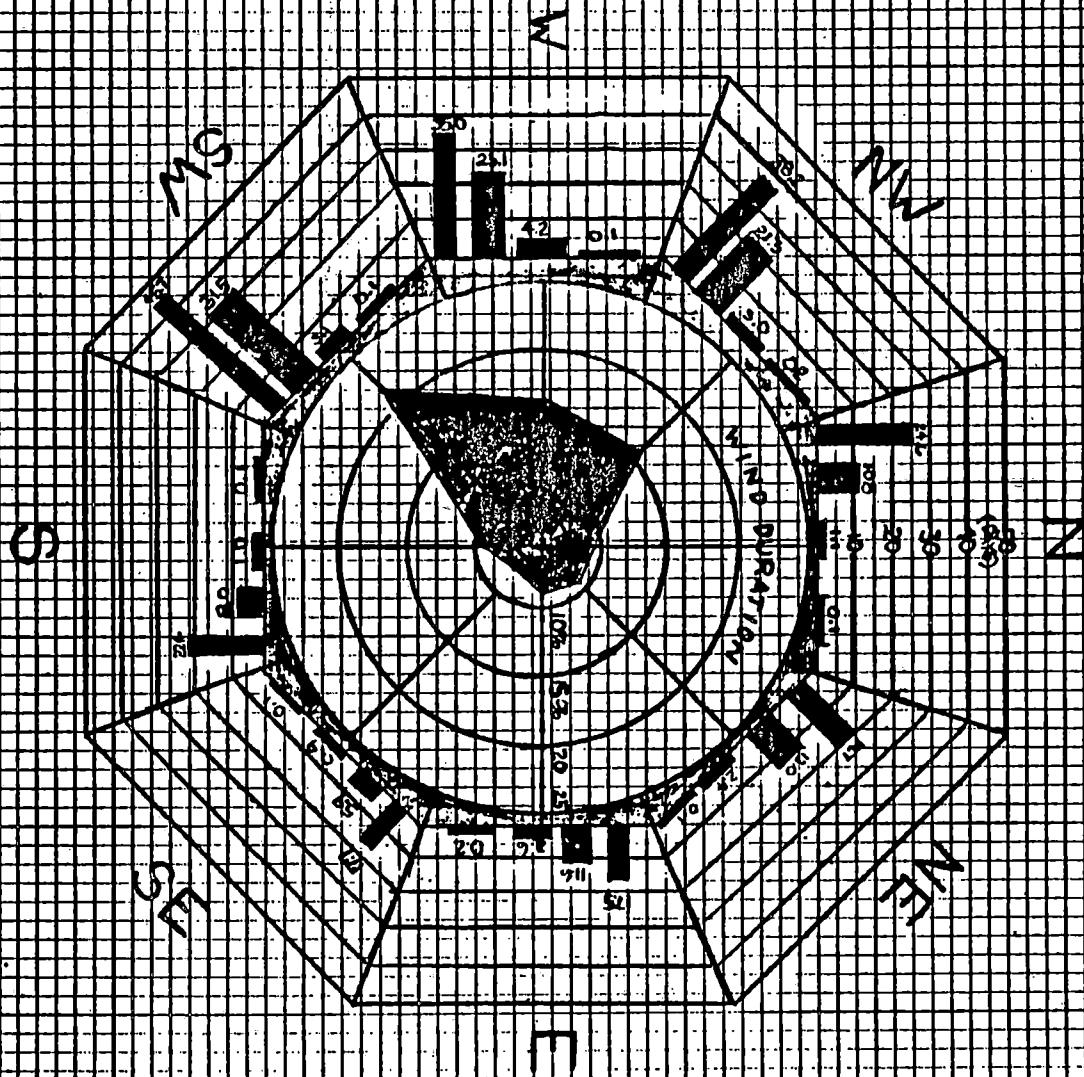
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SI
FUR A 500. FOOT PICE BASIN
SPECIALING COMPUTATION FOR 1986
CONTINUED
TRANSPORT RATIO METHOD

DEPTH (FT./MLR)	DEPTH RATIO	INFLUX VOLUME (CU.YDS./DAY)	TRANSPORT RATIO	TRANSPORT VOLUME (CU.YDS./DAY)	CLT OF CHANNEL TRANSPORT VOLUME (CU.YDS./DAY)	CHANNEL DEPTH (FT./DAY)	CHANNEL DEPTH (FT./MLR)	DAY	CUMULATIVE VOLUME SHOULDED (CU.YDS.)
12.90	0.621	1065.3	0.304	323.0	72.3	0.0307	12.87	180.	153608.5
12.84	0.620	1065.3	0.307	326.9	73.5	0.0304	12.84	181.	154348.6
12.81	0.625	1065.3	0.305	326.6	73.5	0.0304	12.81	182.	155087.2
12.78	0.627	1065.3	0.311	329.6	74.5	0.0308	12.78	183.	155823.7
12.75	0.628	1065.3	0.313	332.6	75.5	0.0308	12.75	184.	156558.1
12.72	0.630	1065.3	0.315	336.8	76.5	0.0308	12.72	185.	157290.6
12.68	0.631	1065.3	0.317	336.8	77.5	0.0308	12.68	186.	158021.0
12.65	0.633	1065.3	0.319	338.9	78.5	0.0308	12.65	187.	158749.4
12.62	0.634	1065.3	0.321	341.0	79.5	0.0308	12.62	188.	159475.8
12.59	0.636	1065.3	0.323	343.1	80.5	0.0309	12.59	189.	160208.1
12.56	0.638	1065.3	0.324	345.2	81.5	0.0309	12.56	190.	160922.3
12.53	0.641	1065.3	0.326	347.3	82.5	0.0309	12.53	191.	161642.3
12.50	0.643	1065.3	0.329	349.4	83.5	0.0309	12.50	192.	162360.3
12.47	0.642	1065.3	0.331	351.6	84.5	0.0309	12.47	193.	163076.1
12.44	0.644	1065.3	0.333	353.8	85.5	0.0309	12.44	194.	163789.8
12.41	0.646	1065.3	0.335	356.0	86.5	0.0309	12.41	195.	164501.2
12.38	0.647	1065.3	0.337	358.2	87.5	0.0309	12.38	196.	165210.5
12.35	0.649	1065.3	0.339	360.5	88.5	0.0309	12.35	197.	165917.5
12.32	0.650	1065.3	0.341	362.7	89.5	0.0309	12.32	198.	166622.3
12.28	0.652	1065.3	0.343	365.0	90.5	0.0309	12.28	199.	167324.9
12.25	0.654	1065.3	0.345	367.3	91.5	0.0309	12.25	200.	168025.1
12.22	0.655	1065.3	0.347	369.6	92.5	0.0309	12.22	201.	168723.1
12.19	0.657	1065.3	0.350	372.0	93.5	0.0309	12.19	202.	169418.7
12.16	0.659	1065.3	0.352	374.3	94.5	0.0309	12.16	203.	170112.0
12.13	0.660	1065.3	0.354	376.7	95.5	0.0309	12.13	204.	170802.9
12.10	0.662	1065.3	0.356	379.1	96.5	0.0309	12.10	205.	171491.4
12.07	0.664	1065.3	0.359	381.6	97.5	0.0309	12.07	206.	172177.5
12.04	0.667	1065.3	0.363	384.0	98.5	0.0309	12.04	207.	172861.2
12.01	0.669	1065.3	0.366	386.3	99.5	0.0309	12.01	208.	173542.4
11.98	0.671	1065.3	0.369	388.6	100.5	0.0309	11.98	209.	174221.2
11.94	0.673	1065.3	0.371	390.9	101.5	0.0309	11.94	210.	174897.4
11.90	0.675	1065.3	0.373	393.2	102.5	0.0309	11.90	211.	175571.6

WIND DIAGRAM

SOUTH SHORE OF LONG ISLAND
20 YR. AVERAGE (1940-1959)



LEGEND

VELOCITY RANGE (MPH)

0 TO 12

OVER 12 TO 20

OVER 20 TO 30

OVER 30

Spent
1/2/58

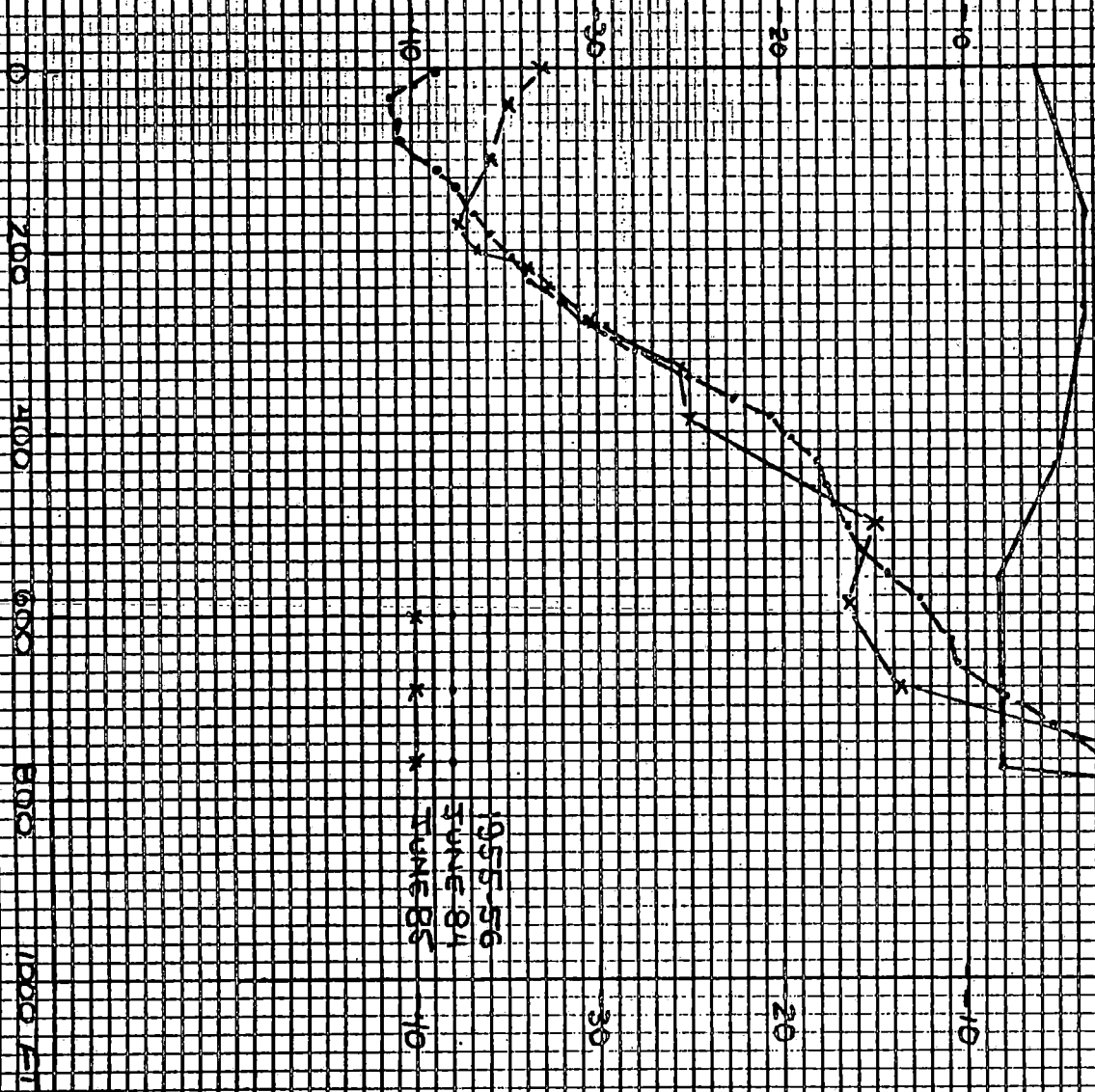
SHINECOCK INLET
COMPARATIVE CHANNEL
CROSS SECTIONS

STA 2+00

WEST
BENT

EAST
BENT

0 (F.M.W.)



1955-56
JUNE 56
JUNE 85

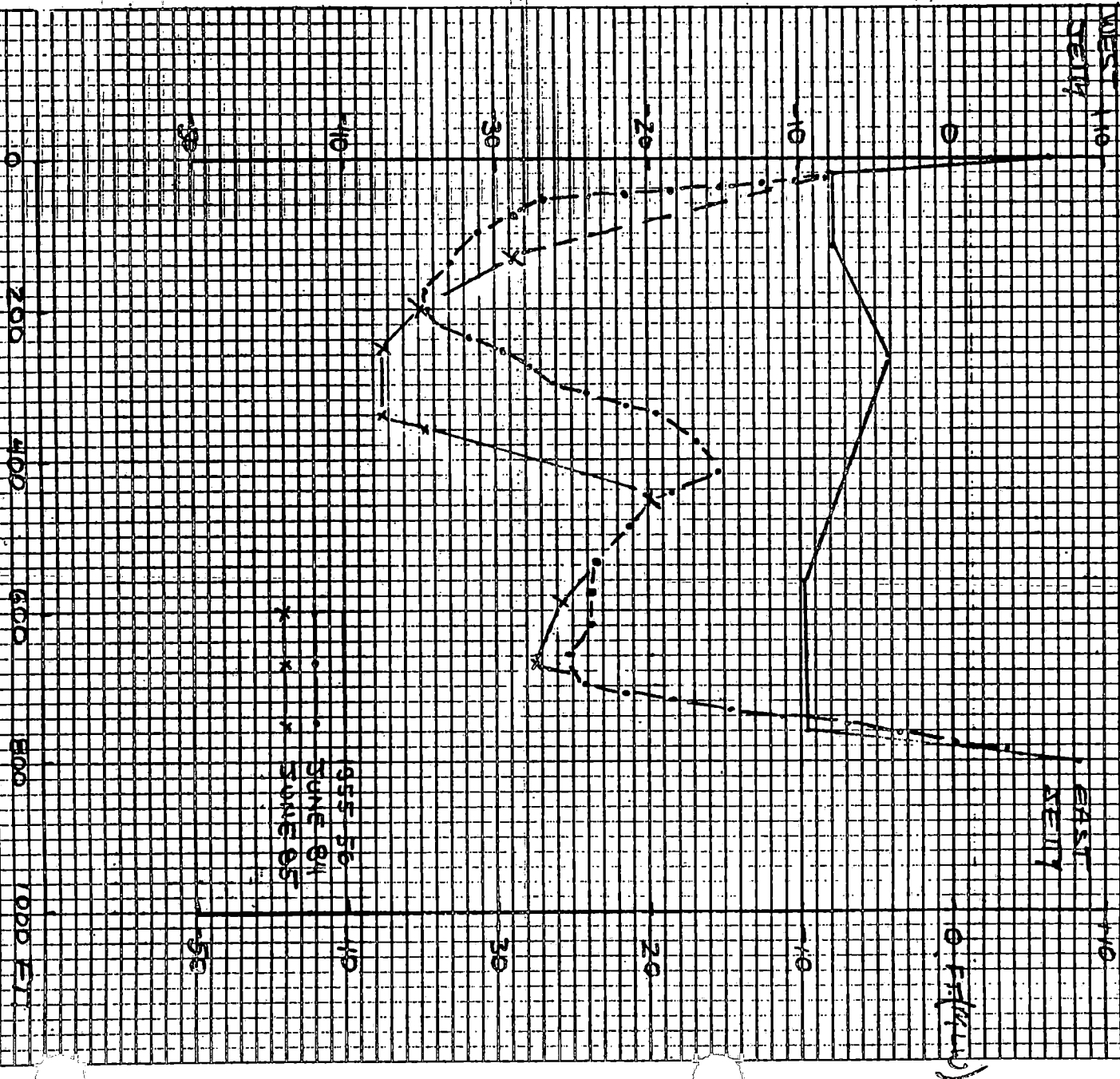
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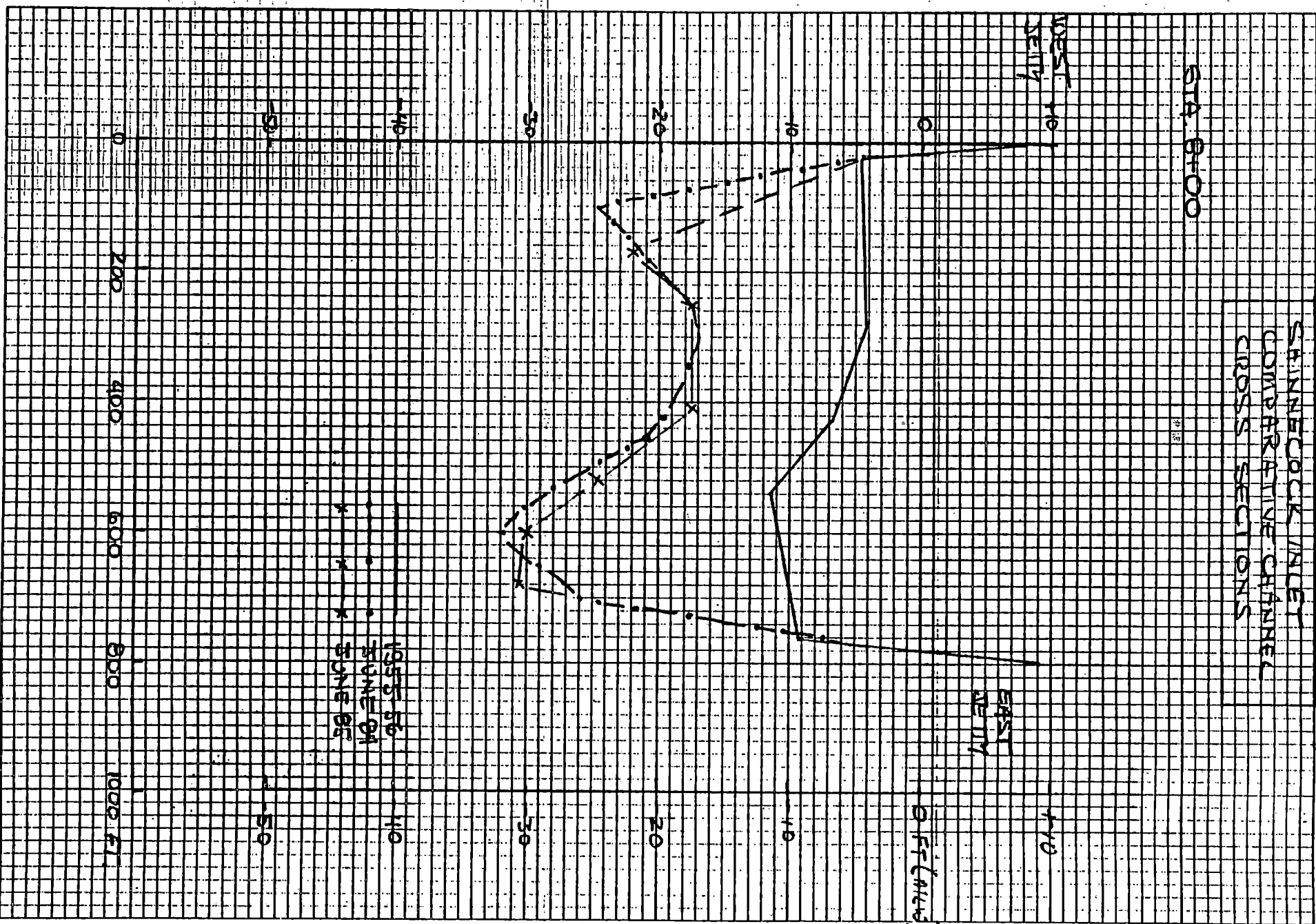
FIGURE C3-3



SHINNECOCK INLET
COMPARATIVE CHANNEL
CROSS SECTIONS

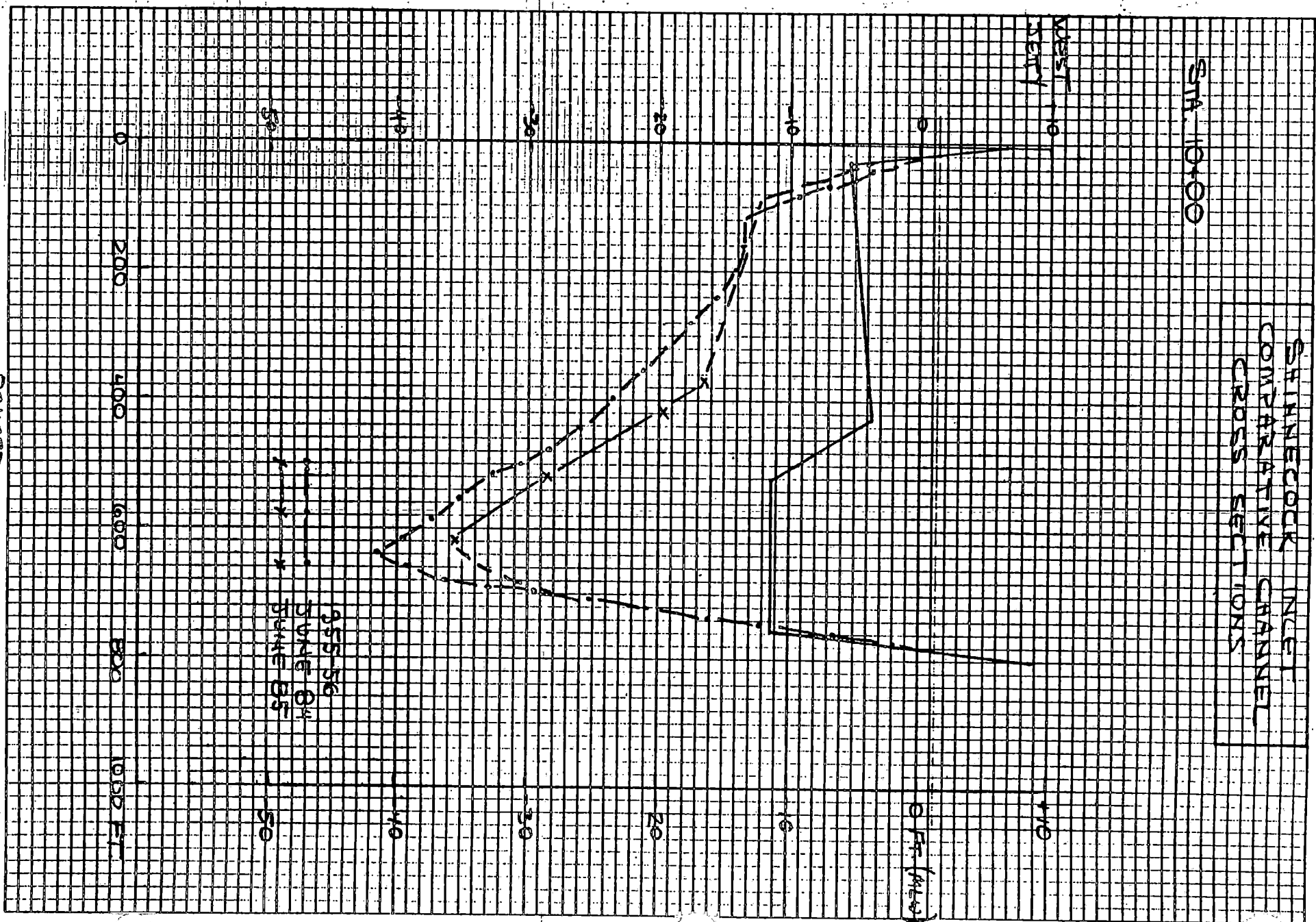
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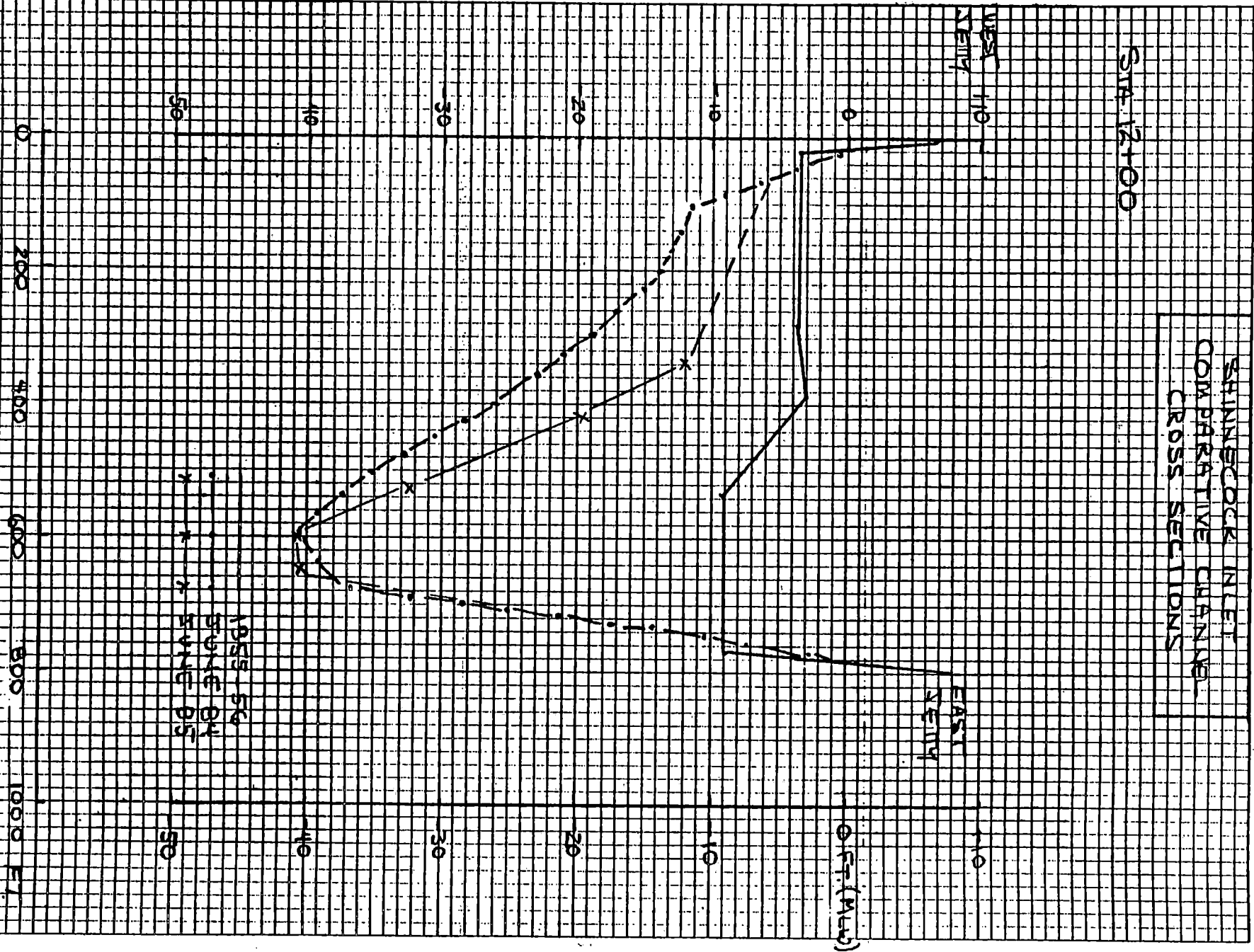
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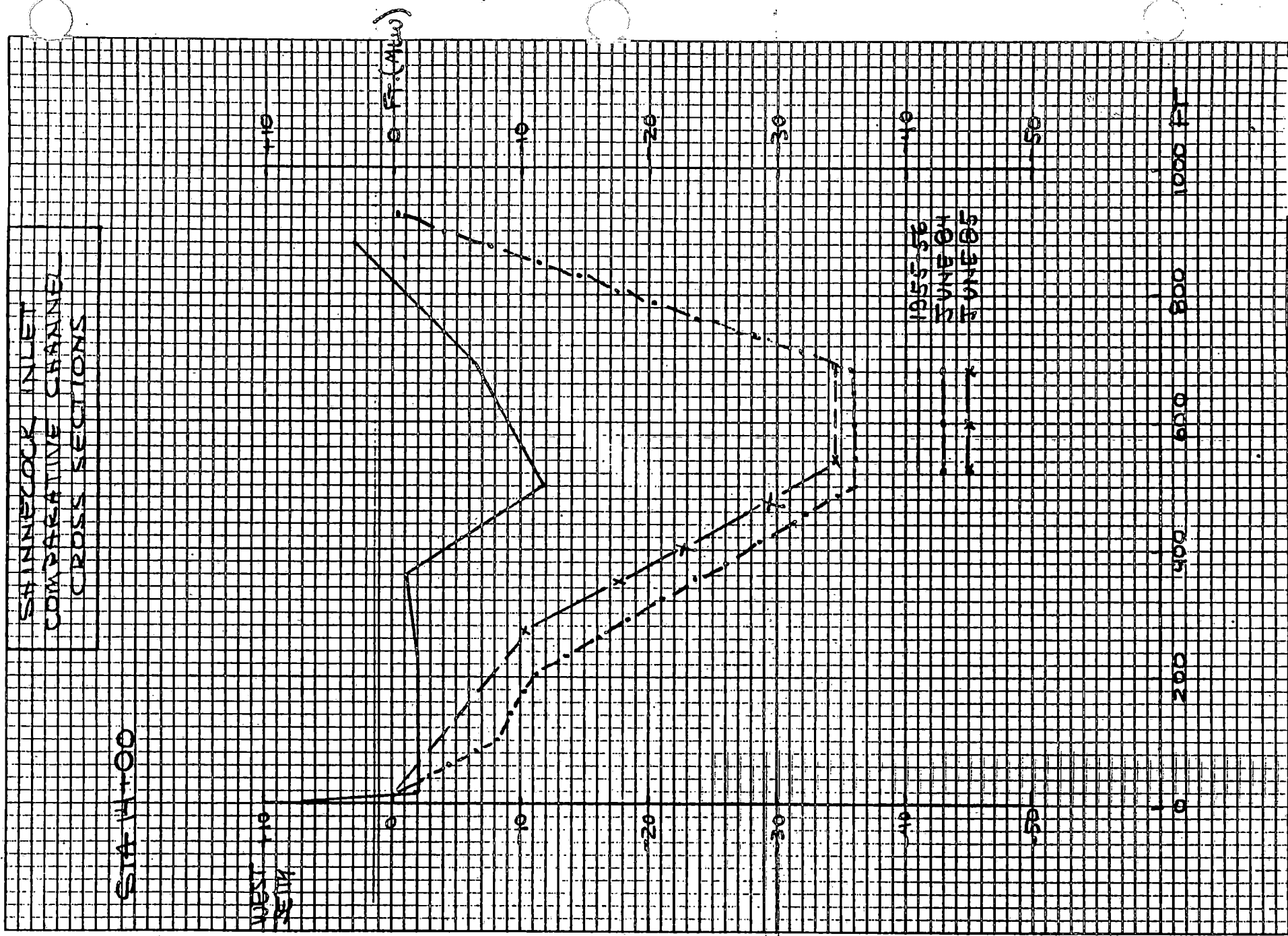
REVISED

FIGURE C3-7



REVISED

FIGURE C3-8

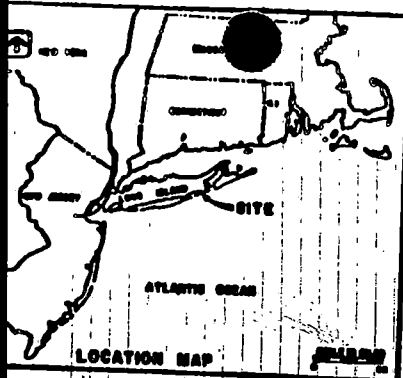


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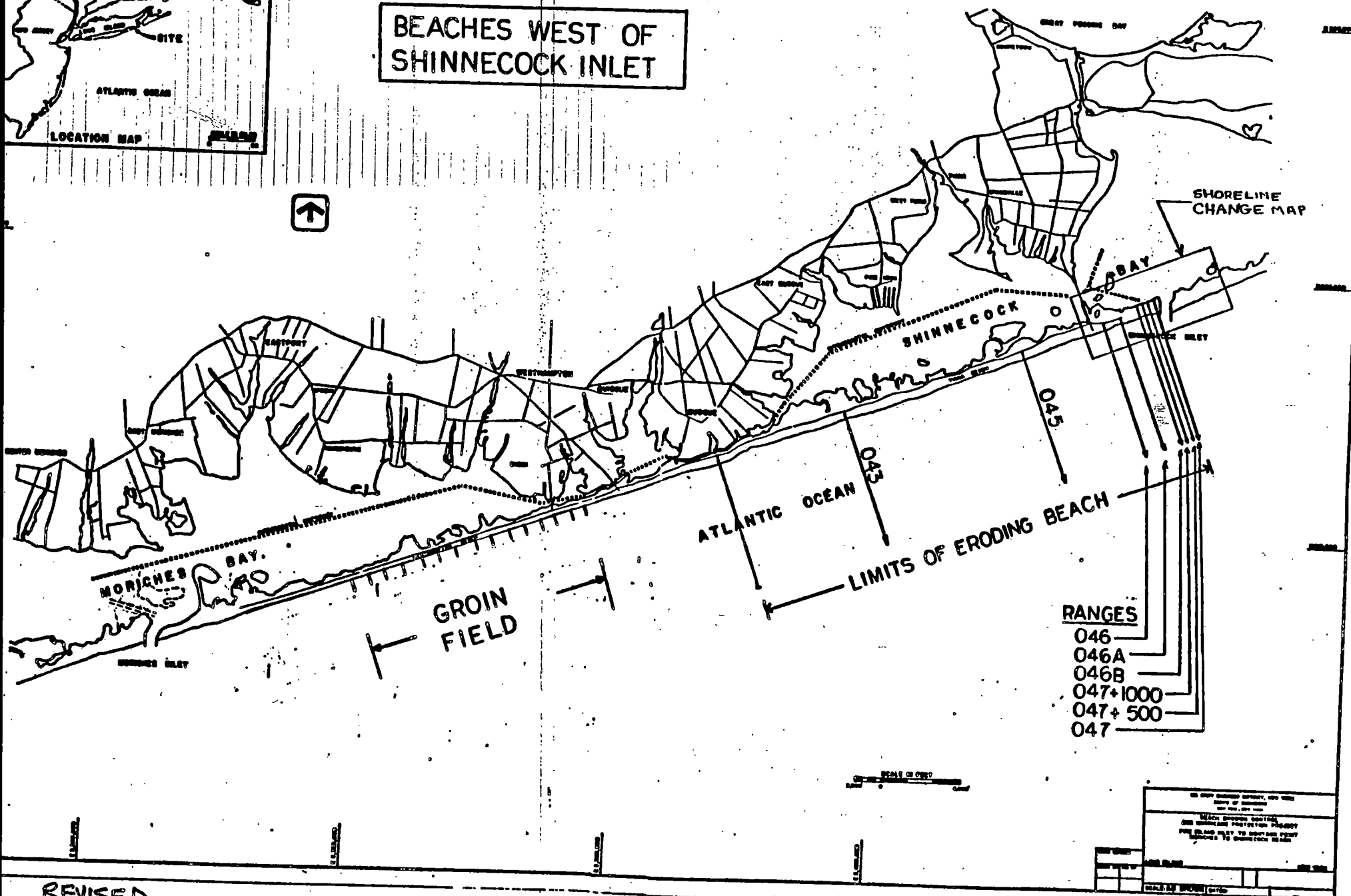
FIGURE C3-9

46:0703

K&E
10 X 10 TO THE INCH = 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.



BEACHES WEST OF SHINNECOCK INLET

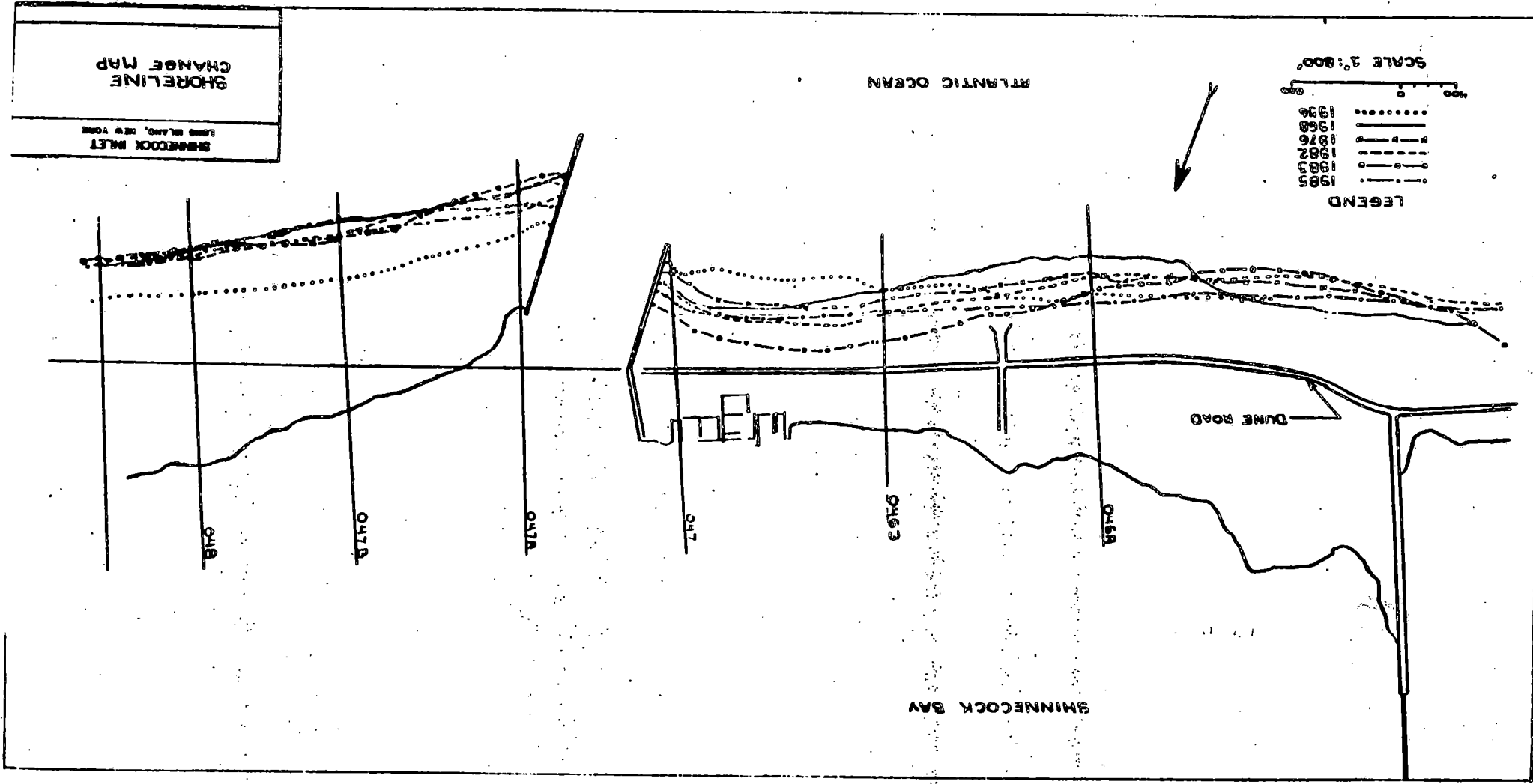


REVISED

FIGURE C4

REVISED

FIGURE 25



LEGEND

FLOOD DELTA MHW LINES

- Δ— 1956
- x— 1968
- 1978
- o— 1982
- — 1985

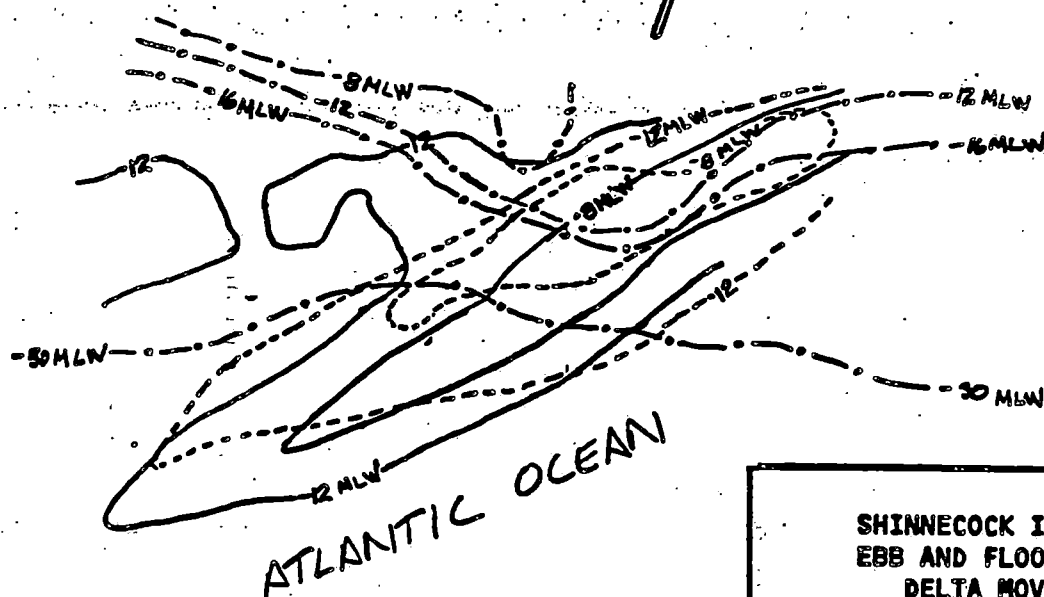


SHINNECOCK BAY

LEGEND

EBB DELTA CONTOURS

- DEC. 1955
- JUNE 1984
- JUNE 1985



SHINNECOCK INLET

ATLANTIC OCEAN

SHINNECOCK INLET GDM
EBB AND FLOOD TIDAL
DELTA MOVEMENT

REVISED

FIGURE C6

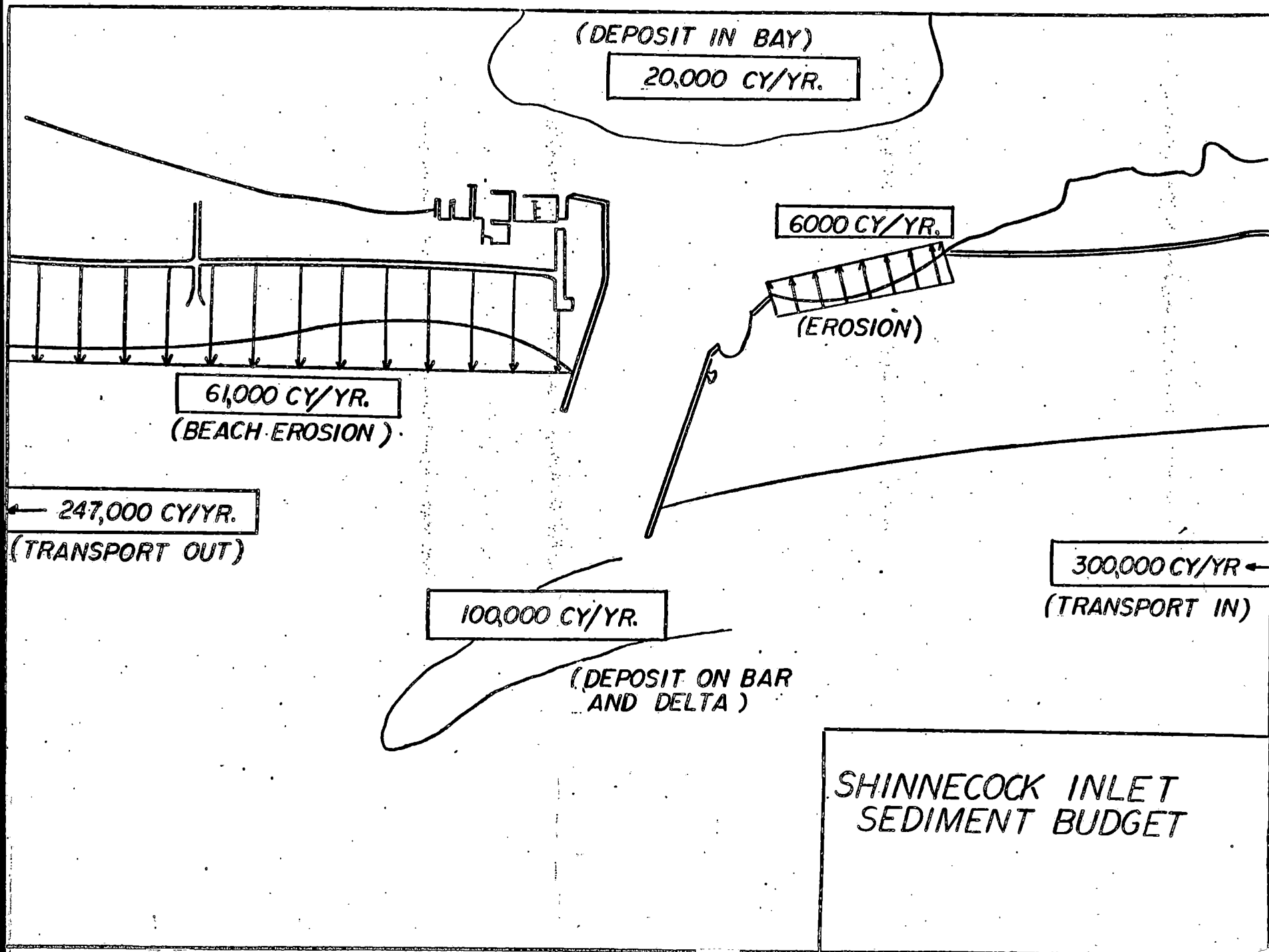


FIGURE C7

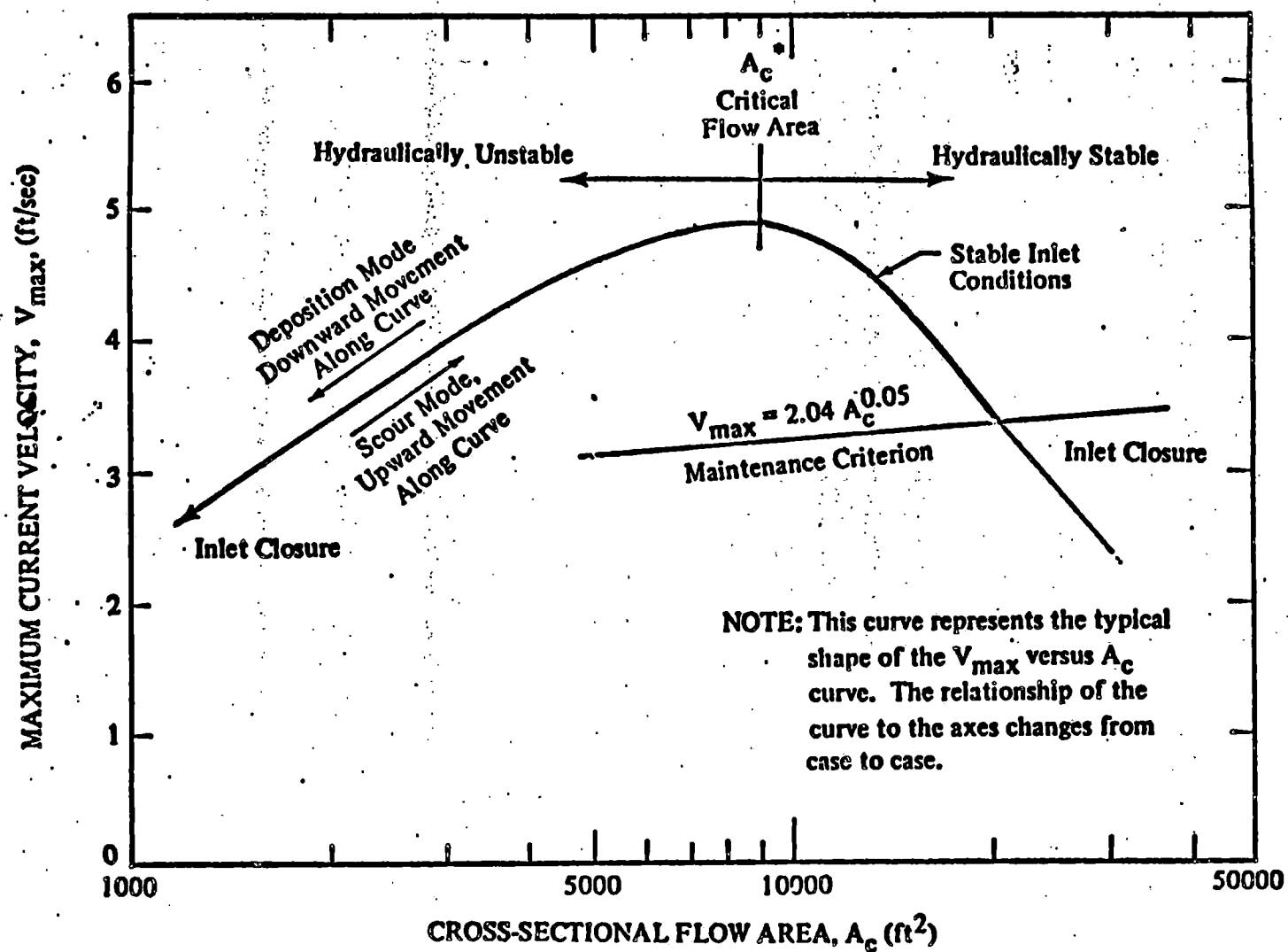


FIGURE C8 Typical Hydraulic Stability Curve Showing Various Inlet Stability Conditions.

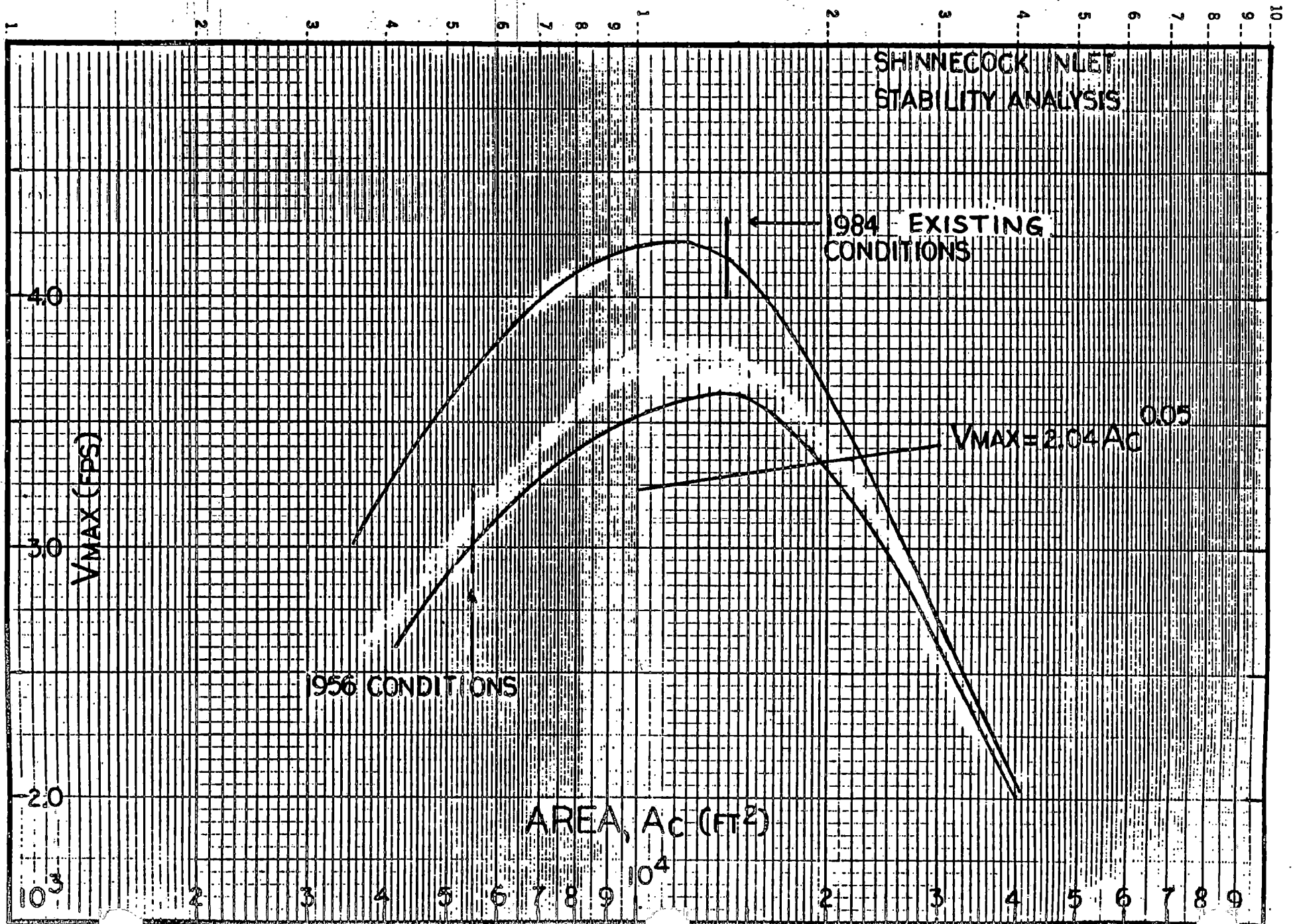
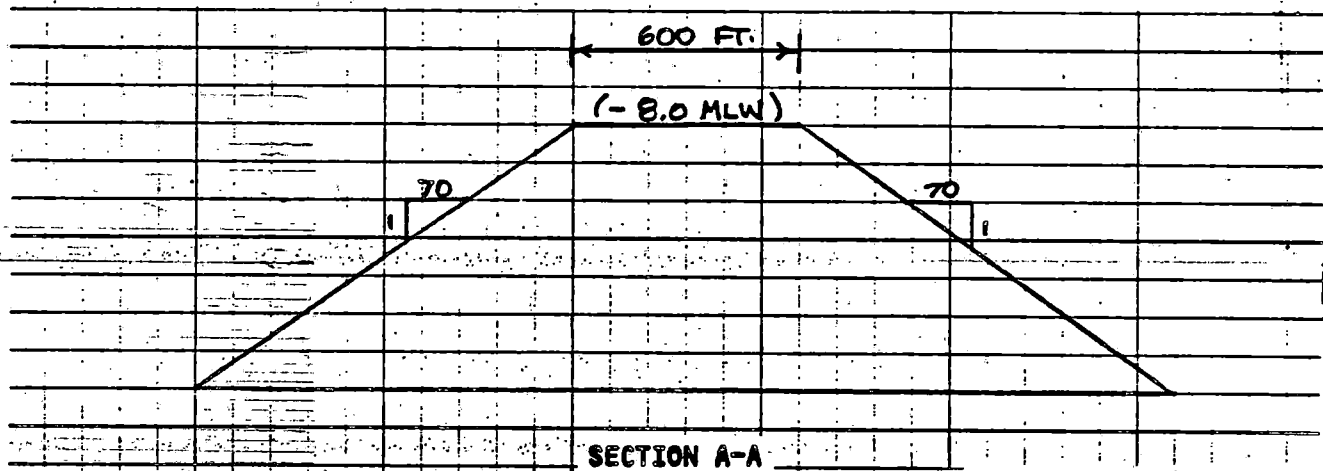
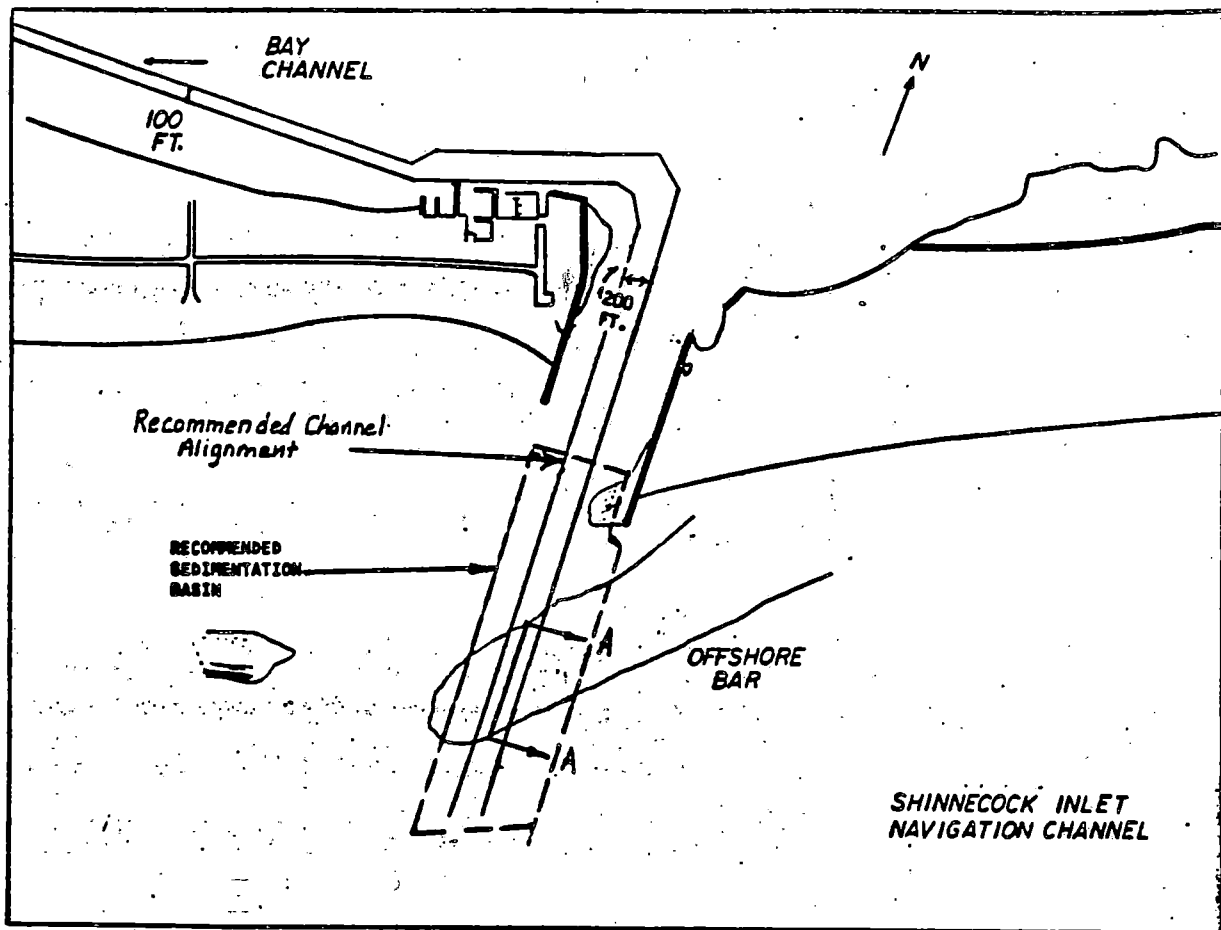
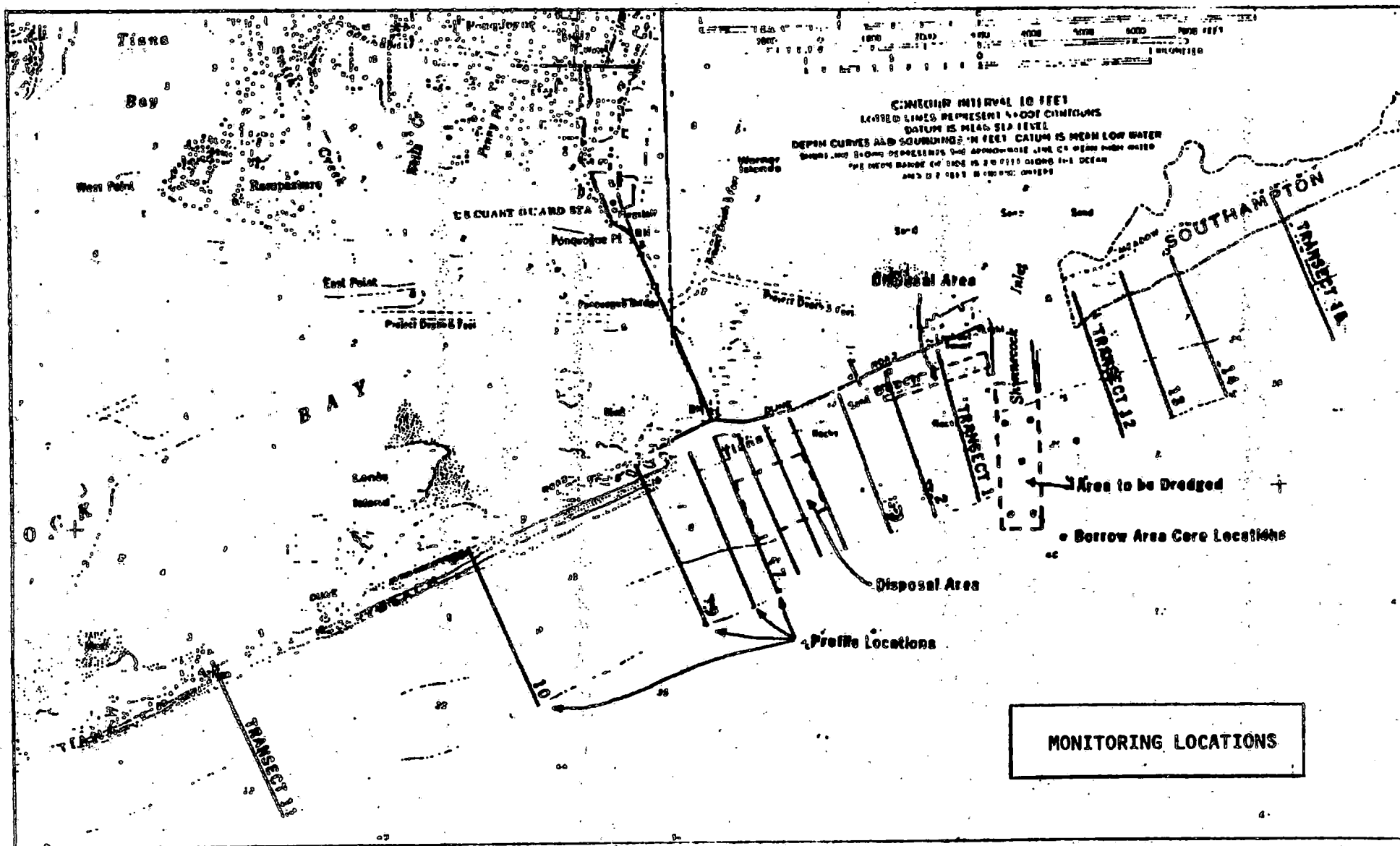


FIGURE C9



RECOMMENDED CHANNEL ALIGNMENT
AND SEDIMENTATION BASIN



REVISED

FIGURE C11

COMPUTATION SHEET		Page <u>C1-1</u> of <u>8</u>	
Subject STABILITY ANALYSIS		Project SHINNECOCK INLET	
Computed by	Date	Checked by	Date

STABILITY CONSIDERATIONS

1. The stability of Shinnecock Inlet was estimated using the inlet analytical hydraulic model (Reference 1) based on principles developed by Keulegan (Reference 2). The model relates the maximum flow velocity in an inlet to the minimum cross-sectional area of the channel. Application of the model to Shinnecock Inlet is contingent upon the assumptions listed below.

- a. The inlet cross-sectional area is uniform over the length of the inlet,
- b. The ocean tide can be represented by a sinusoidal function,
- c. The bay water level rises and falls uniformly,
- d. There is no substantial inflow to the bay other than through the inlet,
- e. and the bay area is constant over all tide ranges.

The results obtained are considered meaningful in the identification of possible inlet trends, and not as a basis for design.

2. The stability analysis is based on the development of a stability curve representative of conditions at a particular inlet. The peak of this curve, which plots a relationship between inlet minimum cross-sectional area and average maximum current velocity, is known as the critical cross-sectional area and is interpreted to be the point of incipient stability. For minimum cross-sectional areas less than the critical area the flow is governed by frictional forces. This results in an inlet unstable to changes in flow area or maximum velocity. When the flow area is reduced by shoaling, or if the velocity is reduced by changed flow characteristics the inlet responds by further reducing area or velocity until the inlet closes. Conversely, an unstable inlet which starts to scour, by either a reduction in sediment supply or an increase in velocity, will continue to scour until the critical flow area is achieved. For cross-sectional areas greater than the critical area, the flow through the inlet is governed by the continuity requirement resulting in an inlet stable to changes in flow area or velocity. In this condition, any change in cross-sectional area will cause the inlet to respond by compensating in such a way as to force its return toward the equilibrium position. A stable inlet can close, however, if the velocity does not exceed the maintenance criterion defined as the velocity needed to scour sand deposits from the inlet channel. This velocity is given by the equation:

$$V_{max} = 2.04 A_c^{0.05}$$

These characteristics are shown on the generalized inlet hydraulic stability curve of Figure 1.

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Subject STABILITY ANALYSIS		Project SHINNECOCK INLET	
Computed by	Date	Checked by	Date

3. Using all available hydrographic survey, bay and ocean tide data, and a measured bay area of $4.07 \times 10^6 \text{ ft}^2$, the stability curves of Figure 2 were developed. The lower curve in this figure was developed from 1956 hydrographic and tidal conditions at Shinnecock Inlet. The minimum inlet cross-sectional area of 5500 ft^2 , as determined from the Nov/Dec 1955-Jan 1956 survey, indicates that the inlet was hydraulically unstable at that point in time. This is due to the fact that the minimum area plots on the 'scour' side of the stability curve. The upper curve of Figure 2 was developed from hydrographic survey and tidal data obtained after the Federal emergency dredging of June 1984. A minimum cross-sectional area of $16,600 \text{ ft}^2$ was determined for the inlet using the hydrographic survey of 16 June 1984. This area plots well in the stable range of the 1984 stability curve, indicating that the inlet is currently in a hydraulically stable condition.

4. Information presented in earlier sections of this report supports the conclusion that the inlet is hydraulically stable at the present time. Figure C1 shows that the tide range in Shinnecock Bay, immediately inside the inlet, continually increased from the time the inlet jetties were constructed in 1952 until about 1964. After 1964 the rate of increase appears to level off and fluctuate about an approximate tide range of 3.0 ft. This value is consistent with the 2.9 mean ocean tide range reported by NOAA for Shinnecock Inlet. The tidal prism, defined as the volume of water entering the bay, is the product of the bay tide range and effective bay surface area. An increase in bay tide range is indicative of an increase in tidal prism, which in turn by hydraulic continuity is proportional to an increase in conveyance through the inlet entrance, provided the volume of water exchanged at the other entrances is relatively small and can be neglected. Therefore it is expected that inlet minimum cross-sectional area data should show similar trends to those exhibited by tide range data. It appears that bay tidal data, and consequently inlet cross-sectional areas, support the conclusion that the inlet is in a stable mode.

References Cited:

- 1) O'Brien, M.P. and Dean, R.G. (1972) Hydraulics and Sedimentary Stability of Coastal Inlets, Proceedings: 13th Coastal Engineering Conference.
- 2) Keulegan, G.H., Tidal Flow in Entrances, Water Level Fluctuations of Basins in Communications with SEAS, Corps of Engineers, U.S. Army, June 1967.
- 3) Czerniak, M.T., (Tetra Tech, Inc.) Engineering and Environmental Assessment for the Stabilization and Sand Bypassing of Moriches Inlet, Prepared for NY District Corps of Engineers, Contract DACW-51-75-C-0015, Jan 1976.

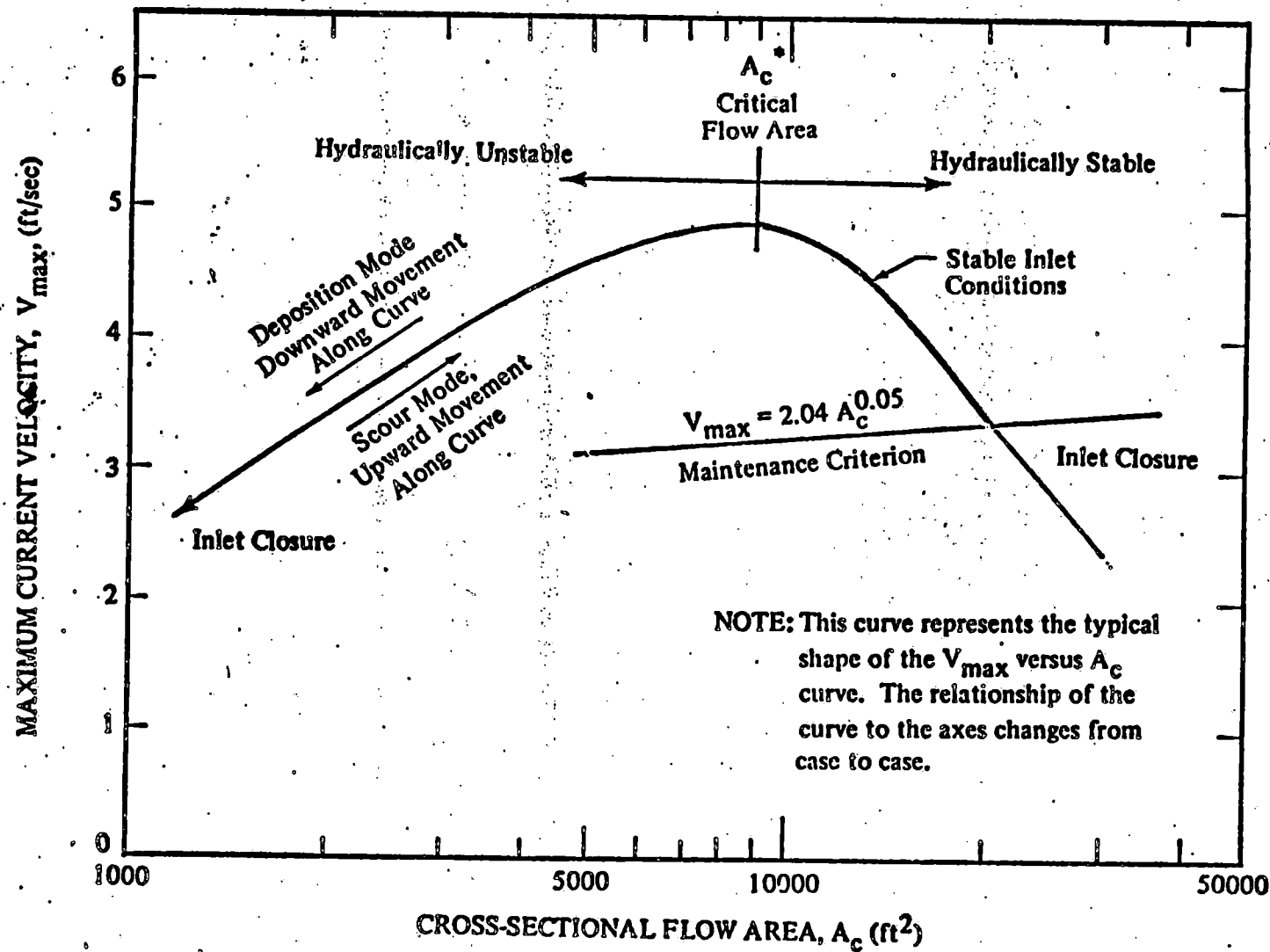
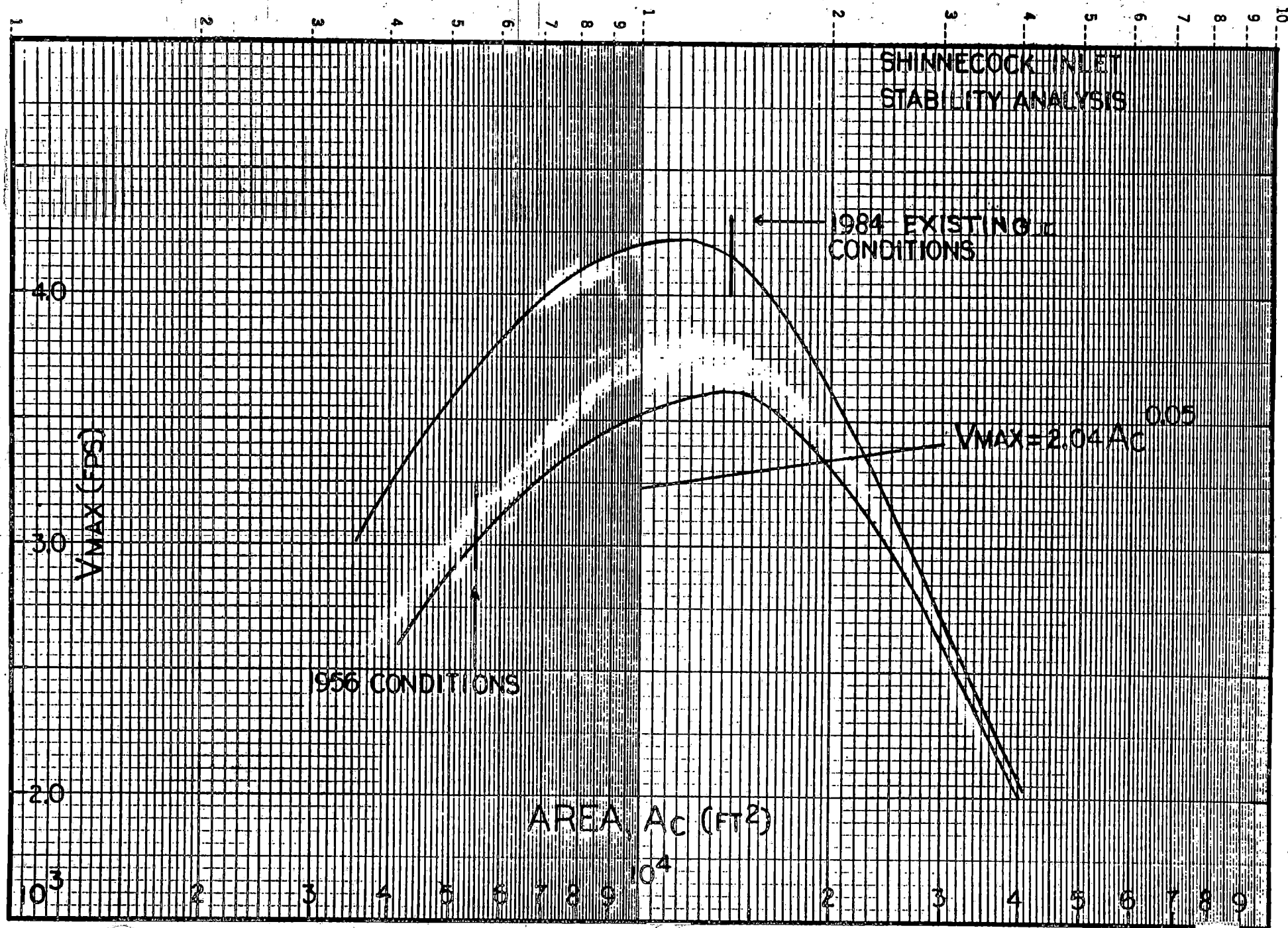


FIGURE 1. Typical Hydraulic Stability Curve Showing Various Inlet Stability Conditions.

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Subject STABILITY ANALYSIS		Project SHINNECOCK INLET
Computed by	Date	Checked by
		Date



COMPUTATION SHEET		Page <u>21-5</u> of <u>8</u>	
Subject STABILITY ANALYSIS		Project SHINNECOCK INLET	
Computed by <u>DM</u>	Date <u>W</u>	Checked by	Date

STABILITY ANALYSIS USING O'BRIEN AND DEAN METHOD

SQUARE FEET TO THE INCH

$$\text{REPLETION COEFFICIENT } K = \frac{T}{2\pi a_0} \frac{A_c}{A_b} \sqrt{\frac{2g a_0}{K_{en} + K_{ex} + fL/4R}} \quad (\text{EQ. 1.})$$

FOR 15 JUNE '84 (POST EMERGENCY DREDGING) CONDITIONS:

$$A_c \text{ (FROM FIG.)} = 16,600 \text{ FT}^2$$

$$R_H = 19.72 \text{ FT.}$$

$$\text{(USING } R_H = A_c / (LW + 2D))$$

$$A_b = 4.07 \times 10^8 \text{ FT}^2 \text{ (MEASURED)}$$

$$K_{en} + K_{ex} = 1.3 \text{ (O'BRIEN + DEAN)}$$

$$a_0 = 1.45 \text{ FT. (NOAA)}$$

$$a_b = 1.30 \text{ FT. (TIDE GAGES)}$$

$$T = 12.42 \text{ HRS (44,700 SEC.)}$$

$$f = 0.03$$

FROM FIG. 4 O'BRIEN + DEAN; USING $a_b/a_0 = 0.9$, $K_E = 1.13$

RE-ARRANGING EQ. 1:

$$L_E = \left[\left(\frac{T A_c}{2\pi K A_b} \right)^2 \frac{2g}{a_0} - (K_{en} + K_{ex}) \right] \frac{4R}{f}$$

$$= \left[\left(\frac{44700 (16,600)}{2\pi (1.13) 4.07 \times 10^8} \right)^2 \frac{(64.4)}{1.45} - 1.3 \right] \frac{4(19.72)}{0.03}$$

$$L_E = 4282$$

USING CONSTANT L_E ,

$$K = \frac{44700}{2\pi (1.45)} \frac{A_c}{4.07 \times 10^8} \sqrt{\frac{(64.4)(1.45)}{1.3 + (0.03)(4282)/4R}}$$

$$K = \frac{1.165 \times 10^{-4} A_c}{\sqrt{1.3 + 32.1/R}}; \quad (\text{EQ. 2.})$$

$$V_{MAX} = \frac{2\pi a_0}{T} \frac{A_b}{A_c} V'_{MAX}$$

$$= 8.295 \times 10^4 \frac{V'_{MAX}}{A_c}; \quad (\text{EQ. 3.})$$

$$P = 2a_b A_b = 2a_0 A_b (a_b/a_0); \quad (\text{EQ. 4.})$$

COMPUTATION SHEET				Page <u>1-6</u> of <u>8</u>
Subject STABILITY ANALYSIS		Project SHINNECOCK INLET		
Computed by <u>DMM</u>	Date	Checked by	Date	

15 JUNE 1984, STABILITY CALCULATIONS:

SHORE S 2 S TO THE INCH

	(1)	(2)	(3)	(4)	(5)	(6)	
A_c (Ft ²)	R_H (Ft.)	K	V'_{MAX}	V_{MAX}	Q_{MAX}	a_b/a_o	P (Ft ³)
2000	2.48	0.062	-	-	-	-	-
3000	3.72	0.111	0.105	2.90	8700	0.121	1.428×10^8
4000	4.94	0.167	0.150	3.11	12440	0.185	2.183×10^8
5000	6.15	0.228	0.210	3.48	17400	0.255	3.010×10^8
6000	7.36	0.294	0.270	3.73	22380	0.335	3.954×10^8
7000	8.56	0.363	0.330	3.91	27370	0.405	4.780×10^8
8000	9.76	0.435	0.385	3.99	31920	0.470	5.550×10^8
9000	10.94	0.510	0.445	4.10	36900	0.545	6.433×10^8
10000	12.12	0.586	0.500	4.15	41500	0.610	7.200×10^8
12000	14.46	0.745	0.610	4.22	50640	0.735	8.675×10^8
14000	16.77	0.910	0.690	4.08	57120	0.820	9.678×10^8
16000	19.05	1.079	0.760	3.94	63040	0.885	1.045×10^9
18000	21.30	1.252	0.815	3.76	67680	0.930	1.091×10^9
20000	23.53	1.421	0.865	3.59	71800	0.955	1.127×10^9
25000	29.99	1.892	0.945	3.14	78500	0.985	1.163×10^9
30000	34.29	2.337	0.980	2.71	81300	0.990	1.168×10^9
35000	39.44	2.804	0.990	2.35	82250	0.995	1.174×10^9
40000	44.44	3.277	1.0	2.07	82800	1.0	1.1803×10^9

(1) K FROM (EQ.2)

(2) V'_{MAX} FROM FIG. 3, O'BRIEN + DEAN

(3) V_{MAX} FROM (EQ.3)

(4) $Q_{MAX} = V_{MAX} \times A_c$

(5) a_b/a_o FROM FIG. 4, O'BRIEN + DEAN

(6) P FROM (EQ.4)

FOR MAINTENANCE VELOCITY:

$$V_{MAX} > 2.04 A_c^{0.05}$$

COMPUTATION SHEET		Page <u>61-7</u> of <u>8</u>	
Subject <u>STABILITY ANALYSIS</u>		Project <u>SHINNECOCK INLET</u>	
Computed by <u>DMM</u>	Date	Checked by	Date

STABILITY ANALYSIS USING O'BRIEN AND DEAN METHOD :

FOR 1955 - JAN 1956 CONDITIONS :

$$A_c = (\text{FROM FIG. }) 5500 \text{ FT}^2$$

$$a_o = 1.4 \text{ FT. (NOAA)}$$

$$R_H = 6.76 \text{ FT}$$

$$a_b = 0.35 \text{ FT. (SURVEY REPORT)}$$

$$(\text{USING } R_H = A_c / (W + 2D))$$

$$T = 12.42 \text{ HRS (44700 SEC)}$$

$$A_B = 4.07 \times 10^8 \text{ FT}^2 (\text{MEASURED})$$

$$f = 0.03$$

$$K_{en} + K_{ex} = 1.3 (\text{O'BRIEN + DEAN})$$

FROM FIG. 4 O'BRIEN AND DEAN, USING $a_b/a_o = 0.25$, $K_E = 0.22$

RE-ARRANGING EQUATION 1 :

$$l_E = \left[\left(\frac{T A_c}{2\pi K_{AB}} \right)^2 \frac{2g}{a_o} - (K_{en} + K_{ex}) \right] \frac{4R}{f}$$

$$= \left[\left(\frac{44700 (5500)}{2\pi (0.22) 4.07 \times 10^8} \right)^2 \frac{64.4}{1.4} - (1.3) \right] \frac{4(6.76)}{0.03}$$

$$l_E = 6746 \text{ FT.}$$

USING CONSTANT l_E ,

$$K = \frac{T}{2\pi a_o} \frac{A_c}{A_B} \sqrt{\frac{2g a_o}{K_{en} + K_{ex} + 5l_E/R}} \quad ; \quad (\text{EQ. 1})$$

$$K = \frac{44700}{2\pi (1.4)} \frac{A_c}{4.07 \times 10^8} \sqrt{\frac{64.4 (1.4)}{1.3 + 50.6/R}}$$

$$K = 1.185 \times 10^{-4} \frac{A_c}{\sqrt{1.3 + 50.6/R}} \quad ; \quad (\text{EQ. 2})$$

$$V_{MAX} = 80093 \frac{V'_{MAX}}{A_c} \quad ; \quad (\text{EQ. 3})$$

$$P = 2a_b A_B = 2a_o A_B (a_b/a_o)$$

$$P = 1.1396 \times 10^9 (a_b/a_o) \quad ; \quad (\text{EQ. 4})$$

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COMPUTATION SHEET		Page C1-8 of 8	
Subject STABILITY ANALYSIS		Project SHINNECOCK INLET	
Computed by <i>DM</i>	Date	Checked by	Date

1955 - JAN 1956 STABILITY CALCULATIONS

	(1)	(2)	(3)	(4)	(5)	(6)
Ac (Ft ²)	2000	248	0.051	-	-	-
Rh (Ft)	3.72	0.092	-	-	-	-
K	0.051	-	-	-	-	-
V'max	0.125	0.182	2.50	10.000	0.160	1.823 x 10 ³
Vmax	2.92	3.07	3.26	22.820	0.280	3.191 x 10 ³
Qmax	14.600	18.420	26.400	43.200	0.350	3.989 x 10 ³
ab/a	0.139	0.192	0.330	0.480	0.410	4.672 x 10 ³
P (Ft ³)	0.051	0.092	0.330	0.480	0.410	4.672 x 10 ³
	2.48	3.72	0.092	0.139	0.160	1.823 x 10 ³
	6.15	7.36	0.230	0.348	0.210	2.393 x 10 ³
	7.36	8.56	0.285	0.435	0.280	3.191 x 10 ³
	8.56	9.76	0.330	0.480	0.350	3.989 x 10 ³
	9.76	10.94	0.372	0.540	0.410	4.672 x 10 ³
	10.94	12.12	0.435	0.600	0.480	5.470 x 10 ³
	12.12	14.46	0.506	0.660	0.540	6.154 x 10 ³
	14.46	16.77	0.540	0.760	0.660	7.521 x 10 ³
	16.77	19.05	0.635	0.760	0.760	8.661 x 10 ³
	19.05	21.30	0.710	0.830	0.830	9.459 x 10 ³
	21.30	23.53	0.775	0.930	0.890	1.014 x 10 ⁴
	23.53	25.76	0.830	1.014	0.930	1.059 x 10 ⁴
	25.76	27.99	0.870	1.111	0.975	1.111 x 10 ⁴
	27.99	30.29	0.970	1.128	0.990	1.128 x 10 ⁴
	30.29	32.44	0.990	1.134	0.995	1.134 x 10 ⁴
	32.44	34.44	0.995	1.139	0.995	1.139 x 10 ⁴
	34.44	36.44	0.995	1.139	0.995	1.139 x 10 ⁴
	36.44	38.44	0.995	1.139	0.995	1.139 x 10 ⁴
	38.44	40.44	0.995	1.139	0.995	1.139 x 10 ⁴
	40.44	42.44	0.995	1.139	0.995	1.139 x 10 ⁴

(2) V'max FROM FIG. 3, O'BRIEN + DEAN

(3) Vmax FROM (EQ. 3)

(4) Qmax = Vmax x Ac

(5) ab/a FROM FIG. 4, O'BRIEN + DEAN

(6) P FROM (EQ. 4)

FOR MAINTENANCE VELOCITY:

Vmax > 2.04 Ac^{0.05}

(O'BRIEN + DEAN)

COMPUTATION SHEET

Page 21 of 1Subject Design Wave Analysis - West Jetty
Head Section - Existing Design

Project SHINNECOCK INLET

Computed by

Date 9/86

Checked by

Date

To determine the maximum wave resisted by existing west jetty head section equation 7-116 SPM pg. 205 will be used as follows:

$$W = \frac{w_r H^3}{K_D (S_r - 1)^3 \cot \theta}$$

where

W = weight in pounds of an individual armor unit in the primary cover layer.

Maximum size of existing head armor units is 12 tons.

w_r = unit weight (sat. surf. dry) of armor unit
lbs/ft³ - use 165 lbs/ft³

H = maximum design wave height at the structure in ft.

S_r = specific gravity of armor, relative to water at the structure
 $S_r = w_r / w_w$
 $S_r = 165 / 64.0 = 2.58$

w_w = unit weight of water, 64.0 lbs/ft³

θ = angle of structure slope
 $\cot \theta = 1.5$

K_D = stability coefficient, for rough angular quarry stone head section, on a 1V on 1.5 H for a breaking wave
use $K_D = 1.9$

Substituting

$$H_{\max}^3 = \frac{(24,000)(2.58 - 1)^3 (1.5)(1.9)}{(165)} = 1635.1$$

$$H_{\max} = 11.8 \text{ feet}$$

COMPUTATION SHEET

Page 3-1 of 2

Subject Design Current Velocity

Project SHINNECOCK INLET

Computed by

Date 9/86

Checked by

Date

The maximum velocity of tidal currents in mid channel through a navigation opening can be approximated by Eq 7-12B pg 7-25b, SPM:

$$V = \frac{4\pi Ah}{3Ts} \quad (7-12B)$$

where:

V = maximum velocity at center of opening

T = Period of Tide (12.4 hrs = 44,640 sec)

A = Surface area of bay ($16 \text{ mi}^2 = 446,054,400 \text{ sq. ft.}$)

S = Cross-sectional area of opening (16,600 sq. ft.)

h = range of tides in bay (ft.)

$$V = \frac{4\pi(446,054,400)h}{3(44,640)(16,600)}$$

$$V = 2.52 h$$

For the estimated bay tidal range resulting from a 1938 Hurricane (Recurring) of 4.0 feet (from Fire Island to Montauk BEC & HP Survey Report) to velocity is given

$$V = 2.52(4.0) = 10.1 \text{ ft/sec}$$

$\therefore$ 10 fps is design current velocity at jetty head section

COMPUTATION SHEET

Page C3-2 of 2

Subject Design Current Velocity

Project SHINNECOCK INLET

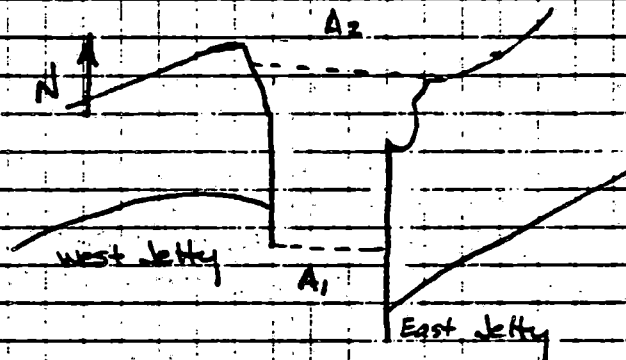
Computed by

Date 9/86

Checked by

Date

To estimate a maximum probable design current velocity at the bay shoreline east of the inlet, the Continuity Equation was utilized.



$$Q = VA$$

$Q_1 = Q_2$ where Q_1 and Q_2 are the discharges at the cross sections 1 and 2

$$V_1 A_1 = V_2 A_2$$

$$A_2 \approx 29,000 \text{ ft}^2$$

$$V_2 = V_1 \frac{A_1}{A_2}$$

Substituting in computed maximum probable velocity at the inlet throat and measured cross-sectional areas

$$V_2 = 10 \text{ fps} \times \frac{16,600 \text{ ft}^2}{29,000 \text{ ft}^2} = 6.9 \text{ fps}$$

$$V_2 \approx 7.0 \text{ ft/sec.}$$

This velocity will not however control the revetment design. The revetment design is controlled by wind generated bay waves shown in computation C5. The revetment design is detailed in Computation D1.

COMPUTATION SHEET		Page 4-101-4	
Subject: DESIGN WAVE ANALYSIS		Project: SHIMMUCK INLET GDM	
Computed by		Date: 9/86	Checked by
			Date

1. The wave climatology selected for use in this study was available by the U.S. Army Corps of Engineers Experiment Station and titled "Atlantic Coast Wind and Shallow Water Significant Wave Information" (Ref 10). The tables used were for station # 46. See Tables C-4.1 & C-4.2

2. Refraction and shoaling coefficients were estimated using a simplified method (Ref 26). The following assumptions are implicit in this approach:

- effects of currents are precluded
- wave-wave interaction precluded
- effects of wave energy reflection on shoals precluded
- attenuation by friction precluded
- assumes straight and 11 contours.

DIRECTION OF WAVE APPROACH	SIGNIF II	WAVE HGT	PERIOD	SHOALING COEF	WAVE HGT
		@ 30' depth	(sec)		(ft)

30° - 59.4°	11	12.5	9.5	0.85	0.85	0.6	11.1
(187° - 217°)	21						
60° - 89.4°	14.2	11		1.06	1.12	15	15.9
(157° - 187°)							
90° - 119.4°	14.2	11		1.06	1.12	15	15.9
(127° - 157°)							
120° - 149.4°	10.8	9.5		0.85	0.85	9.2	9.6
(97° - 127°)							

COMPUTATION SHEET

Page 4-2 of 4

Subject DESIGN WAVE HEIGHT
WEST / EAST JETTY HEAD SECT

Project Shinnecock Inlet GDM

Computed by

Date 9/86

Checked by

Date

MAXIMUM
WAVE HEIGHT TABLE (CONT'D):

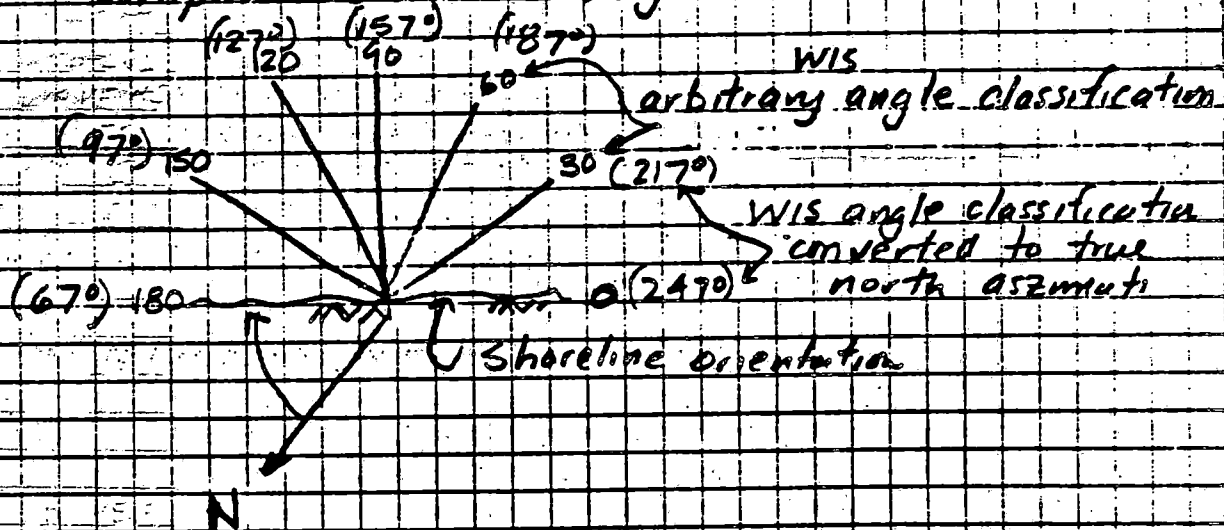
DIRECTION OF WAVE APPROACH	SIGNIFICANT WAVE HGT. 30' depth (FT)	WAVE PERIOD (SEC)	$K_r \cdot K_s$ @ 20' @ 30'	REFRACTED SHOAL WAVE HGT (FT) @ 20' @ 30'
150-179° (67-97°) [75°]	7.5	6.5	0.6 0.55	4.7 3.6

∴ Maximum Wave Height Expected = 16 Ft.

NOTES:

1/ Wave direction, height and period obtained from WIS tables C-4.1, C-4.2

2/ Wave direction converted to true north compass azimuth using



3/ Average of WIS wave angle section measured from the shore normal for use in refraction analysis (Ref 26)

4/ Refraction and shoaling coefficient $K_r \cdot K_s$ obtain from Ref. 26

COMPUTATION SHEET

Page 04.3 of 4

Subject DESIGN WAVE ANALYSIS -
WEST JETTY HEAD SECTION

Project

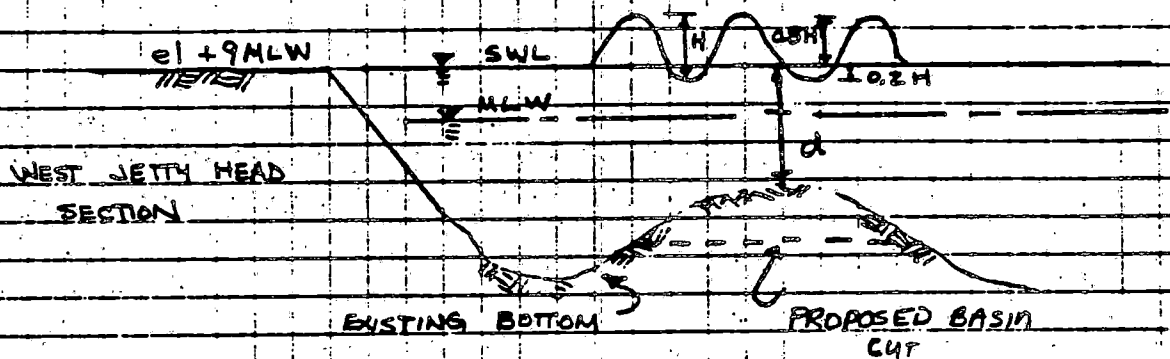
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The design wave which allows for the full impact of a breaking wave upon the structure (see Chap. 7 Section 7.9, pg. 7-202, SPM) and is limited by the depth of water above the existing bottom ($H = 0.78 d$, Eq 2-91, pg 2-130, SPM) is computed assuming a non-linear surface profile as shown below.



TRY SWL = +8 FT MLW

Depth at bar (d_s) = $8 + 14 = 22$ ft.

Depth limited wave height = $0.78 / 22 = 17.16$ ft.

Depth of trough below SWL = $0.2 (17.16) = 3.43$ ft

elevation of trough = $+8 \text{ MLW} - 3.4 = 4.6$ ft MLW

Full Impact Is Not Achieved

IMPROVED

+4.6 ft MLW $\leq$ +9.0 ft MLW

SWL	d_s	Depth limited wave height	Depth of trough below SWL	Elevation of trough	Full Impact Achieved
+8.0 MLW	22	17.16	3.43	4.6	NO
+10.0	24	18.7	3.7	6.3	NO
+12.0	26	20.3	4.1	7.9	NO
+13.0	27	21.1	4.2	8.78	NO
+14.0	28	21.8	4.4	9.6	NO

Full IMPACT is achieved for design SWL between +13 MLW and +14 MLW

TRY SWL = +13.2

13.2 27.2 21.2 4.24 8.95 YES

Depth Limited Wave Height = 21.2 ft.
(Improved Condition)

COMPUTATION SHEET

Page CA-4 of 4Subject DESIGN WAVE ANALYSIS
WEST/EAST JETTY HEADProject Shinnecock Inlet BDM

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EXISTING CONDITION Waves Breaking on Existing Bar

<u>SWL</u>	<u>ds</u>	<u>Depth Limited</u> <u>Wave Height</u>	<u>Depth of Trough</u> <u>below SWL</u>	<u>El. of</u> <u>Trough</u>	<u>Full Impact</u> <u>Achieved</u>
+8.0 MLW	16'	12.5'	2.5'	+5.5 MLW	NO
+10.0	18'	14.0'	2.8'	+7.2 MLW	NO
+12.0	20'	15.6'	3.1'	+8.9 MLW	YES
+12.5	20.5'	16.0'	3.2'	+9.3 MLW	NO

0 FULL IMPACT IS ACHIEVED FOR EXISTING COND.
SWL = +12 FT MLW

DEPTH LIMITED WAVE HEIGHT = 15.6 FT.
(EXISTING CONDITION)

Design Wave Height for Jetty Head Section = 16 ft.

Based on N.I.S. Hindcast
and Refraction-Shallowing Analysis.

COMPUTATION SHEET

Page C5-1 of 1

Subject Design Wave Height for
Proposed Revetment

Project SHINNECOCK INLET

Computed by

Date 9/86

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Date

To stabilize the bayside of the dune and prevent material losses, a revetment was designed using Corps criteria. Although the shoreline in the vicinity of the proposed revetment is sheltered from the ocean waves it is not sheltered from waves generated within the bay. Using the procedures published in the SPM and ETL 1110-2-211 for generation of shallow water waves, a breaking wave was computed.

Estimated bay depth = 8.0 ft MLW

Surge + Tide level = +7.3 ft MLW

(+6.0 ft NGVD)

Fetch length = 14,500 ft

Wind Velocity U_A = 79 mphusing procedures in
ETL 1110-2-221

h (water depth)	H (wave height)	T (wave period)	Figure (SPM)
----------------------	----------------------	----------------------	-----------------

15

3.3

3.2

3-29

Assume wave height = 3.3 ft

wave period = 3.2 sec

COMPUTATION SHEET

Page 061 of 1

Subject CHANNEL WIDTH DESIGN

Project SHINNECOCK INLET

Computed by LMK

Date 9/86

Checked by

Date

The width of the navigation channel at Shinnecock Inlet was determined by the procedure given in EM 1110-2-1615, Hydraulic Design of Small Boat Harbors. Two design vessels, one fishing vessel and one recreational vessel, were chosen for the two-way traffic. The beam width of the design recreational vessel is 15 ft., and the beam width of the design commercial vessel is 22 ft. Allowances for outriggers used by the commercial fishing vessels was included in the channel width.

CHANNEL WIDTH (VESSELS WITH VERY GOOD MANEUVERABILITY)BANK CLEARANCE LANE (COMMERCIAL) $150\% \times 22' = 33 \text{ ft.}^*$ MANEUVERING LANE (COMMERCIAL) $160\% \times 22' = 35 \text{ ft.}$

70 ft. for Outriggers = 70 ft.

SHIP CLEARANCE LANE (COMMERCIAL) $80\% \times 22' = 18 \text{ ft.}$ MANEUVERING LANE (RECREATIONAL) $160\% \times 15' = 24 \text{ ft.}$ BANK CLEARANCE (RECREATIONAL) $150\% \times 15' = 23 \text{ ft.}^*$

203 ft.

The Design Channel Width will be 200 ft.

* Bank Clearance as Per Cent of the vessel beam were increased due to existence of the rubble mound jetties and the adverse weather conditions.

COMPUTATION SHEET		Page <u>C7-1</u> of <u>8</u>	
Subject <u>Shoaling Analysis for a Channel Basin Cut Through An Offshore Bar-Transport Ratio</u>		Project <u>SHINNECOCK INLET</u>	
Computed by	Date <u>9/86</u>	Checked by	Date

TRANSPORT RATIO METHOD
FOR
SHOALING OF A DREDGED CUT
THROUGH THE BAR SEAWARD OF AN INLET

This method was developed by Dr. Cyril Galvin, under contract DACW51-79-C-0046 for the New York District, specifically with reference to Moriches Inlet.

Assumptions. This is an analysis of the shoaling likely to occur in a cut through a typical ocean bar around the mouth of an inlet. The analysis depends on the following assumptions:

1. Sand is set in motion by the shoaling and breaking of waves.
2. Once set in motion, the sand is transported by whatever net currents exist at the site. For the dredged channel, these currents are assumed to be mostly due to the ebb flow of the tidal prism coming out of the inlet.
3. Wave motion is adequately described by linear theory.
4. Sediment motion depends on the bottom shear which is primarily due to the bottom water motion under shoaling and breaking waves.

General Equation. The purpose of this analysis is to compare the sediment transport potential in the dredged cut with the sediment transport on the bar before dredging. The general equation relates sediment transport to the bottom shear which initiates sediment motion and the ambient current which moves the sediment whose motion has been initiated.

$$\text{Sediment Transport Rate} = \text{Coefficient} \times \text{Bottom Shear} \times \text{Ambient Current} \quad (1)$$

Since this analysis compares two conditions in the same environment, it is assumed that the coefficients for pre and post dredging conditions are the same. Thus, the ratio of post dredging to pre-dredging sediment transport is:

$$\text{Transport ratio} = \text{Bottom Shear Ratio} \times \text{Ambient Current Ratio} \quad (2)$$

Bottom Shear Ratio. Shear is proportional to the bottom velocity squared.

$$\tau = \text{constant} \times U^2$$

(3)

COMPUTATION SHEET		Page <u>C7-2</u> of <u>8</u>	
Subject	Transport Ratio Method	Project	SHINNECOCK INLET
Computed by	Date 9/86	Checked by	Date

The bottom water velocity under linear waves is sinusoidal, and the peak velocity, U , will be used to represent this bottom velocity. In shallow water, for linear theory,

$$U^2 = g H^2 / (4d) \quad (4)$$

If we use a subscript 1 to indicate the condition before dredging and subscript 2 to indicate the condition after dredging, then the bottom shear ratio is

$$\frac{\tau_2}{\tau_1} = \frac{U_2^2}{U_1^2} \quad (4)$$

$$= \frac{H_2^2}{H_1^2} \frac{d_1}{d_2} \quad (5)$$

From conservation of energy flux for linear waves in shallow water,

$$\frac{H_2^2}{H_1^2} = \left(\frac{d_1}{d_2} \right)^{1/2} \quad (6)$$

So the bottom shear ratio turns out to depend entirely on the ratio of pre to post dredging depths.

$$\frac{\tau_2}{\tau_1} = \left(\frac{d_1}{d_2} \right)^{3/2} \quad (7)$$

Ambient Current Ratio. The general equation (1) is blind to whatever causes the ambient current on the bar and dredged cut. For the case of the dredged cut in the bar opposite an inlet, it is assumed that the dominant current is due to the ebb tide. The general relation for the current velocity is

$$V = Q/A \quad (8)$$

where Q is the discharge and A is the channel area. For the two-dimensional unit channel, A equals depth times 1 foot. So the ambient current ratio is,

$$\frac{V_2}{V_1} = \frac{Q_2}{Q_1} \frac{d_1}{d_2} \quad (9)$$

assuming that the discharge will remain the same after dredging and the ambient current ratio is

$$\frac{V_2}{V_1} = \frac{d_1}{d_2} \quad (10)$$

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5 1 1

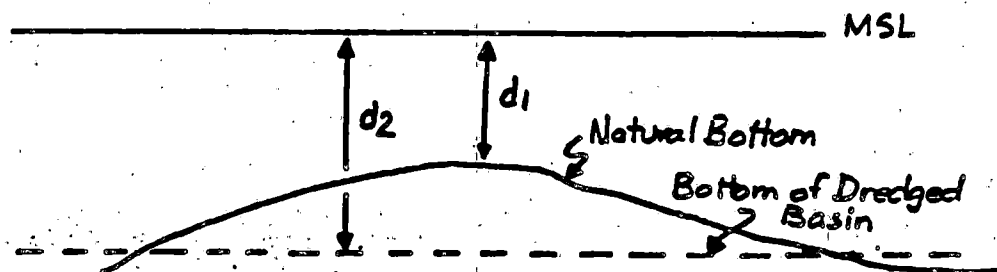
SHINNECOCK

SHINNECOCK 228 Apr 79

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Subject <i>Transport Ratio Method</i>		Project <i>SHINNECOCK INLET</i>	
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Transport Ratio. It is now possible to combine the bottom shear ratio with the ambient current ratio to get the transport ratio, post dredging to pre dredging conditions. For the case where $Q_1 = Q_2$ in (10),

$$\text{Transport Ratio} = (d_1/d_2)^{5/2} \quad (11)$$



This ratio may be interpreted as follows, where d_1 and d_2 are defined by the above figure. The table evaluates equation (11) for given values of d_1/d_2 , the ratio of pre to post dredging depth, measured from Mean Sea Level.

d_1/d_2	Transport Ratio
0.25	0.031
0.5	0.18
0.7	0.41
0.8	0.57
0.9	0.77
0.95	0.88

The transport ratio is a measure of potential for transporting sediment in the cut after dredging, relative to sediment transport before dredging. For example, if the ratio is 1.0, then as much sand will be taken away by the tidal flow as is brought to the channel. However, as can be seen from equation (11), the only time the transport ratio will be 1.0, equation is when $d_1 = d_2$, that is, the channel is not deepened at all.

If the dredged depth is double the natural depth, d_1/d_2 equals 0.5, then the table indicates the transport ratio is 0.18, or roughly the potential to transport out one cubic yard for every 6 cubic yards carried in from the sides of the channel (which are assumed to remain at pre dredging depth, d_1).

The following is an example calculation for a 500 ft wide deposition basin.
 The natural depth of the shoal is -8.0 ft MLW
 channel design depth is -12.0 ft MLW
 dredge depth is -18.0 ft MLW

Gross Longshore Transport Volume 400,000 cu/y
 Transport By Passing the Inlet Below -18.0 ft MLW = 2.8 %

SI FOR A 500. FOOT WIDE BASIN
 TRANSPORT RATIO METHOD

DEPTH RATIO	INFLCH TRANSPORT VOLUME (CU.YDS./DAY)	TRANSPORT RATIO	CUT OF CHANNEL TRANSPORT VOLUME (CU.YDS./DAY)	CHANNEL SHOAL VOLUME (CU.YDS.)	CHANNEL DEPTH SHOALE (FT./DAY)	NEW CHANNEL DEPTH (FT./MLW)	DAY	CUMULATIVE VOLUME SHOALE (CU.YDS.)
18.00	0.445	1065.3	0.132	140.3	925.0	0.0263	17.98	925.0
17.98	0.446	1065.3	0.133	140.9	924.5	0.0264	17.99	1849.4
17.95	0.446	1065.3	0.133	141.4	924.0	0.0264	17.93	2773.3
17.93	0.447	1065.3	0.134	141.9	923.4	0.0264	17.90	3696.7
17.90	0.447	1065.3	0.134	142.4	922.9	0.0264	17.87	4619.5
17.87	0.448	1065.3	0.135	142.9	922.4	0.0265	17.85	5541.9
17.85	0.448	1065.3	0.135	143.5	921.9	0.0265	17.82	6463.7
17.82	0.450	1065.3	0.136	144.0	921.3	0.0265	17.79	7385.8
17.79	0.450	1065.3	0.136	144.5	920.8	0.0265	17.77	8305.7
17.77	0.451	1065.3	0.137	145.1	920.2	0.0265	17.74	9225.9
17.74	0.452	1065.3	0.137	145.6	919.7	0.0266	17.71	10145.5
17.71	0.452	1065.3	0.138	146.1	919.2	0.0266	17.69	11064.6
17.69	0.453	1065.3	0.138	146.7	918.6	0.0266	17.66	11983.2
17.66	0.454	1065.3	0.139	147.2	918.1	0.0266	17.63	12901.2
17.63	0.454	1065.3	0.139	147.8	917.5	0.0267	17.61	13818.7
17.61	0.455	1065.3	0.140	148.4	916.9	0.0267	17.58	14735.6
17.58	0.456	1065.3	0.140	148.9	916.4	0.0267	17.56	15651.9
17.56	0.456	1065.3	0.141	149.5	915.8	0.0267	17.53	16567.7
17.53	0.457	1065.3	0.141	150.1	915.2	0.0268	17.50	17482.9
17.50	0.457	1065.3	0.142	150.6	914.7	0.0268	17.47	18397.5
17.47	0.458	1065.3	0.142	151.2	914.1	0.0268	17.45	19311.5
17.45	0.459	1065.3	0.143	151.8	913.5	0.0268	17.42	20225.8
17.42	0.460	1065.3	0.143	152.4	912.9	0.0269	17.39	21137.9
17.39	0.461	1065.3	0.144	153.0	912.3	0.0269	17.37	22050.2
17.37	0.461	1065.3	0.145	153.6	911.8	0.0269	17.34	22961.9
17.34	0.462	1065.3	0.145	154.1	911.2	0.0269	17.31	23873.8
17.31	0.463	1065.3	0.146	154.7	910.6	0.0269	17.29	24783.5
17.29	0.463	1065.3	0.146	155.3	910.0	0.0270	17.26	25693.4
17.26	0.464	1065.3	0.147	156.0	909.4	0.0270	17.23	26602.7

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Subject TRANSPORT RATIO METHOD

Project SHINNEDOCK INLET

COMPUTATION SHEET

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COMPUTATION SHEET

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Subject TRANSPORT RATIO METHOD

Project SHINNECOCK INLET

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SHEET 315 OF THE MAP

SHEET 315 OF THE MAP

FOR A 500. FOOT WIDE ESTIA

TRANSPORT RATIO METHOD

DEPTH (FT. MLU)	DEPTH RATIO	INFLOW VOLUME (CU. YDS./DAY)	TRANSPORT RATIO	TRANSPORT VOLUME (CU. YDS./DAY)	NEW CHANNEL DEPTH (FT. MLU)	NEW CHANNEL DEPTH (FT. MLU)	CUMULATIVE VOLUME SHALED (CU. YDS.)	DAY
17.23	0.465	1065.3	0.147	156.6	0.0270	17.21	27511.4	30.
17.21	0.466	1065.3	0.148	157.2	0.0270	17.18	28419.5	31.
17.19	0.467	1065.3	0.149	157.8	0.0271	17.15	29326.9	32.
17.15	0.468	1065.3	0.150	158.4	0.0271	17.13	30233.8	33.
17.13	0.469	1065.3	0.151	159.0	0.0271	17.10	31140.8	34.
17.10	0.470	1065.3	0.152	159.7	0.0272	17.07	32049.6	35.
17.07	0.471	1065.3	0.153	160.3	0.0272	17.04	32958.5	36.
17.04	0.472	1065.3	0.154	160.9	0.0272	17.02	33867.4	37.
16.99	0.473	1065.3	0.155	161.6	0.0272	16.99	34776.3	38.
16.94	0.474	1065.3	0.156	162.2	0.0273	16.96	35685.2	39.
16.91	0.475	1065.3	0.157	162.9	0.0273	16.94	36594.1	40.
16.88	0.476	1065.3	0.158	163.5	0.0273	16.91	37503.0	41.
16.85	0.477	1065.3	0.159	164.2	0.0273	16.88	38411.9	42.
16.82	0.478	1065.3	0.160	164.9	0.0274	16.85	39320.8	43.
16.77	0.479	1065.3	0.161	165.5	0.0274	16.83	40229.7	44.
16.74	0.480	1065.3	0.162	166.2	0.0274	16.80	41138.6	45.
16.72	0.481	1065.3	0.163	166.9	0.0275	16.77	42047.5	46.
16.66	0.482	1065.3	0.164	167.5	0.0275	16.74	42956.4	47.
16.63	0.483	1065.3	0.165	168.2	0.0275	16.72	43865.3	48.
16.58	0.484	1065.3	0.166	168.9	0.0275	16.69	44774.2	49.
16.55	0.485	1065.3	0.167	169.5	0.0275	16.66	45683.1	50.
16.52	0.486	1065.3	0.168	170.2	0.0276	16.63	46592.0	51.
16.47	0.487	1065.3	0.169	170.9	0.0276	16.61	47500.9	52.
16.44	0.488	1065.3	0.170	171.6	0.0276	16.58	48409.8	53.
16.39	0.489	1065.3	0.171	172.2	0.0276	16.55	49318.7	54.
16.36	0.490	1065.3	0.172	172.9	0.0277	16.52	50227.6	55.
16.33	0.491	1065.3	0.173	173.5	0.0277	16.50	51136.5	56.
16.30	0.492	1065.3	0.174	174.2	0.0277	16.47	52045.4	57.
16.25	0.493	1065.3	0.175	174.9	0.0277	16.44	52954.3	58.
16.22	0.494	1065.3	0.176	175.6	0.0278	16.41	53863.2	59.
16.19	0.495	1065.3	0.177	176.3	0.0278	16.39	54772.1	60.
16.16	0.496	1065.3	0.178	176.9	0.0278	16.36	55681.0	61.
16.14	0.497	1065.3	0.179	177.6	0.0278	16.33	56589.9	62.
16.11	0.498	1065.3	0.180	178.3	0.0279	16.30	57498.8	63.
16.08	0.499	1065.3	0.181	178.9	0.0279	16.27	58407.7	64.
16.02	0.500	1065.3	0.182	179.6	0.0280	16.25	59316.6	65.
15.97	0.501	1065.3	0.183	180.3	0.0280	16.22	60225.5	66.
15.94	0.502	1065.3	0.184	180.9	0.0280	16.19	61134.4	67.
15.91	0.503	1065.3	0.185	181.6	0.0280	16.16	62043.3	68.
15.88	0.504	1065.3	0.186	182.2	0.0280	16.14	62952.2	69.
15.85	0.505	1065.3	0.187	182.9	0.0280	16.11	63861.1	70.
					0.0281	16.08	64770.0	71.
					0.0281	16.05	65678.9	72.
					0.0282	16.02	66587.8	73.
					0.0282	15.99	67496.7	74.
					0.0282	15.97	68405.6	75.
					0.0282	15.94	69314.5	76.
					0.0282	15.91	70223.4	77.
					0.0283	15.88	71132.3	78.
					0.0283	15.85	72041.2	79.
					0.0283	15.83	72950.1	80.

SI
FOR A 500. FOOT WIDE EASID
TRANSPORT RATE METHOD
CONTINUED

DEPTH (FT. MLW)	DEPTH RATIO	INFLOW TRANSPORT VOLUME (CU. YDS./DAY)	TRANSPORT RATE (CU. YDS./DAY)	CUT OF CHANNEL TRANSPORT VOLUME (CU. YDS./DAY)	CHANNEL SHALING VOLUME (CU. YDS.)	CHANNEL DEPTH SNOALED (FT./DAY)	NEW CHANNEL DEPTH (FT. MLW)	DAY	CUMULATIVE VOLUME SNOALED (CU. YDS.)
15.83	0.506	1065.3	0.182	193.7	871.6	0.0283	15.80	81.	72942.8
15.80	0.507	1065.3	0.183	194.6	869.7	0.0284	15.77	82.	73813.5
15.77	0.508	1065.3	0.184	195.5	869.8	0.0284	15.74	83.	74683.3
15.74	0.509	1065.3	0.185	196.4	869.0	0.0284	15.71	84.	75552.2
15.71	0.510	1065.3	0.186	197.2	868.1	0.0284	15.68	85.	76420.2
15.68	0.511	1065.3	0.186	198.1	867.2	0.0285	15.66	86.	77287.3
15.66	0.512	1065.3	0.187	199.0	866.3	0.0285	15.63	87.	78153.5
15.63	0.513	1065.3	0.188	199.9	865.4	0.0285	15.60	88.	79018.8
15.60	0.514	1065.3	0.189	200.9	864.4	0.0285	15.57	89.	79883.2
15.57	0.514	1065.3	0.190	201.8	863.5	0.0286	15.54	90.	80746.7
15.54	0.515	1065.3	0.191	202.7	862.6	0.0286	15.51	91.	81609.3
15.51	0.516	1065.3	0.192	203.6	861.7	0.0286	15.48	92.	82470.9
15.48	0.517	1065.3	0.193	204.6	860.7	0.0286	15.46	93.	83331.6
15.46	0.518	1065.3	0.193	205.5	859.8	0.0287	15.43	94.	84191.3
15.43	0.519	1065.3	0.194	206.5	858.8	0.0287	15.40	95.	85050.1
15.40	0.520	1065.3	0.195	207.4	857.9	0.0287	15.37	96.	85907.9
15.37	0.521	1065.3	0.196	208.4	856.9	0.0288	15.34	97.	86764.7
15.34	0.522	1065.3	0.197	209.4	855.9	0.0288	15.31	98.	87620.6
15.31	0.523	1065.3	0.198	210.4	854.9	0.0288	15.28	99.	88475.5
15.28	0.524	1065.3	0.199	211.4	853.9	0.0288	15.26	100.	89329.4
15.26	0.525	1065.3	0.200	212.4	852.9	0.0289	15.23	101.	90182.3
15.23	0.526	1065.3	0.201	213.4	851.9	0.0289	15.20	102.	91034.2
15.20	0.527	1065.3	0.202	214.4	850.9	0.0289	15.17	103.	91885.8
15.17	0.528	1065.3	0.203	215.4	849.9	0.0289	15.14	104.	92734.9
15.14	0.529	1065.3	0.204	216.4	848.9	0.0290	15.11	105.	93583.7
15.11	0.530	1065.3	0.205	217.3	847.8	0.0290	15.08	106.	94431.5
15.08	0.531	1065.3	0.206	218.3	846.8	0.0290	15.05	107.	95278.3
15.05	0.532	1065.3	0.207	219.6	845.7	0.0291	15.02	108.	96123.9
15.02	0.533	1065.3	0.208	220.6	844.7	0.0291	14.99	109.	96968.6
14.99	0.534	1065.3	0.209	221.7	843.6	0.0291	14.97	110.	97812.1
14.97	0.535	1065.3	0.210	222.8	842.5	0.0291	14.94	111.	98654.6
14.94	0.536	1065.3	0.211	223.9	841.4	0.0292	14.91	112.	99496.0
14.91	0.537	1065.3	0.212	225.0	840.3	0.0292	14.88	113.	100336.3
14.88	0.538	1065.3	0.213	226.1	839.2	0.0292	14.85	114.	101175.5
14.85	0.539	1065.3	0.214	227.2	838.1	0.0292	14.82	115.	102013.6
14.82	0.540	1065.3	0.215	228.3	837.0	0.0293	14.79	116.	102850.5
14.79	0.542	1065.3	0.216	229.4	835.9	0.0293	14.76	117.	103686.4
14.76	0.543	1065.3	0.217	230.6	834.7	0.0293	14.73	118.	104521.1
14.73	0.544	1065.3	0.218	231.7	833.6	0.0294	14.70	119.	105354.6
14.70	0.545	1065.3	0.219	232.9	832.4	0.0294	14.67	120.	106187.0
14.67	0.546	1065.3	0.220	234.0	831.3	0.0294	14.64	121.	107018.2
14.64	0.547	1065.3	0.221	235.2	830.1	0.0294	14.62	122.	107848.3
14.62	0.548	1065.3	0.222	236.4	828.9	0.0295	14.59	123.	108677.2
14.59	0.549	1065.3	0.223	237.6	827.7	0.0295	14.56	124.	109504.8
14.56	0.550	1065.3	0.225	238.8	826.5	0.0295	14.53	125.	110331.3
14.53	0.551	1065.3	0.226	240.0	825.3	0.0295	14.50	126.	111156.6
14.50	0.553	1065.3	0.227	241.2	824.1	0.0296	14.47	127.	111980.6
14.47	0.554	1065.3	0.228	242.5	822.9	0.0296	14.44	128.	112803.4
14.44	0.555	1065.3	0.229	243.8	821.6	0.0296	14.41	129.	113625.0
14.41	0.556	1065.3	0.230	244.9	820.4	0.0296	14.38	130.	114445.3

COMPUTATION SHEET

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Project SHINNECOCK INLET

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Date _____

SHALING COMPUTATION FOR 1986
FOR A 300. FOOT WIDE BASIN
TRANSPORT RATIO METHOD

CONTINUED

DEPTH (FT. MLW)	DEPTH RATIO	INFLU TRANSPORT VOLUME (CU. YDS./DAY)	TRANSPORT RATIO	CUT OF CHANNEL TRANSPORT VOLUME (CU. YDS./DAY)	CHANNEL SHOAL VOLUME (CU. YDS.)	CHANNEL DEPTH SHOALED (FT./DAY)	NEW CHANNEL DEPTH (FT. MLW)	DAY	CUMULATIVE VOLUME SHOALED (CU. YDS.)
14.31	0.957	1065.3	0.232	246.2	819.1	0.0297	14.35	131.	115264.3
14.35	0.959	1065.3	0.233	247.3	817.8	0.0297	14.32	132.	116082.1
14.32	0.959	1065.3	0.234	248.4	816.5	0.0297	14.29	133.	116898.6
14.29	0.961	1065.3	0.235	250.1	815.2	0.0297	14.26	134.	117713.8
14.26	0.962	1065.3	0.236	251.4	813.9	0.0298	14.23	135.	118527.7
14.21	0.963	1065.3	0.238	252.7	812.6	0.0298	14.20	136.	119340.3
14.20	0.964	1065.3	0.239	254.0	811.3	0.0298	14.17	137.	120151.5
14.17	0.965	1065.3	0.240	255.3	810.0	0.0298	14.14	138.	120961.4
14.14	0.966	1065.3	0.241	256.7	808.6	0.0299	14.11	139.	121770.8
14.11	0.968	1065.3	0.243	258.0	807.3	0.0299	14.08	140.	122577.2
14.08	0.969	1065.3	0.244	259.4	805.9	0.0299	14.05	141.	123383.1
14.05	0.970	1065.3	0.245	260.8	804.5	0.0299	14.02	142.	124187.5
14.02	0.971	1065.3	0.247	262.2	803.1	0.0300	13.99	143.	124990.6
13.99	0.972	1065.3	0.248	263.6	801.7	0.0300	13.96	144.	125792.3
13.96	0.974	1065.3	0.249	265.0	800.3	0.0300	13.93	145.	126592.5
13.93	0.975	1065.3	0.251	266.4	798.9	0.0300	13.90	146.	127391.3
13.90	0.976	1065.3	0.252	267.9	797.4	0.0301	13.87	147.	128188.7
13.87	0.977	1065.3	0.253	269.3	796.0	0.0301	13.84	148.	128984.6
13.84	0.978	1065.3	0.255	270.8	794.5	0.0301	13.81	149.	129779.1
13.81	0.980	1065.3	0.256	272.3	793.0	0.0301	13.78	150.	130572.1
13.78	0.981	1065.3	0.257	273.4	791.6	0.0302	13.75	151.	131363.6
13.75	0.982	1065.3	0.258	274.3	790.0	0.0302	13.72	152.	132153.6
13.72	0.984	1065.3	0.260	276.4	788.5	0.0302	13.69	153.	132942.1
13.69	0.985	1065.3	0.262	278.3	787.0	0.0302	13.66	154.	133729.0
13.66	0.986	1065.3	0.263	279.8	785.5	0.0303	13.63	155.	134514.4
13.63	0.987	1065.3	0.265	281.4	783.9	0.0303	13.60	156.	135298.3
13.60	0.989	1065.3	0.266	283.0	782.3	0.0303	13.57	157.	136080.6
13.57	0.990	1065.3	0.268	284.5	780.8	0.0303	13.54	158.	136861.3
13.54	0.992	1065.3	0.269	286.1	779.2	0.0303	13.51	159.	137640.4
13.51	0.993	1065.3	0.271	287.7	777.6	0.0304	13.48	160.	138418.0
13.48	0.994	1065.3	0.272	289.4	775.9	0.0304	13.45	161.	139193.9
13.45	0.996	1065.3	0.274	291.0	774.3	0.0304	13.42	162.	139968.1
13.42	0.997	1065.3	0.275	292.6	772.7	0.0304	13.39	163.	140740.7
13.39	0.998	1065.3	0.277	294.3	771.0	0.0304	13.36	164.	141511.7
13.36	0.600	1065.3	0.276	296.0	769.3	0.0305	13.33	165.	142281.0
13.33	0.601	1065.3	0.280	297.7	767.6	0.0305	13.30	166.	143048.5
13.30	0.602	1065.3	0.282	299.4	765.9	0.0305	13.27	167.	143814.4
13.27	0.604	1065.3	0.283	301.1	764.2	0.0305	13.24	168.	144578.6
13.24	0.605	1065.3	0.285	302.8	762.5	0.0305	13.21	169.	145341.0
13.21	0.607	1065.3	0.286	304.6	760.7	0.0306	13.18	170.	146101.6
13.18	0.608	1065.3	0.288	306.4	758.9	0.0306	13.14	171.	146860.5
13.14	0.609	1065.3	0.290	308.1	757.2	0.0306	13.11	172.	147617.7
13.11	0.611	1065.3	0.291	309.9	755.4	0.0306	13.08	173.	148373.0
13.08	0.612	1065.3	0.293	311.7	753.6	0.0306	13.05	174.	149126.5
13.05	0.614	1065.3	0.295	313.6	751.7	0.0307	13.02	175.	149878.1
13.02	0.615	1065.3	0.297	315.4	749.9	0.0307	12.99	176.	150628.0
12.99	0.617	1065.3	0.298	317.3	748.0	0.0307	12.96	177.	151375.9
12.96	0.618	1065.3	0.300	319.2	746.1	0.0307	12.93	178.	152122.8
12.93	0.619	1065.3	0.302	321.1	744.2	0.0307	12.90	179.	152866.2

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Project SHINNCOCK INLET

COMPUTATION SHEET

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SI SHALING COMPUTATION FOR 1986

FOR A 300. FOOT WIDE BASIN

CONTINUED

DEPTH (FT. MLW)	DEPTH RATIO	INFLOW TRANSPORT VOLUME (CU. YDS./DAY)	TRANSPORT RATIO	CU. OF CHANNEL TRANSPORT VOLUME (CU. YDS./DAY)	CHANNEL SHOAL VOLUME (CU. YDS.)	CHANNEL DEPTH SHOAL (FT./DAY)	NEW CHANNEL DEPTH (FT. MLW)	DAY	CUMULATIVE VOLUME SHOAL (CU. YDS.)
12.90	0.621	1065.3	0.304	323.0	742.3	0.0307	12.87	180.	153608.5
12.87	0.622	1065.3	0.305	324.9	740.4	0.0307	12.84	181.	154348.8
12.84	0.624	1065.3	0.307	326.9	738.5	0.0308	12.81	182.	155087.2
12.81	0.625	1065.3	0.308	328.8	736.5	0.0308	12.78	183.	155823.7
12.78	0.627	1065.3	0.311	330.6	734.5	0.0308	12.75	184.	156558.1
12.75	0.628	1065.3	0.313	332.8	732.5	0.0308	12.72	185.	157290.6
12.72	0.630	1065.3	0.315	334.8	730.5	0.0308	12.68	186.	158021.8
12.68	0.631	1065.3	0.317	336.8	728.5	0.0308	12.65	187.	158749.4
12.65	0.633	1065.3	0.319	338.9	726.4	0.0308	12.62	188.	159475.6
12.62	0.634	1065.3	0.321	341.0	724.3	0.0308	12.59	189.	160200.1
12.59	0.636	1065.3	0.323	343.1	722.2	0.0309	12.56	190.	160922.3
12.56	0.638	1065.3	0.324	345.2	720.1	0.0309	12.53	191.	161642.3
12.53	0.639	1065.3	0.326	347.3	718.0	0.0309	12.50	192.	162360.3
12.50	0.641	1065.3	0.329	349.4	715.9	0.0309	12.47	193.	163076.1
12.47	0.642	1065.3	0.331	351.6	713.7	0.0309	12.44	194.	163789.8
12.44	0.644	1065.3	0.333	353.8	711.5	0.0309	12.41	195.	164501.2
12.41	0.646	1065.3	0.335	356.0	709.3	0.0309	12.38	196.	165210.5
12.38	0.647	1065.3	0.337	358.2	707.1	0.0309	12.35	197.	165917.5
12.35	0.649	1065.3	0.339	360.5	704.8	0.0309	12.31	198.	166622.3
12.31	0.650	1065.3	0.341	362.7	702.6	0.0309	12.28	199.	167324.9
12.28	0.652	1065.3	0.343	365.0	700.3	0.0309	12.25	200.	168025.1
12.25	0.654	1065.3	0.345	367.3	698.0	0.0309	12.22	201.	168723.1
12.22	0.655	1065.3	0.347	369.6	695.7	0.0309	12.19	202.	169418.7
12.19	0.657	1065.3	0.350	372.8	693.3	0.0309	12.16	203.	170112.8
12.16	0.659	1065.3	0.352	374.3	691.0	0.0309	12.13	204.	170802.9
12.13	0.660	1065.3	0.354	376.7	688.6	0.0309	12.10	205.	171491.4
12.10	0.662	1065.3	0.356	379.1	686.2	0.0309	12.07	206.	172177.5
12.07	0.664	1065.3	0.359	381.6	683.7	0.0309	12.04	207.	172861.2
12.04	0.665	1065.3	0.361	384.0	681.3	0.0309	12.01	208.	173542.4
12.01	0.667	1065.3	0.363	386.5	678.8	0.0309	11.98	209.	174221.2
11.98	0.669	1065.3	0.366	389.0	676.3	0.0309	11.94	210.	174897.4
11.94								210.	174897.4

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COMPUTATION SHEET

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APPENDIX D

JETTY REHABILITATION AND REVETMENT

APPENDIX D

JETTY REHABILITATION AND REVETMENT

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APPENDIX D

JETTY REHABILITATION AND REVETMENT

D1. GENERAL. The existing condition of the east and west jetties at Shinnecock Inlet and its history has been evaluated using aerial photos, previous reports, condition surveys in June 1984, April 1986, and numerous field visits. Based upon the information provided by these sources, the recommended plan of improvement for jetty rehabilitation was formulated. Rehabilitation of the east & west jetties is in accordance with the Shore Protection Manual 1984.

D2. Pertinent Data on Existing Structures.

a. East Jetty

1. Originally constructed to a length of about 1360 ft. in 1953 by the State of New York.
2. Crest Width 12 feet.
3. Crest elevation +7.8 N.G.V.D. (+9 mlw)
4. Jetty Trunk - Side Slopes one vertical on three-halves horizontal.
5. Original stone units in head portion 6 to 12 tons.
6. Stone revetment 700 ft. long constructed in 1953 -2 to 4 ton stone.

b. West Jetty

1. Originally constructed to a length of about 850 feet in 1953 by the State of New York.
2. West Jetty extended to a total length of 950 feet in 1954.
3. Crest width 12 feet.
4. Crest elevation +7.8 N.G.V.D. (+9 mlw)
5. Jetty trunk side slopes one vertical on three-halves horizontal.
6. Original stone units in head portion 6 to 12 tons.

7. Pile Crib revetment was constructed in 1939 at the north end of the west side of the Inlet and replaced by armor stone revetment in 1982.

D3. Ocean Stillwater Level and Maximum Wave. As defined in the Cooperative Beach & Interim Hurricane Study, July 1958, Atlantic Coast Of Long Island, New York, Fire Island Inlet to Montauk Point, the design stillwater level was estimated as the design hurricane surge or Standard Project Hurricane Surge which is the total surge resulting from occurrence of the 1944 hurricane on a path coincident with that of the 1938 hurricane moving with a forward speed of 35 mph resulting in a surge level of el. +13.2 m.s.l. or 14.4 mlw. This is a maximum possible design stillwater level. However, as a result of the bathymetry fronting the jetties as well as full wave impact consideration, the maximum design wave height at the jetty head were developed using a +12.0 m.l.w. design stillwater level. Refer to Appendix C, Comp. Sheet C4 for further analysis. The maximum impact wave to be added on to the design stillwater is 16 ft. which would break on the jetty heads; this wave would break before it reaches the jetty trunk due to the shallow depths near the toe of the trunk.

D4. Existing Condition of the Jetties. The east and west rubble mound jetties at Shinnecock Inlet were constructed in 1953-1954 in an effort to stabilize the Inlet. Since that time, the jetties have been appreciably damaged in sections: the east jetty, in some locations, has been completely washed out; rehabilitation of the west jetty was done in 1982. Review of the jetty condition surveys has shown that currently, aside from several isolated sections of significant damage, the jetties are structurally stable. The jetties have continued to stabilize the Inlet, however, without rehabilitation they will continue to sustain damage and at some future date, estimated to be as early as 10 years, may totally fail.

D5. A. West Jetty. Before the original construction of the west jetty in 1953-1954, a pile crib revetment was built at the north end of the west side of the Inlet in 1939 and was revetted with stone in 1947. This pile crib revetment began failing in the 1960's and was in need of complete rehabilitation by the late 1970's. In 1982, Suffolk County Department of Public Works reconstructed the pile crib revetment and part of the west jetty. The pile crib revetment was replaced by a rubble mound jetty. One hundred and seventy feet of the original jetty was reconstructed and the capstones were reset to their original design configurations.

D6. Recent field investigation has shown that the portion of the jetty which was rehabilitated in 1982 is in good condition and has retained its 1982 design configuration. Except for the jetty's outer end, there has been no sloughing of the cap stones and good interlocking exists. The top of the jetty has not settled, and there is no leakage of sands. The outer portion of the west jetty has suffered damages since 1954, and presently the seaward 200 ft. of the jetty is unraveling which is connected with the development of scour hole to el - 50 mlw at the jetty's outer end. The jetty head has not retained its design configuration, and the capstones have scattered.

D7. B. East Jetty. There has been no maintenance of the east jetty since its construction. Considerable damage has occurred at certain sections along the length of the jetty, and continued damage is expected if repairs are not undertaken.

D8. Along the length of the jetty, the stones on the Inlet side are sustaining minor sloughing in some sections (shown on Plate No. 4) while those stones on the beach side have retained their original position. There are two isolated areas of complete jetty washout at the northern end of the jetty. Wave action and overwash from the Inlet has eroded away the sand on the beach side of the jetty at these washouts; continued loss of sand would further undermine the existing jetty. As shown on Plate No. 4, there are areas along the jetty which have had minor crest settlement and some loss of interlocking of capstones. The shoaling adjacent to the jetty is due primarily to sand traveling over and thru the jetty at damaged sections. The most seaward 250 feet of the jetty is damaged and unraveling which is connected with the development of a scour hole to elevation - 25 mlw at the jetty's outer end. The original 700 ft. of revetment northeast of the jetty has completely washed away and the shoreline is receding. In addition, due to the strong bay currents especially on the ebb tide which flow in close proximity to the shoreline north and east of the Inlet, significant scouring has occurred to the bay shoreline within approximately 1,000 ft. east of the Bay end of the jetty. This scouring has resulted in a shoreline recession rate of approximately 15 ft./year which could lead to a breach through the barrier beach at some future time, perhaps 20 to 30 years, as occurred at Moriches Inlet in 1980. More immediately, continued erosion in this area will contribute to undermining the northern section of the jetty. In summary, aside from the failing outer and failed inner sections, the majority of the jetty, although sustaining damage has continued to perform adequately.

D9. Future Condition of the Jetties. Based on field inspections in December 1983, April 1984, June 1985 and March 1986 and photo inspections of August 1954, March 1956,

November 1968, April 1973, December 1978, November 1980 and March 1982, there have been two rates of damage established in order to project the future condition of the east jetty without jetty rehabilitation. The east jetty is considered the key to future conditions since it is further along in its deterioration than the west jetty. A long term rate of damage to initially isolated damaged sections which is approximately 30 feet/year since 1954 has not caused jetty failure but has weakened its condition and led to a shorter term rate of more severe damage, which is proceeding at the rate of approximately 100 ft/year since April 1984 and is projected to cause jetty failure as early as 10 years. Subsequent to jetty failure, it is estimated that sand from behind the jetty will infringe the Inlet in 4 years.

D10. Adequacy of Existing Jetties. The existing stone sizes of the armor layer of both jetties at their head sections vary from 6 to 12 tons, which are adequate for an 11.8 foot breaking wave, based on Hudson's Equation (SPM pg. 7-205). The maximum depth-limited wave which could break on the jetty head (which would be the design wave height) is a 16 foot wave. The ratio of wave ($H=11.8$ ft.) heights between the 0% - 5% damage condition ($H=16.0$ ft.) and design height ($h=11.8$ ft.) for existing conditions results in damage rates that are within Corps of Engineers limits of acceptability (30%) from SPM Section 7E. However, additional jetty maintenance costs, further discussed in paragraph D8 have been included in the rehabilitation scheme to account for the higher than Corps designed damage levels. The cover layer slopes of 1 on 1.5 are acceptable to Corps criteria for slope stability. Both jetties have only one layer of armor stone which is not in compliance with the Shore Protection Manual (1984) design criteria for breaking waves at head sections which specifies that two layers of armor stone are necessary in rubble structure design. This lack of sufficient cover layer stone and the scouring of the underlying sand at the oceanward toe of each of the jetties has lead to the unraveling of the head sections of the jetties. The configuration of the jetty which replaced the west jetty pile crib revetment is acceptable to Corps criteria, and the stone sizes are acceptable for the wave climate at that part of the Inlet.

D11. The east and west jetties have accomplished their purpose of stabilizing Shinnecock Inlet. They have kept the beach fill in place on either side of the Inlet. Based on a review of photographs as well as numerous site visits, it was determined that generally the jetties are not leaking any significant amount of sand. The sand located on the Inlet side of the east jetty's toe has been deposited there primarily by movement of sand over the crest of the jetty and thru severely damaged jetty sections.

D12. In summary, the jetties are adequately sized, but need an extra layer of capstone at the head sections to meet Corps criteria. This, along with increased maintenance costs have been incorporated into the jetty rehabilitation plan.

D13. Recommended Plan of Improvement. To rehabilitate the jetties at Shinnecock Inlet, specific repairs are recommended to prevent the structural failure of the jetties. All damages detailed in the existing condition section will be repaired so that the jetties will be able to keep the Inlet stable and to permit continued navigation of the Inlet. The plan of rehabilitation is displayed in Table B3 of the Cost Appendix and Plate No. 4.

D14. A. West Jetty. The oceanward two hundred foot section of the west jetty will be repaired as follows. A four foot thick scour blanket of 800 pound stone will be laid on the existing bottom over approximately 38,000 square feet to prevent additional scouring at the oceanward toe of the rehabilitated jetty. Refer to Comp. Page D4. New capstone and core stone will be needed to supplement the displaced stones of the existing jetty's 200 ft. outer end. The rehabilitation of the outer most 50 ft. will be upgraded from the as-built 1 layer of 6 to 12 ton cap stone with 1 on 1.5 slope to 2 layers of 12 ton avg. cap stone with 1 on 2 slope in order to reduce damage levels to 25% as per SPM sect. 7E. Refer to Plate No. 5 for details.

D15. B. East Jetty. Major repairs are necessary at certain sections on the east jetty to assure that it will not fail in the future.

D16. To replace the jetty section (approximately 200 feet in length) at the northern end of the jetty where there has been complete or partial washout, new capstone, corestone and bedding will be required for restoration. The new capstone for this section has been upgraded from the minimum 4 ton as built condition to a minimum 6 ton project improvement design to preclude washout. It is to be noted that washout of this section of jetty is believed to have been significantly impacted by washout of 700 ft. of adjacent revetment from a severe 1954 storm and subsequent flanking. As stated in paragraph D7c, the design of the revetment section to replace washed out revetment has also been upgraded to a jetty section to preclude washout. In addition, the rebuilt jetty alignment in this section of washout has been shifted from its original alignment to avoid proximity of a scour hole. In other sections where settlement and sloughing of the jetty stones have occurred (a total of approximately 730 feet), the original cap stones will be removed and core and bedding supplemented and stabilized and capstone reset to insure interlocking of the stones. Stone size will not be upgraded in this section since performance has been adequate with

acceptable damage levels. Similar to the west jetty, a 250 ft. outer section of the east jetty will have to be totally rebuilt with the rehabilitation of the outer most 50 ft. upgraded to 2 layers of 12 ton avg. capstone with a 1 on 2 slope in order to reduce damage levels to 25%. A scour blanket for toe stability will be placed consisting of a 4 ft. thick armor stone layer over 60,000 s.f. of ocean bottom at the outer toe of the jetty. Refer to Plate No. 5 and Comp Page D4 for details.

D17. C. Revetment. In addition to the work recommended on the jetties, 260 ft. of revetment north east and adjacent to the east jetty will replace a washed out section of revetment. It is to be noted that this revetment section has been upgraded in design to a trapezoidal section with 6 ton minimum capstone size to preclude the type of washout that previously occurred.

D18. In order to preclude erosion on the Bay side of the barrier beach adjacent to the east jetty, a new section of revetment, 1,000 ft. long as shown on Plate No. 5, is recommended. Due to its location, no direct ocean influence is anticipated on this length of revetment and therefore, was designed for Bay conditions. The SPM and EM-1110-2-1614, "Design of Coastal Revetment, Seawalls and Bulkheads" were utilized for the design of the new revetment and shown on Computation Sheet No. D1. Design computations are shown on Comp. Page D1. It is to be noted that the location of 260 ft. of revetment to be replaced (indicated in the previous paragraph) required a design with ocean influence, unlike the new revetment which totally faces the Bay and is sufficiently distant from wave influence from the Inlet. In addition, the top elevation of the revetment has been set at el. +9 mlw (the crest elevation of the adjacent jetty). This allows for a 25 year bay surge level and a runup of 1.5 ft. Even though, with design project hurricane ocean surge levels, submergence of the structure could occur, it is not cost effective to extend the top el. to +13 mlw for this condition as compared with including a higher maintenance cost for a top of revetment elevation of +9 mlw.

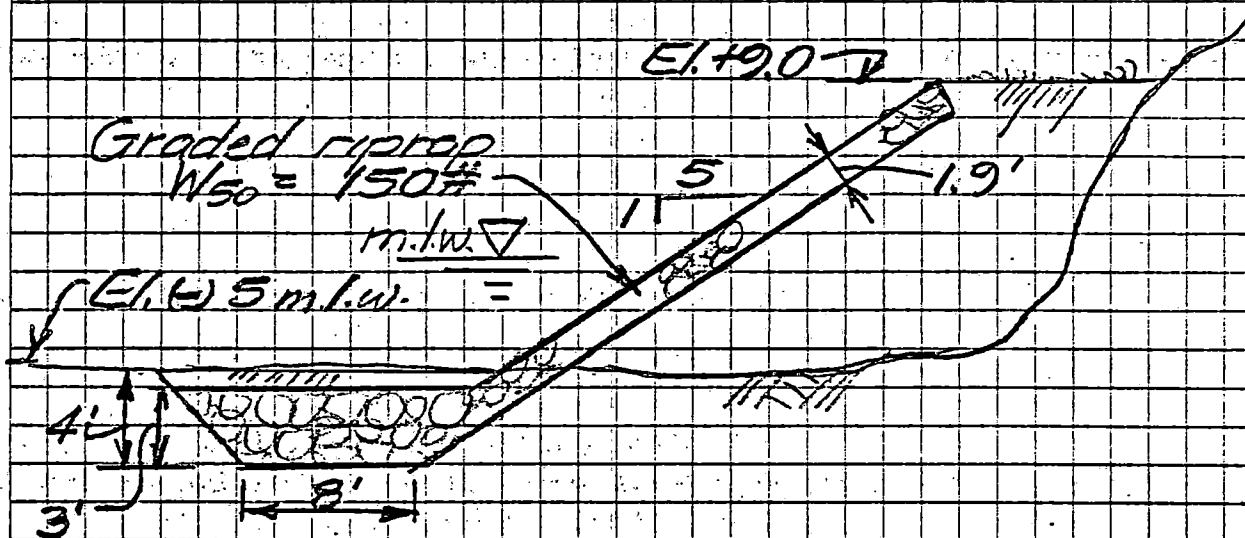
D19. Maintenance. Stone structures designed from Corps criteria are anticipated to sustain a 0% to 5% range of damage. Customarily, annual maintenance of a Corps designed stone structure is estimated to be 0.5% of its first cost. Since the jetties are not designed to Corps criteria but are anticipated to sustain an acceptable damage rate of 25%, the annual maintenance cost have been increased to 2.0% of first cost to allow for the anticipated higher level of damage.

D20. Since the new 1,000 ft. revetment adjacent to the east jetty was designed from Corps criteria with the additional condition that submergence could occur with design project

hurricane ocean surge levels, a 1.0% of the first cost for annual maintenance costs has been included.

D21. Summary. It is expected that upon rehabilitation of the east and west jetties and periodic maintenance provided thereafter, the jetties will continue to function as a navigation structure without excessive damage, as has occurred historically without the benefit of periodic maintenance.

COMPUTATION SHEET

Page D1 of 6Subject New Stone Revetment Project Shinnecock InletComputed by AcDate 9/19/86Checked by LMKDate 9/22/86

From Computation Sheet C-5, the following design conditions are applicable:

Design wave height (H) = 3.3 ft.

Design stillwater level = +6.0 NGVD (+7.3 m.l.w.)
(incl. surge & tide)

Design wave period (T) = 3.2 seconds

From EMM 1110-2-1614:

To determine weight of stone for graded riprap revetment:

$$W_{50} = \frac{\gamma_r H^3}{K_p (S_r - 1)^3 \cot \theta}$$

where

H = design wave height

γ_r = unit weight of stone

S_r = specific gravity of stone

K_p = stability coefficient

θ = structure slope

thus

$$W_{50} = \frac{(172)(3.3)^3}{(2.2)(\frac{172}{64} - 1)^3 (5)} = 120 \# \text{ say } 150 \#$$

COMPUTATION SHEET

Page D2 of 6

Subject New Stone Revetment Project Shinnecock Inlet
 Computed by re Date 9/19/86 Checked by LMK Date 9/22/86

For the revetment layer thickness:

$$r_{min} = 2.0 \left(\frac{W_{50 min}}{\gamma_r} \right)^{0.33}$$

$$= 2.0 \left(\frac{150}{172} \right)^{0.33} = 1.9 \text{ ft.}$$

To determine the top el. of the revetment, the runup must be calculated as follows from Chapter 7, Section II of the SPM:

The equivalent deepwater wave height (H_0') of the design wave must first be calculated using a deepwater depth (in the Bay) of 10 ft:

$$\frac{d}{H_0} = \frac{d}{(5.12) T^2} = \frac{10}{(5.12)(3.2)^2} = 0.1907$$

From Table C-2 of SPM

$$H/H_0' = .9162 \quad \text{for } H = 3.3$$

$$H_0' = 3.3 / .9162 = 3.60$$

$$\therefore \frac{H_0'}{g T^2} = \frac{3.6}{(32.2)(3.2)^2} = .0109$$

For a depth of water at structure toe

$$d_s = 5 + 7.3 = 12.3$$

$$\& \frac{d_s}{H_0'} = 12.3 / 3.6 = 3.42$$

From Fig. 7-12 (SPM) for $\cot \theta = 5$

$$R/H_0' = 0.73 \quad \text{or}$$

$$R = (0.73)(3.6) = 2.6 = \text{runup on a smooth slope}$$

COMPUTATION SHEET

Page D3 of 6Subject New Stone Revetment Project Shinnecock InletComputed by HLDate 9/19/86Checked by LMKDate 9/22/86

To calculate the runup on the given graded riprap slope refer to Fig. 7-19 (SPM).

$$\left[\frac{R}{H_o'} \right]_{\text{riprap}} \text{ for a } 1 \text{ on } 2 \text{ slope} = 1.0$$

From Fig. 7-12 (SPM) for a 1 on 2 slope

$$\left[\frac{R}{H_o'} \right]_{\text{smooth}} = 1.75$$

Now to determine the reduction of runup based on a riprapped slope vs. a smooth slope

$$\frac{\left[\frac{R}{H_o'} \right]_{\text{riprap}}}{\left[\frac{R}{H_o'} \right]_{\text{smooth}}} = \frac{1.0}{1.75} = 0.57$$

Therefore the runup on a graded riprap slope:

$$R_{\text{riprap}} = (0.57)(R_{\text{smooth}}) = (0.57)(2.6) = 1.5 \text{ ft.}$$

Thus the top el. of the revetment is the design SWL (including surge & tide) plus runup:

$$T/\text{Rev. El.} = +7.3 \text{ m.l.w.} + 1.5 \text{ ft.} = +8.8 \text{ m.l.w.}$$

$$\text{say } +9.0 \text{ m.l.w.}$$

COMPUTATION SHEET

Page DA of 6Subject Scour BlanketProject Shinnecock InletComputed by seDate 9/19/86Checked by LAKDate 9/22/86

To determine the stone size for the scour blanket, refer to Section IV of Chapter 7 of the SPM which defines revetment stone weight design based on velocity criteria.

Equation 7-142 (SPM) states that the min. weight of stable stone =

$$W = 0.029 V^6 \frac{\gamma_r}{g^3} \left(\frac{\gamma_w}{\gamma_r - \gamma_w} \right)^3 \left(\frac{1 - \sin^2 \theta}{\sin^2 \phi} \right)^{-3/2}$$

where V = velocity of water acting on stone
 γ_r = unit weight of stone
 γ_w = unit weight of water
 g = acceleration of gravity
 θ = angle of structure slope
 ϕ = riprap angle of repose

This equation uses Izbash's coefficient value of 1.20 for embedded stone. The equation therefore should be corrected using Izbash's value of 0.86 for non-embedded stone. This results in an adjusted Eq 7-142 of

$$W = .1617 V^6 \frac{\gamma_r}{g^3} \left(\frac{\gamma_w}{\gamma_r - \gamma_w} \right)^3 \left(\frac{1 - \sin^2 \theta}{\sin^2 \phi} \right)^{-3/2}$$

Using a $V = 10$ f/s developed in Appendix C, at both jetty ends the max. $\theta = 26.6^\circ$ (1 on 2 slope) from hydrographic survey

$$W = (.1617)(10)^6 \frac{172}{(32.2)^3} \left[\frac{64}{172-64} \right]^3 \left[\frac{1 - (.50)^2}{(.64)^2} \right]^{-3/2}$$

= 713# per 300#; 2 layers are recommended

Therefore, the scour blanket stone sizes at both jetty heads are 2 layers of 800# stone.

COMPUTATION SHEET

Page DS of 6Subject Jetty Damage LevelsProject Shinnecock InletComputed by scDate 9/19/86Checked by LWKDate 9/22/86

To determine anticipated damage levels with project improvements at the jetty heads, the stone size is 12 ton units (2 layers) with a 1 on 2 side slope. Using Hudson's Eq.:

$$H = \left[\frac{W K_0 (S_r - 1)^3 \cot \theta}{\gamma_r} \right]^{1/3}$$

where W = Stone weight
 K_0 = Stability coefficient
 S_r = Specific weight of stone
 γ_r = unit weight of stone
 θ = structure slope

thus

$$H = \left[\frac{(24,000)(1.6)(2.58-1)^3(2)}{172} \right]^{1/3}$$

= 12.1 ft. = Wave height that can be resisted by a breaking wave at the jetty head.

However, based on Appendix C, the max. design wave that could break on the jetty heads is 16.0 ft. The associated damage levels for a structure designed for a 16.0 ft. breaking wave is 0% to 5% based on SP19. Since the structure can resist up to a 12.1 ft. wave with 0% to 5% damage levels, by using a max. wave of 16.0 ft., the anticipated damage levels would increase to 25% based on Table 7-9 for

$$H/H_{D=0} = \frac{16.0}{12.1} = 1.33$$

COMPUTATION SHEET

Page D6 of 6Subject Jetty Damage LevelsProject Shinnecock InletComputed by RLDate 7/19/86Checked by WPKDate 7/22/86

8 SQUARE 5 X 5 TO THE INCH

To determine the damage levels at the jetty trunk with 6 ton min. stone size and 1 on 1.5 slopes using Hudson's Eq. for wave height associated with given stone size & slope

$$H = \left[\frac{W K_r (S_r - 1)^3 \cot \theta}{\gamma_r} \right]^{1/3}$$

$$= \left[\frac{(12,000)(2.9)(2.58 - 1)^3 (1.5)}{172} \right]^{1/3}$$

$$= 10.4 \text{ ft.}$$

From Appendix C, for a SWL = +12.0 m.l.w. and depths at the jetty toe averaging (-) 5 m.l.w. the max. wave associated with depth limitations at the toe is $(.78)(17) = 13.3 \text{ ft.}$

Therefore from SPM, Table T-9

$$\text{for } \frac{H_i}{H_o} = \frac{13.3}{10.4} = 1.28 \text{ or}$$

15% - 20% anticipated damage levels for the jetty trunk subjected to a max. wave condition

APPENDIX E
SHINNECOCK INLET NAVIGATION STUDY
ECONOMIC ANALYSIS

APPENDIX E
SHINNECOCK INLET NAVIGATION STUDY
ECONOMIC ANALYSIS

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SHINNECOCK INLET NAVIGATION STUDY
ECONOMIC ANALYSIS

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Shinnecock Inlet

Economic Appendix

I. Introduction

This appendix is prepared in accordance with the Water Resources Council's Economic and Environmental, Principles and Guidelines, for Water Related Land Resource Implementation Studies, dated March 1983. It presents an evaluation of the benefits that would result from the proposed plan of improvement for Shinnecock Inlet. The plan of improvement is described in detail in the main report. Briefly, the plan consists of an entrance channel 10 feet deep at mean low water and 200 feet wide from that depth in the Atlantic Ocean to Shinnecock Bay, a distance of approximately .7 miles.

Previous studies of Shinnecock Inlet identified several categories of benefits that might result from various plans of improvement. Appendix B, Evaluation of Benefits, contained in the Survey Report, Moriches and Shinnecock Inlet, Long Island, New York, dated September 1957 and revised 11 July 1958 presented the following categories of benefits.

- a. Increased fish and shell fish catch in the ocean.
- b. Increased shell fish production in Moriches, Shinnecock and Great South Bays.
- c. Use of the inlet by pleasure and sport fishing boats.
- d. Reduction of vessel damage.
- e. Provision for access to harbors of refuge.
- f. Control of beach erosion.
- g. Pollution abatement.
- h. Increased bay recreational boating.

This appendix will treat the following navigation categories:

1. Commercial fishing benefits.
2. Benefits from the protection of navigation facility.
3. Recreational fishing benefits.

Many of the categories included in the original survey report are no longer applicable. For example, pollution abatement was not analysed because it was based on the assumption that the plan of improvement would significantly improve the water quality in Shinnecock Bay. However, water quality in Shinnecock Bay has significantly improved since the 1957 survey report. The New York State Department of Environmental Conservation has currently rated the bay water "suitable for shell fishing for market purposes and primary and secondary contact recreation." Other categories were also eliminated because they would not be realized with the recommended plan of improvement. Changes in the Planning Guidance Notebook and the actual activities within Shinnecock Inlet during the last thirty years also mandated a reclassification of the benefit categories.

Terminology -In this appendix ocean conditions are described as calm, normal and adverse. The percentages of time that these conditions occur were provided by the United States Coast Guard and confirmed by local fishermen. These terms are explained below:

Calm - Calm conditions are characterized by minimal waves and swells. If the channel depth is sufficient, vessels will not have problems utilizing the inlet. With sufficient depth, a vessel could easily and safely navigate the inlet. Calm conditions are estimated to occur about 5 percent of the time.

Normal - Normal conditions comprise the range between adverse and calm reflecting the majority of ocean usage. These conditions occur approximately 60 percent of the time.

Under the without project conditions during normal ocean conditions the inlet will be unsafe and dangerous to navigate for all users. Under without project conditions the waves and swells would be significantly greater than under an improved condition. Normal conditions are reflected by 1.5 foot wave activity under an improved condition.

Adverse - Under adverse conditions the inlet is unsafe and dangerous because of weather or bad sea conditions. A plan of improvement would not alleviate this danger. This condition

occurs approximately 35 percent of the time. Adverse conditions are not affected by the tidal cycle.

II. General Navigation Conditions In The Inlet

Historical Inlet Conditions - Fishermen and marina operators stated that as long as twenty years ago, there were few problems entering or leaving the inlet during normal ocean conditions. All vessels which were not constrained by depth, were able to leave and enter at any time. There was sufficient depth in the inlet for the historic fleet. In the 1970's, breakers began to occur in the inlet. Breakers are caused by insufficient channel depth for the ocean currents and waves passing through the channel. Because of their nature, breakers are usually minimized near high tide, and because tide is predictable, breakers have an element of predictability. Vessel captains indicated a preference to enter and leave at high tide. Siltation was filling in the inlet and causing it to become shallower and narrower. This was causing the breakers to occur more often and encroach across the inlet.

Existing Inlet Conditions - Commercial fishing boats, charter boats, and private recreational boats currently use Shinnecock Inlet. Potential navigation benefits are applicable to all users of Shinnecock Inlet because no user is immune to the navigation problems within Shinnecock Inlet.

Under calm conditions, no wind or waves, the large commercial fishing vessels go through an existing 100' wide slot in the sandbar. The slot is 13.5 feet deep mean low water. The largest fishing vessel draws 11.5 feet. Two feet are available for safety clearance at low tide. The largest fishing vessels are approximately 22 feet wide. The remaining vessels, the charter boats and recreational boats, navigate the sand bar without difficulty under calm conditions.

Under normal conditions, there are two lines of breakers across the front of the inlet. The deepest water forms a navigable slot between the breakers for boats to enter and leave Shinnecock Inlet. This navigation requires total knowledge of the inlet and competent seamanship to use the meandering path. Charter boats and private recreational boats do not go over the sand bar because it is dangerous due to the breaker line during normal ocean conditions. None of the vessels are constrained by the depth of the channel.

Under the range of normal conditions that currently exist, superior local knowledge and seamanship is required to safely go through the slot. There is risk of damage to the vessel and possible injury to the boaters. Recreational boaters and charter boaters on occasion do refrain from leaving under existing normal ocean conditions. Commercial fishing vessels do try to operate under these conditions, because the vessels are more durable than the recreational vessels. Their captains are professional seamen with superior local knowledge. They also have the flexibility to wait for high tide to minimize the breaker problem.

On occasion during normal ocean conditions in the current inlet, a strong wind or a storm tide will make the risk of operating excessive even for commercial fishing boats. This disrupts the schedule of the fishermen because the sea beyond the breakers is calm and suitable for fishing. This results in lost fishing time.

The navigable slot is difficult to utilize because the slot shifts frequently, and if poor weather conditions exist, the slot can shift in several days. When the commercial fishing vessels go through the slot, there is no room for maneuvering due to the narrowness and meandering of the channel. Captains using the inlet indicated that boats often hit the side of the slot. A vessel that goes through the slot, makes its commitment a significant distance before it reaches the slot. Turning around under dangerous sea conditions risks capsizing the vessel. In 1985, several vessels were damaged in or near the navigable slot. Approximately \$10,000 worth of damages were reported. In other cases, the inlet was so dangerous that vessels either stayed in Shinnecock Bay or stayed at sea, but, they neither entered nor left Shinnecock Bay by way of Shinnecock Inlet. The specific existing conditions for various types of vessels are described in the following sections.

III. Commercial Fishing Evaluation

Data Collection - Data on the commercial fishing operations detailed in following analysis was collected from a variety of sources. Existing condition information reflects the actual fleet currently in Shinnecock Inlet. Interviews were conducted with fishermen and captains of the existing fleet to collect data consisting of vessels operating practices, such as the actual time and character of the fishing trips. This information included the time spent fishing, based on

the size of the vessel, the speed of the vessel, the size and type of crew on board, and the average amount of fish landings. This information was further verified by site visits to the inlet and field observations of vessels utilizing the inlet.

Cost data utilized in the analysis was provided primarily by the fishermen and users of the inlet, relative to specific vessel size. The data was more broadly confirmed by the Fishermen's Wive Association. This organization monitors the fishing activity in the inlet and is well informed regarding inlet operations. Some specific cost data such as insurance costs, maintenance costs and moorage costs were initially derived as a percent of vessel value, as done in the Institute of Water Resources guidance, dated 31 August 1983, on Shallow Draft Vessel Costs. These figures were then modified to reflect site specific costs incurred at Shinnecock Inlet.

To further verify the data used in the economic analysis, the National Marine Fisheries Service (NMFS), Analytical Services Branch, was contacted to insure that the figures utilized were consistent with data collected by their office, data used in other NMFS studies and data from other North Atlantic fishing operations.

Existing Commercial Fishing Boat Usage - Commercial fishing boats are the largest vessels going through Shinnecock Inlet. Optimal operating characteristics in an unrestricted channel are described in Table 1. The range of drafts for 70-79 long vessels actually varies from 8.5 feet to 11.5 feet. Most of the fishing boats over 70 feet use high tide to enter and exit the inlet. It is important to note that vessels do not utilize the tide because of an existing depth constraint. The additional available water depth simply improves the navigability of the narrow slot.

Under normal sea conditions, when the sea is rough enough to increase the risks of utilizing the inlet, vessels very often refrain from going out. Occasionally, vessels may have to wait to enter. Disruptions in the commercial vessels schedules effects the current profitability of the fleet. The majority of all fish shipments leaving Shinnecock Inlet are scheduled for Thursdays because the commercial fleet largely service the Fulton Fish Market in New York City. The fish are transported by truck from Shinnecock to New York City. The trucks routinely leave before dawn on each Friday. The Fulton Fish Market and other large fish markets used for

TABLE 1

SHINNECOCK INLET

VESSEL OPTIMAL OPERATING PROFILE

EXISTING FLEET (JAN. 1986)

DESCRIPTION

	40-49	50-59	60-69	70-79	80+	TOTALS
VESSEL LENGTH						
DRAFT	5	7	8	10	10.5	
BEAM	12	17	19	21	23	
SPEED(KNOTS)	8	8	8	8	8	
VESSEL COSTS	\$50,000	\$125,000	\$150,000	\$200,000	\$500,000	
LIFE (years)	20	20	20	20	20	
NUMBER OF DAYS FISHING	160	180	200	210	220	
	x	x	x	x	x	
HOURS FISHED PER DAY	12	24	24	24	24	
	=	=	=	=	=	
TIME SPENT FISHING(HOURS)	1920	4320	4800	5040	5280	
TIME SPENT PER FISHING TRIP (HOURS)	12	32	36	42	53	
NUMBER OF TRIPS	160	135	133	120	100	
CREW SIZE						
AVERAGE	2	3	3	4	8	
NUMBER OF FISHING VESSELS	14	9	9	10	4	46
LANDINGS PER TRIP	\$313	\$926	\$1,128	\$1,667	\$5,000	

wholesale distribution are closed during the weekend. Therefore, if the fishermen miss this schedule, the fish cannot be sold until Monday morning. This significantly reduces the value of the catch.

Fish Landings - Fish catches for Shinnecock Inlet are shown in Table 2. For Shinnecock, the great majority of fish come from NMFS area 613, some from NMFS 616 and small amounts from other areas. Fishing areas are displayed in Figure 1. Landings for Shinnecock Inlet, by area are displayed in Table 3. The actual fish landed in Shinnecock Inlet are displayed in Table 4. Shinnecock Inlet lands whole fresh fish from short trip vessels. Most of Suffolk County area 613 finfish landings are through Shinnecock Inlet.

Table 5 shows that for area 613, in 1984, approximately two thirds of its landings, \$5,700,000, were in Suffolk County. About \$1,750,000 worth of fish were landed in Rhode Island and \$400,000 combined in the nearby New Jersey counties of Monmouth and Ocean. Under \$4,000 worth of fish were landed in Nassau County.

Table 6 shows landings for the existing fleet at Shinnecock Inlet assuming fishing vessels continue to operate under the deteriorating conditions. Under January 1986 conditions, even though approximately 25% of the fishing opportunities are anticipated to be lost because of dangerous inlet conditions, expected landings for the fleet equal approximately \$5.4 million. Actual landings were \$5,500,000. This minor discrepancy between estimated and actual landings is caused by minor variations in actual vessel operations. Since the unnavigable conditions are caused by the breakers and the narrowness of the channel, analysis by vessel draft is not applicable, and all commercial vessels are affected equally in the analysis.

Fish Capacity - In order for inlet conditions to impact commercial fishing, there must be fish available for harvesting. Therefore, sustainable yield was estimated. The National Marine Fisheries Service has estimates of sustainable yield for various fisheries, but they are not broken down by NMFS area.

Estimates of sustainable yield for the major economic fish species excluding scallops are contained in Table 7. These species accounted for three quarters of Suffolk County NMFS area 613 non-scallop landings. Table 7 shows that sustainable yield is approximately 1.79 times the \$4,600,000

TABLE 2

SHINNECOCK INLET
FISH LANDINGS 1983 THROUGH 1986

YEAR	WEIGHT (LBS)	VALUE \$
1983	8,350,000	\$4,400,000
1984	8,200,000	\$4,600,000
1985	9,100,000	\$5,500,000
1986	8,334,000	\$5,524,000

SOURCE: NATIONAL MARINE FISHERIES SERVICE

SHINNECOCK INLET
1986 FISH LANDINGS BY AREA

TABLE 3

AREA	POUNDS	VALUE
613	6,166,000	\$3,995,000
616	1,794,000	\$1,313,000
537	321,000	\$152,000
611	40,000	\$29,000
525	5,000	\$18,000
533	8,000	\$17,000
TOTAL	8,334,000	\$5,524,000

SOURCE: NATIONAL MARINE FISHERIES SERVICE

TABLE 4
1986 SHINNECOCK INLET LANDINGS

FISH	POUNDS	VALUE
Anchovies	65	\$10
Anglerfish	79,197	\$74,775
Bluefish, Unc	237,059	\$61,813
Bonito	5,414	\$2,571
Butterfish, Lg	120	\$124
Butterfish, sm	23,815	\$4,876
Butterfish, unc.	271,449	\$153,797
Cod, At, Unc	187,237	\$189,962
Dolphinfish	20	\$38
Eels, Common	6,307	\$8,979
Eels, Conger	10	\$5
Flounder, At, Blackback, Unc	149,999	\$130,512
Flounder, At, Flukd, Jumbo	905	\$1,486
Flounder, At, Fluke, Lg	1,292	\$2,140
Flounder, At, Fke, Unc	850,487	\$1,291,334
Flounder, At, Fluke, Md	4,665	\$7,741
Flounder, At, Gray sole, Unc	1,705	\$1,883
Flounder, At, Sand	45,675	\$15,474
Flounder, At, Yellowtail, Lg	2,805	\$2,999
Flounder, At, Yellowtail, sm	5,160	\$3,842
Flounder, At, Yellowtail, Unc	176,590	\$158,892
Hake, At, Red	51,693	\$17,325
Herring, At, Sea	845	\$174
Mackerel, At	355,842	\$41,384
Marlin, Blue	900	\$225
Menhaden, At & Gf	17,100	\$1,863
Ocean Pout	730	\$183
Pollock, At & Pa, Unc	198	\$76
Scups or Porgies, Lg	6,100	\$6,842
Scups or Porgies, Md	15,790	\$14,791
Scups or Porgies, Sm	2,635	\$2,537
Scups or Porgies, Unc	621,940	\$565,175
Sea Basses, At, Black, Lg	735	\$1,286
Sea Basses, At, Black, Sm	375	\$656
Sea Basses, At, Black, Unc	75,035	\$110,510
Sea Robins	595	\$119
Sea Trout, Gray, Unc	79,549	\$69,604
Shad, Unc	4,392	\$1,248
Sharks, Dogfish, Unc	63,546	\$21,463
Sharks, Unc	1,086	\$1,363
Sharks, Thresher	125	\$125
Sharks, Dogfish, Spiny	101,760	\$6,106
Skates	74,751	\$5,933
Spanish Mackerel	1,042	\$831
Sturgeons, Comm-Green & White	12,121	\$9,386
Swellfish(Tails)	400	\$1,708
Swordfish	22,235	\$77,236

Tautog	13,996	\$6,135
Tilefish	142	\$240
Tuna, Albacore	1,900	\$1,215
Tuna, Bluefin, unc	75	\$281
Tuna, Yellowfin	15,935	\$22,726
Tuna, Unc	260	\$221
Tuna, Big Eye	300	\$1,023
White Perch	830	\$445
Whiting, Unc	1,131,057	\$472,010
Finfishes, Unc, Bait, An. Food	1,923	\$96
Crab, Jonah (Claws)	100	\$100
Horseshoe Crab	100	\$5
Lobster, American, Unc	17,875	\$53,157
Clams, Ocean Quahog	2,890	\$1,012
Clams, Soft, Public	1,216	\$3,967
Clams, Unc	102,168	\$418,166
Mussels, Sea	19,190	\$19,440
Oyster, East., Mkt, Pbl, Fall	1,440	\$6,725
Scallop, Sea	1,970	\$10,439
Squid, Long Finned	3,458,913	\$1,434,980
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	8,333,776	\$5,523,785

TABLE 5

SHINNECOCK INLET
WHERE FISH CAUGHT IN AREA 613 WERE LANDED IN 1984
(NON SCALLOP LANDINGS)

COUNTY AND STATE	POUNDS	VALUE	VALUE / POUNDS
CUMBERLAND, MAINE	3,300	\$1,336	\$0.40
BRISTOL, MASS.	434,700	\$253,819	\$0.58
NEWPORT, RHODE ISLAND	1,873,200	\$1,110,359	\$0.59
WASHINGTON, R. I.	1,423,500	\$645,448	\$0.45
ATLANTIC, N. J.	0	\$0	
CAPE MAY, N. J.	80,000	\$19,852	\$0.25
MONMOUTH, N. J.	194,600	\$210,169	\$1.08
OCEAN, N. J.	472,900	\$197,057	\$0.42
NASSAU, N. Y.	1,000	\$3,594	\$3.59
WORCESTER, MD	0	\$0	
NEWPORT NEWS, VA	33,800	\$18,123	\$0.54
CITY OF HAMPTON, VA	161,400	\$66,623	\$0.41
YORK, VA	98,900	\$40,403	\$0.41
TOTAL NON SCALLOP LANDINGS (EXCLUDING SUFFOLK CO)	4,777,300	2,566,783	\$0.54
PERCENTAGE OF TOTAL	31%	31%	
NON SCALLOP LANDINGS FOR SUFFOLK COUNTY	10,700,000	\$5,700,000	\$0.53
PERCENTAGE OF TOTAL	69%	69%	
TOTAL NON-SCALLOP LANDINGS	15,477,300	\$8,266,783	\$0.53

TABLE 6

SHINNECOCK INLET
FISHING CONDITIONS

LANDINGS UNDER EXISTING CONDITIONS

LENGTH	40-49	50-59	60-69	70-79	80+	
NUMBER OF DAYS FISHING (OPTIMAL)	160	180	200	210	220	
% LOST BECAUSE OF INLET	25%	25%	25%	25%	25%	
ACTUAL DAYS FISHING	120	135	150	158	165	
TIME SPENT FISHING (HOURS)	1,440	3,240	3,600	3,792	3,960	
TIME PER FISHING TRIP (HOURS)	12	32	36	42	53	
NUMBER OF TRIPS	120	101	100	90	75	
LANDINGS PER TRIP	313	926	1128	1667	5000	
ACTUAL LANDINGS PER VESSEL	\$37,560	\$93,526	\$112,800	\$150,030	\$375,000	
NUMBER OF FISHING VESSELS	14	9	9	10	4	
TOTAL LANDINGS FOR MINNECOCK INLET FLEET	\$525,840	\$841,734	\$1,015,200	\$1,500,300	\$1,500,000	\$5,383,074

COST DATA

VARIABLE COSTS

COSTS PER DAY

FUEL AND OIL	\$58	\$137	\$153	\$188	\$333
SUPPLIES	\$17	\$38	\$47	\$63	\$167

TOTAL VARIABLE COSTS PER DAY	\$75	\$175	\$200	\$250	\$500
ACTUAL DAYS FISHING	120	135	150	158	165

ANNUAL VARIABLE COSTS PER VESSEL	\$9,000	\$23,625	\$30,000	\$39,375	\$82,500
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ANNUAL WAGES (40% OF ACTUAL LANDINGS PER VESSEL)	\$15,024	\$37,410	\$45,120	\$60,012	\$150,000
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ANNUAL FIXED COSTS

INSURANCE	\$3,000	\$4,000	\$5,000	\$8,000	\$15,000
DEPRECIATION	\$2,500	\$6,250	\$7,500	\$10,000	\$25,000
MAINTENANCE AND REPAIRS	\$2,000	\$5,000	\$6,000	\$8,000	\$20,000
MOORAGE	\$450	\$550	\$650	\$750	\$1,275

TOTAL ANNUAL FIXED COSTS	\$7,950	\$15,800	\$19,150	\$26,750	\$61,275
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TOTAL ANNUAL COSTS PER VESSEL	\$31,974	\$76,835	\$94,270	\$126,137	\$293,775
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TABLE 7

SHINNECOCK INLET

POTENTIAL FOR INCREASED CATCH FOR VARIOUS FISHERIES

FISH	a	b	c	d	e	f	g	h
	NMFS	NMFS	c=a/b	1984	e=c x d	f=e/d		h=f x g
	ESTIMATE	ESTIMATE	FACTOR	CATCH	POTENTIAL	POTENTIAL		
	OF	OF	POTENTIAL	FOR	SUFFOLK	SUFFOLK		
	POTENTIAL	1984	GROWTH	SUFFOLK	CATCH	CATCH	1984	
	CATCH	CATCH		COUNTY		GROWTH	shinnecock	POTENTIAL
	(METRIC	(METRIC		\$		FACTOR	CATCH	CATCH
	TONS)	TONS)						
COD, ATLANTIC	10	12.2	0.8	\$349,042	\$286,100			
FLOUNDER, ATLANTIC, BLACKBACK(WINTER) UNKNOWN		14.7	1.0	\$156,795	\$156,795			
FLOUNDER, ATLANTIC, FLUKE (SUMMER)	17.5	14.2	1.2	\$742,305	\$914,813			
FLOUNDER, ATLANTIC, YELLOWTAIL	16	5.8	2.8	\$1,524,810	\$4,206,372			
SCUP	10.6	10.6	1.0	\$266,384	\$266,384			
STRIPED BASS	0			\$309,621	\$0			
LOBSTER, AMERICAN	7800	3900	2.0	\$116,600	\$233,200			
SQUID, LONG FINNED	44	22.4	2.0	\$738,535	\$1,450,694			
TOTAL				\$4,204,092	\$7,514,358	1.79	\$4,600,000	\$8,222,000

value of the 1984 catch. Therefore, the potential sustainable fish catch for Shinnecock Inlet is approximately \$8,200,000. Under without project conditions, the landings are well within the estimated sustainable yield.

Without Project Condition -Under future without project conditions, Shinnecock Inlet will become unusable by the base year (1991). Based on interviews with present users, the condition of Shinnecock Inlet has been continually deteriorating.

Because conditions are so dangerous in Shinnecock Inlet, vessel owners and captains of the largest fishing vessels are planning on moving out of Shinnecock Inlet. If nothing is done to improve the inlet, the most probable future condition will eliminate the great majority of the current commercial fleet. By 1991 the slot will become too narrow for vessel use. Coastal and navigational analysis indicates that by 1991 the inlet will deteriorate to such a degree that deep mean low water will equal 8 feet, and the narrowness of the slot will prohibit vessel use. Fishing vessels except the smallest will not be able to fish from Shinnecock Inlet. The majority of the commercial fleet will relocate to other ports.

All potential ports were given consideration in the following analysis. Moriches Inlet is anticipated to be an improved project site by the base year condition for the Shinnecock Inlet analysis. Moriches, the closest south shore port was determined to be viable for the smallest fishing vessels. These vessels have drafts of approximately 5 feet. The vessels are capable of using the Intercoastal Waterway and leaving for ocean fishing through Moriches Inlet. These smaller vessels (usually under 50 feet long) do not make multi-day trips, since they are not as seaworthy as the larger vessels. The additional time spent traveling through the Intercoastal Waterway therefore, reduces the time the vessel spends fishing, and in turn the vessels' landings. It was estimated that the smaller commercial fishing vessels would spend an additional 6 hours traveling through the Intercoastal Waterway. This analysis is shown on Table 7. Since the larger commercial vessels cannot navigate the inland waterway other alternative ports were evaluated.

Moriches Inlet was not viable for the entire relocation of the remaining 32 vessels in the fleet. Neither dock space for the fleet nor commercial facilities for the catch are available. Other ports in Nassau County were also excluded.

as potential alternatives. Currently Nassau County has minimal room for additional large fishing vessels. In addition, historically the fleets out of Nassau County have not fished in NMFS area 613. Its present fleet does all fishing in nearby areas with sufficient harvest.

In evaluating ports to the east of Shinnecock Inlet, Montauk, located approximately 30 miles east of Shinnecock was considered as an alternative port. However, Montauk's docking facilities are currently filled to capacity primarily with recreational boats. The port could not harbor the large commercial fleet from Shinnecock.

It should be noted that the constraints identified for the above ports are not limited to dockage but perhaps more significant limited to commercial fishery facilities that provide adequate storage, refrigeration and distribution equipment. To allow Shinnecock Inlet to function as a vital commercial port approximately 5.5 million dollars were invested in the port to enable the docks and facilities to serve the size of the existing fleet.

The most likely alternative port in Suffolk County for the Shinnecock fleet is Greenport. Greenport is located approximately 60 miles from Shinnecock Inlet or approximately 6 hours by water for a commercial fishing vessel. Historically a fleet did operate out of Greenport, however, the fleet has decreased over the years as vessels left to operate out of more profitable locations. Currently Greenport has dock space available and the appropriate facilities to service a large commercial fleet. Dockmasters at Greenport were contacted and strongly indicated their willingness and ability to assume the Shinnecock fleet. Even in light of the fact that travel time to fishing sites would increase by 12 hours per trip (6 hours one way from Shinnecock fishing grounds to Greenport) Greenport was determined to be the most probable alternative port.

Table 8, 9 and 10 show the most probable without project conditions for landings, annual costs and net income. Actual vessel operating data, and projected usage is based on extensive interviews with fishermen and dock operators. The National Marine Fishermen Service data on fishing vessel operations, including the costs of various items, were checked to confirm the interview data.

TABLE 8

SHINNECOCK INLET

LANDINGS USING ALTERNATIVE PORTS

(WITHOUT PROJECT CONDITION)

VESSEL LENGTH	40-49	50-59	60-69	70-79	80+ TOTALS
ALTERNATIVE PORT	MORICHES	GREENPORT	GREENPORT	GREENPORT	GREENPORT
TIME PER TRIP USING SHINNECOCK	12	32	36	42	53
	+	+	+	+	+
TRAVEL TIME IN HOURS BETWEEN SHINNECOCK AND ALTERNATE PORT	6	12	12	12	12
	=	=	=	=	=
TOTAL TIME PER TRIP USING ALTERNATIVE PORT(HOURS)	18	44	48	54	65
NUMBER OF DAYS FISHING	160	180	200	210	220
TIME SPENT FISHING(HOURS)	1920	4320	4800	5040	5280
	/	/	/	/	/
TOTAL TIME PER TRIP USING ALTERNATIVE PORT(HOURS)	18	44	48	54	65
	=	=	=	=	=
TOTAL NUMBER OF TRIPS	107	98	100	93	81
	x	x	x	x	x
LANDINGS PER TRIP	313	926	1128	1667	5000
	=	=	=	=	=
TOTAL ANNUAL LANDINGS PER VESSEL USING ALTERNATIVE PORT	\$33,491	\$90,748	\$112,800	\$155,031	\$405,000
	x	x	x	x	x
NUMBER OF FISHING VESSELS	14	9	9	10	4
ANNUAL LANDINGS USING ALTERNATE PORT	\$468,874	\$816,732	\$1,015,200	\$1,550,310	\$1,620,000
					\$5,471,116

TABLE 9

SHINNECOCK INLET

CALCULATION OF ANNUAL COSTS UNDER WITHOUT
PROJECT AND WITH PROJECT CONDITIONS

VESSEL LENGTH	40-49	50-59	60-69	70-79	80+
VARIABLE COSTS (BOTH WITHOUT PROJECT AND WITH PROJECT CONDITIONS)					
COSTS PER DAY					
FUEL AND OIL	\$58	\$137	\$153	\$188	\$333
SUPPLIES	\$17	\$38	\$47	\$63	\$167
TOTAL VARIABLE COSTS PER DAY	\$75	\$175	\$200	\$250	\$500
NUMBER OF DAYS FISHING	160	180	200	210	220
ANNUAL VARIABLE COSTS PER VESSEL	\$12,000	\$31,500	\$40,000	\$52,500	\$110,000
TOTAL ANNUAL LANDINGS PER VESSEL USING ALTERNATIVE PORT (WITHOUT PROJECT CONDITIONS)	\$33,491	\$90,748	\$112,800	\$155,031	\$405,000
ANNUAL WAGES (40% OF ACTUAL LANDINGS PER VESSEL)	\$13,396	\$36,299	\$45,120	\$62,012	\$162,000
ANNUAL FIXED COSTS					
INSURANCE	\$3,000	\$4,000	\$5,000	\$8,000	\$15,000
DEPRECIATION	\$2,500	\$6,250	\$7,500	\$10,000	\$25,000
MAINTENANCE AND REPAIRS	\$2,000	\$5,000	\$6,000	\$8,000	\$20,000
MOORAGE	\$450	\$550	\$650	\$750	\$1,275
TOTAL ANNUAL FIXED COSTS	\$7,950	\$15,800	\$19,150	\$26,750	\$61,275
ANNUAL VARIABLE COSTS	\$12,000	\$31,500	\$40,000	\$52,500	\$110,000
ANNUAL WAGES	\$13,396	\$36,299	\$45,120	\$62,012	\$162,000
ANNUAL FIXED COSTS	\$7,950	\$15,800	\$19,150	\$26,750	\$61,275
TOTAL ANNUAL COSTS PER VESSEL	\$33,346	\$83,599	\$104,270	\$141,262	\$333,275
NUMBER OF FISHING VESSELS	14	9	9	10	4
TOTAL ANNUAL COSTS FOR SIZE CLASS	\$466,844	\$752,391	\$938,430	\$1,412,620	\$1,333,100
					\$4,903,385

TABLE 10

SHINNECOCK INLET

ANNUAL NET INCOME USING ALTERNATIVE PORT

(WITHOUT PROJECT CONDITION)

TOTALS

VESSEL LENGTH	40-49	50-59	60-69	70-79	80+	TOTALS
ANNUAL LANDINGS USING	\$468,874	\$816,732	\$1,015,200	\$1,550,310	\$1,620,000	\$5,471,116
ALTERNATIVE PORT						
TOTAL ANNUAL COSTS FOR SIZE	\$466,844	\$752,391	\$938,430	\$1,412,620	\$1,333,100	\$4,903,385
CLASS						
ANNUAL NET INCOME USING	\$2,030	\$64,341	\$76,770	\$137,690	\$286,900	\$567,731
ALTERNATIVE PORT (WITHOUT						
PROJECT CONDITION)						

Table 8 shows that the estimated landings equal approximately \$5.5 million for the present Shinnecock fleet for Shinnecock Inlet without a plan of improvement. Table 8 indicates that the costs of operations for the fleet are \$4,900,000. It should be noted that whether Shinnecock Inlet is open or closed, the cost of operations for the fleet does not change; the critical change will be the amount of landings which determines the productivity of the fishing operations.

Table 10, the net income using an alternative port, is the difference between the annual landings in Table 8, without project conditions, and, the annual costs in Table 9, without project conditions. The net income for the present fleet, under without project conditions (Shinnecock Inlet closed), is estimated at \$574,000.

With Project Conditions - The proposed plan of improvement is a 10 foot mean low water channel with a width of 200 feet. With 3 feet of high tide, the channel will have 13 feet of available water. Based on interviews with fishermen and experience at other ports, it was identified that the fishing vessels operate on average, with 2 feet of clearance.

Fishing boats under 70 feet long, which in almost all cases have drafts under 9 feet, will be able to enter and leave with little regard to overloading or the tidal cycle. Larger boats will continue to make use of the tide. The larger vessels schedule themselves to leave and return on the tide whenever necessary. Because the boats can fish close to Shinnecock Inlet, the larger fishing vessels do not lose any time fishing by waiting for the necessary amount of tide. Tidal "delays" are not incurred by any of the vessels. With a 10 foot channel all existing vessels except the 11.5 foot draft vessel will operate out of Shinnecock Inlet. It is projected that the 11.5 foot draft vessel would be replaced by a shallower draft vessel that would continue to use Shinnecock Inlet.

Table 11 shows landings for the existing fleet with the plan of improvement. The time spent fishing has not changed. The time spent fishing is more efficiently used; more trips are made, and more fish are landed. Therefore, with a plan of improvement, the existing fleet (with the 11.5 foot draft vessel replaced) lands approximately \$2,000,000 more fish or a total of \$7,175,000 shown in Table 11. Table 12 shows that the net income for the existing fleet under with project conditions equals approximately \$2,267,000.

TABLE 11

SHINNECOCK INLET

ANNUAL LANDINGS UNDER WITH PROJECT CONDITIONS FOR EXISTING FLEET					TOTALS	
VESSEL LENGTH	40-49	50-59	60-69	70-79	80+	
NUMBER OF DAYS FISHING	160	180	200	210	220	
NUMBER OF TRIPS	160	135	133	120	100	
	x	x	x	x	x	
VESSEL LANDINGS PER TRIP	\$313	\$926	\$1,128	\$1,667	\$5,000	
	=	=	=	=	=	
ANNUAL LANDINGS PER VESSEL	\$50,000	\$125,000	\$150,000	\$200,000	\$500,000	
UNDER WITH PROJECT CONDITIONS						
	x	x	x	x	x	
NUMBER OF FISHING VESSELS	14	9	9	10	4	
	=	=	=	=	=	
ANNUAL LANDINGS PER SIZE CLASS						
UNDER WITH PROJECT CONDITIONS	\$700,000	\$1,125,000	\$1,350,000	\$2,000,000	\$2,000,000	\$7,175,000

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TABLE 12

SHINNECOCK INLET
ANNUAL PROFITS WITH PROJECT CONDITIONS
FOR EXISTING FLEET

VESSEL LENGTH	40-49	50-59	60-69	70-79	80+	TOTALS
ANNUAL LANDINGS PER SIZE CLASS						
UNDER WITH PROJECT CONDITIONS	\$700,000	\$1,125,000	\$1,350,000	\$2,000,000	\$2,000,000	\$7,175,000
	-	-	-	-	-	-
TOTAL ANNUAL COSTS FOR SIZE CLASS	\$466,844	\$752,391	\$938,430	\$1,412,620	\$1,333,100	\$4,903,385
	=	=	=	=	=	=
ANNUAL NET PROFITS BY SIZE CLASS (WITH PROJECT CONDITIONS)	\$233,156	\$372,609	\$411,570	\$587,380	\$666,900	\$2,271,615

Future Commercial Fishing Fleet - It is projected that under with project conditions there would be two additional 80+ foot long fishing vessels with drafts of approximately 10 feet utilizing Shinnecock Inlet. The projection is based on interviews with fishermen, the Fishermen's Cooperative and other local interests and officials. Many fishermen have indicated a desire to fish from Shinnecock Inlet. In 1985, three 80+ foot long fishing vessels with drafts of approximately 10 feet, came on line in Shinnecock Inlet.

The two additional commercial trawlers would have total landings of approximately \$1,000,000. This is based on the data presented in Table 11, annual landings per vessel under with project conditions for 80+ foot vessels. This would increase total landings of the entire Shinnecock fleet to approximately \$8,200,000. With the projected fleet, the inlet would reach the maximum sustainable yield. Table 13 shows the net income that would result from the additional 80+ foot fishing vessels.

Damage to Commercial Facilities - Under existing conditions, erosion is destroying property on both sides of Shinnecock Inlet. On the west side of Shinnecock Inlet there are improved properties that consist of three major commercial fishing and docking structures valued at approximately \$5,500,000. When erosion causes a breach in this area, the facilities will be destroyed. Based on an existing erosion rate of 3 acres per year, the facilities will be physically destroyed in 1996. It is noted that the economic viability of the commercial fishing facilities would end in 1991 the baseyear of the project, since this is when the inlet would be unnavigable. The vitality of the facilities is dependant solely on a functioning inlet. Since some residual usage may occur after 1991, the physical destruction of the facilities was utilized in the analysis. The average annual damages associated with this occurrence, \$324,000, are shown on Table 13A.

Under with project conditions work is necessary in this area to insure inlet stability. Since the improved condition insures the existence of valuable commercial structures the benefit for the prevention of damages to the commercial facilities has been claimed. The existence of the commercial facilities represent income generated from a functioning inlet. The structure value of \$5,500,000 is used as a proxy for the income potential of the warehousing operations of commercial fishing business. The structure value represents

TABLE 13

SHINNECOCK INLET
NET INCOME WITH PROJECT CONDITIONS
FOR NEW FLEET

	TOTALS				
VESSEL LENGTH	40-49	50-59	60-69	70-79	80+
ANNUAL NET PROFITS BY SIZE CLASS (WITH PROJECT CONDITIONS)	\$233,156	\$372,609	\$411,570	\$587,380	\$666,900
	\$2,271,615				
	/	/	/	/	/
NUMBER OF FISHING VESSELS	14	9	9	10	4
	=	=	=	=	=
NET INCOME PER VESSEL	\$16,654	\$41,401	\$45,730	\$58,738	\$166,725
	x	x	x	x	x
PROFIT FROM NEW FISHING VESSELS WITH PROJECT	0	0	0	0	2
	=	=	=	=	=
PROFIT FROM NEW FISHING VESSELS WITH PROJECT	\$0	\$0	\$0	\$0	\$333,450
					\$333,450

TABLE 13A

Shinnecock Inlet

Damage to Commercial Facilities

Value of Facilities		\$5,500,000
Projected Year of Destruction	1996	
Projected Year of Project Completion	1991	

Number of years for present worth analysis	5	
Project Life (Years)	50	
Interest rate (decimal)	0.08875	
Present worth factor		0.65367091

Present worth of damages in 1991		\$3,595,000
Interest and Amortization factor		0.09003

Average Annual Damages		\$324,000

the minimum income potential of the facilities and is therefore representative of a conservative income estimate. These damages prevented under with project conditions were included as a project benefit. The total average annual benefits of \$324,000 are included in the commercial fishing benefits.

Benefit Analysis - Benefits are displayed in Table 14. Benefits are the difference in net income between with project conditions and without project conditions. Total net income from the fishing fleet with the plan of improvement is approximately \$2,605,065, total net income from the fishing fleet without the plan of improvement is approximately \$567,731. This commercial fishing benefit equals approximately \$2,037,334. Benefits from the prevention of damage to the commercial facilities equal \$324,000. Total commercial fishing benefits equal approximately \$2,361,300.

IV. Head Boat Evaluation

Head Boat Operating Characteristics - A head boat is a vessel that goes on a regular schedule to fishing locations selected by its captain. Each passenger on the boat is charged a preset price. Head boats are usually large boats 40-90 feet long that carry between 30 and 150 fishermen. Their drafts are usually 6 feet and under. A head boat does not take reservations. A head boat will advertise its schedule and passengers go to the docks at the advertised appointed time. A head boat cannot alter its schedule or make use of the tidal cycle to mitigate for dangerous sea or inlet conditions.

Historical Conditions - Fifteen years ago there were two head boats operating out of Shinnecock Bay. They had few problems using Shinnecock Inlet. Estimated income for these vessels based on a recent study of a nearby operation is contained in Table 15. In 1985, there was one head boat. The owner and captain stated that the vessel was taken out of business because Shinnecock Inlet was too dangerous to navigate. On one occasion, the vessel suffered several thousand dollars worth of damage when returning through Shinnecock Inlet due to breaker action within the channel. The head boat went out of business even though there was an active market and experienced recreational fishermen have noted that the area outside of Shinnecock Inlet is very good for fishing.

TABLE 14

SHINNECOCK INLET
COMMERCIAL FISHING BENEFIT CALCULATION

VESSEL LENGTH	40-49	50-59	60-69	70-79	80+	TOTALS
ANNUAL NET PROFITS BY SIZE CLASS (WITH PROJECT CONDITIONS)	\$233,156	\$372,609	\$411,570	\$587,380	\$666,900	\$2,271,615
ANNUAL NET INCOME USING ALTERNATE PORTS (WITHOUT PROJECT CONDITION)	\$2,030	\$64,341	\$76,770	\$137,690	\$286,900	\$567,731
BENEFITS FROM SHINNECOCK PLAN OF IMPROVEMENT TO EXISTING FLEET	\$231,126	\$308,268	\$334,800	\$449,690	\$380,000	\$1,703,884
PROFIT FROM NEW FISHING VESSELS WITH PROJECT	\$0	\$0	\$0	\$0	\$333,450	\$333,450 ⁺
BENEFITS TO COMMERCIAL FISHING UNDER PLAN OF IMPROVEMENT						\$2,037,334
BENEFITS FROM THE PREVENTION OF DAMAGE TO THE COMMERCIAL FACILITIES						\$324,000
TOTAL BENEFITS TO COMMERCIAL FISHING UNDER PLAN OF IMPROVEMENT						\$2,361,334
				ROUNDED		\$2,361,300

TABLE 15

SHINNECOCK INLET
PROJECTED INCOME FOR ATTRACTED
HEAD BOATS

(1986 PRICES)
WITH PROJECT
HEAD BOATS

CHARACTERISTICS:

Current value	\$250,000
Number of days used	150
Number of trips	250

COST (\$)

Variable cost(fuel, wages and supplies)	\$51,900
Fixed costs (insurance, moorage and taxes)	\$33,000
Depreciation	\$25,300

Total cost	\$110,200
Cost per day	\$735
Cost per trip	\$441

GROSS INCOME (\$)	\$261,375
Income per day	\$1,743
Income per trip	\$1,046

NET INCOME PER VESSEL	\$151,175
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Number of vessels if project is implemented	5
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PROJECTED TOTAL NET INCOME	\$755,875
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SOURCE OF DATA: INTERVIEWS IN AREA, STUDIES OF HISTORICAL USAGE
AND COMPARATIVE STUDIES OF SIMILAR AREAS.

Existing Head Boat Usage - At the present time there are no head boats operating out of Shinnecock Bay.

Without Project Conditions - Under without project conditions there will be no head boats in Shinnecock Bay because the inlet will continue to be too dangerous to use.

With Project Conditions - Under the recommended plan of improvement, Shinnecock Inlet will be a 10 foot mean low water channel. An analysis was performed to confirm the likelihood of head boats operating out of Shinnecock Inlet, under a with project condition, considering the proximity of other vital south shore ports. Moriches Inlet was reviewed as a potential substitute for a Shinnecock Inlet fleet. The evaluation indicated that head boats and charter boats are not expected to operate from Moriches Inlet as a substitute location for Shinnecock Inlet because Moriches Inlet is too far away to serve the population centers around Shinnecock Inlet. A analysis of vessel use shows that for the New Jersey and New York Atlantic Coast, major head boat and charter boat docks are approximately 20 miles apart. Each port has a different customer base. The significant demand and vitality of the head and charter boat industry can be illustrated by the following data:

TABLE 16
MAJOR HEADBOAT AND CHARTER BOAT DOCKS

<u>Inlet</u>	<u>Head Boats</u>	<u>Charter Boats</u>	<u>Distance from Previous Ports (Miles)</u>
BARNEGAT N.J.	6	25	--
MANASQUAN N.J.	10	25	15
SHREWSBURY N.J.	12	20	20
ROCKAWAY L.I.	26	90	20
E. ROCKAWAY L.I.	40	50	10
JONES L.I.	12	40	10
FIRE ISLAND L.I.	14	50	20
MORICHES L.I. (PROJECTED)	12	30	30
SHINNECOCK L.I.	-	45	15
MONTAUK L.I.	10	35	30

Therefore, it has been determined that Shinnecock Inlet will have a separate and unique customer service base. This is reflected in the economic analysis. Two head boats with capacities similar to the historic fleet of Shinnecock Bay can be expected to return. The head boats would return because the dangerous conditions in Shinnecock Inlet would be eliminated, and the demand for the vessels would exist.

Future Head Boat Fleet - An additional three head boats are projected to come to Shinnecock Inlet under with project conditions. Based on historical patterns and interviews with marina operators and local officials, there is sufficient parking and dock space for a total of five head boats. Marina operators confirmed that they could provide necessary physical capacity relating to berthing, parking and other

requisite services for five head boats. These five head boats would have a total net income of approximately \$755,900 per year as displayed in Table 15.

Benefit Analysis - Benefits are the difference between the net income under with project conditions and the net income under without project conditions. The total net income generated by the projected local head boat fleet equals approximately \$755,900.

V. Charter Boats Evaluation

Charter Boat Operating Characteristics - Charter boats are usually cabin cruisers between 25 and 40 feet long which can carry a maximum of 6 passengers. They have professional captains. Drafts are under 5 feet. Vessel drafts do not affect the operation through Shinnecock Inlet. In Shinnecock, these vessels are part time boats. During the time the vessels are not used commercially, they are used by their owners for private fishing. Under calm conditions in Shinnecock Inlet, charter boats go out without difficulty. Under normal conditions, the two lines of breakers across the inlet create a slot through which the vessels currently navigate. When the slot is wide enough, charter boats captains have the ability to navigate without difficulty. When the slot is narrow and meandering, the channel becomes extremely treacherous. Charter boat captains have expert knowledge, and can safely navigate the inlet under conditions that would be dangerous and prohibitive for most recreational boaters. When the risks become excessive, however, they do not go through the inlet. They, like the commercial fishermen discussed earlier, lose trips on occasion because the inlet is too dangerous to navigate while the sea outside is suitable for navigation.

Existing Charter Boat Usage - At present, there are approximately 45 charter deep sea fishing boats that use Shinnecock Inlet on a regular basis. The vessels average 50 ocean trips per year for a total of 2,250 trips per year for the existing fleet. Net income is \$506,700 under existing conditions. Calculations are displayed in Table 17.

Without Project Conditions - Under without project conditions, under normal sea conditions, breakers in the inlet would be very severe and the narrowness of the inlet would make the inlet unnavigable. Under the without project condition, charter boats could not operate profitably. Because adverse conditions occur approximately 35% of the

TABLE 17

CHANGE IN CHARTER VESSEL INCOME IN
SHINNECOCK INLET UNDER VARIOUS ALTERNATIVES

	EXISTING AND WITH PROJECT CONDITIONS			WITHOUT PROJECT CONDITIONS	
	PRICE PER TRIP	NUMBER OF TRIPS	TOTALS	NUMBER OF OCEAN TRIPS	INCOME
REVENUE	\$500	2252	\$1,126,000	173	\$86,500
VARIABLE COSTS (WAGES, FUEL AND SUPPLIES)	\$162	2252	\$364,824	173	\$28,026
FIXED COSTS (DEPRECIATION, MOORAGE TAXES AND INSURANCE)	\$113	2252	\$254,476	173	\$254,476
TOTAL COSTS	\$275	2252	\$619,300	173	\$282,502
NET INCOME	\$225		\$506,700		(\$196,002)

SOURCES OF DATA:

NUMBER OF TRIPS AND PRICE PER TRIP FROM INTERVIEWS
COST DATA FROM VARIOUS CORPS' STUDIES

time during the normal boating season, only 65% of the time is available for trips, (60% normal conditions, 5% calm conditions). Because the charter boats could only operate during calm sea conditions, they could only make use of approximately 5% of the boating season. Vessels usage would be reduced to approximately 8% of the current usage, $(.05/.65)$, or approximately 173 trips (7.7% of 2,250). The fixed costs for the boats would not change. Table 18 demonstrates that under the without project conditions, fixed costs are greater than revenues and income is negative. Vessel owners could not operate at a loss and therefore would go out of business.

The charter boat business was reviewed to determine if the owners could alter their operating procedures to maintain a profitable business. The number of trips used in the analysis 2,250 corresponds to ocean trips (deep sea fishing). Boat owners and marinas were contacted to determine the likelihood of vessels operating in the bay. It was determined that the demand for charter boat usage within the bay is so minimal it was not an economically rational alternative. In fact it was noted that demand for bay trips was so minimal they would not even serve as a viable supplement to the reduced number of ocean trips under without project conditions.

With Project Conditions - Under with project conditions, the charter boats will have no difficulty going through Shinnecock Inlet to the ocean under calm or normal conditions.

Future Charter Boat Fleet - The future charter boat fleet is expected to be the same size as the present fleet under with project conditions. Demand for boating is increasing slightly and marina facilities are being maintained. Shinnecock Bay shoreline is fairly well developed, however therefore significant increases in the charter boat fleet are not projected in this study.

Benefit Analysis - Benefits are the difference in net income between the with project conditions and without project conditions or approximately \$506,700 per year. It is equal to the losses that would be incurred, if the charter vessels discontinue their business in the inlet.

VI. Recreational Boating Evaluation

Existing Recreational Boat Usage - Data was collected to identify and quantify the recreational deep sea fishing in the inlet. Twenty five marinas were interviewed and reported they docked approximately 2,000 recreational boats. Based on 1985 observations, approximately 700 vessels regularly go through the inlet approximately 45 times per year, for a total of 31,500 boat trips per year for ocean fishing. Each boat averages slightly less than 5 people per trip so that a total of 151,830 trips are made through the inlet each year.

Virtually all the boats going through the inlet go for the primary purpose of deep sea fishing. This is a specialized type of recreation. It requires significant skill, the opportunities of use in general are limited and the frequency of use is low.

Almost all of recreational vessels have drafts under 5 feet. Under existing conditions, the vessels occasionally, refrain from going through Shinnecock Inlet because of the breaker condition previously described. Vessels are not constrained based on their draft. Under calm sea conditions, recreational boats go over the sand bars because there are no breakers and no need to utilize the deeper slot. Under normal conditions, there are breakers, but the narrow slot between the breakers is currently utilized by the recreational boats. The boat captains are pleasure boaters and attempt to minimize the risks in the inlet. They have limited local knowledge and limited abilities. The boat captains aim to use the deeper water in the channel to minimize risks to the vessel.

Without Project Conditions - Under the without project conditions, breakers will completely encroach across the inlet and the channel will narrow significantly. In 1991 (the base year) the inlet will be approximately 8 feet deep mean low water. However, again it is noted that depth is not the constraining factor. The severe encroachment of the breaker line and the narrowness and meandering of the channel are the elements prohibiting use of the inlet. Under calm conditions, the inlet is safe for recreational boats. However, as discussed earlier, calm conditions exist approximately five percent of the boating season. It is apparent that this is insufficient time to justify the

docking of vessels that are primarily interested in deep sea fishing. The element of risk also becomes a factor in inlet use, in that, a trip may be undertaken by a vessel during calm conditions and yet, the condition may not be calm when the boat returns. Therefore, due to the minimal navigable time available for deep sea fishing and the uncertainty involved, the without project conditions would prohibit all recreational boats from navigating Shinnecock Inlet. Those boats interested in deep sea fishing would either find new berths at Montauk Point, a likely recreational choice, or displace current general recreation boaters at Montauk Point. Recreational deep sea fishing vessels could displace general recreation boats because the deep sea fishermen are preferred customers, generating more income to the docks. Specialized deep sea fishermen buy more fuel and supplies, incur higher costs for dock space, and use other marina services more heavily than general recreational boats.

Shinnecock Inlet users that are forced to use Montauk Point would incur increased costs under the without project condition. These costs consist of travel expenses. The two components of increased travel costs are mileage and time. The mileage cost of approximately \$756,000 is the cost boaters would incur utilizing their cars to go from Shinnecock Inlet to Montauk Point. Based on marina operators observations, there is an average of 2 cars per recreational vessel. The distance is 30 miles each way or 60 miles round trip. The government approved rate for car costs is \$.20 per mile. The calculation of mileage cost is shown on Table 18.

Time cost of approximately \$683,200, the value of recreational time lost travelling, is also calculated on Table 19. A proposed formula suggested in the Water Resource Council's Principles and Guidelines to quantify leisure time, is the use of one-third the average wage rate for adults. One third of the estimated prevailing wage rate of Suffolk County, or \$3.00 per hour, was utilized in the analysis. Increased travel costs from using Montauk Point totals approximately \$1,439,200 per year. Estimates of actual numbers, based on interviews with marina operators, are used in Table 18.

As a sensitivity test, the possibility that the recreational boats could go through an improved Moriches Inlet under without project conditions was analyzed. The results of that analysis indicated it is a more expensive alternative as displayed in Table 19. The vast majority, over 90%, of the present recreational boats going through

TABLE 18

SHINNECOCK INLET
INCREASED COSTS BY USING MONTAUK MARINAS

MILEAGE	number of CARS	round trip MILES	cost per x mile	total mileage costs
	63,000	60	\$0.20	\$756,000
TIME COST	number of people	Round trip Travel time (Hours)	Cost per hour	total time cost
	151,830	1.5	\$3.00	\$683,235
TOTAL TRAVEL COST	total mileage costs	total time cost	=	INCREASED TRAVEL COSTS
	\$756,000	\$683,235		\$1,439,235

MILEAGE, NUMBER OF CARS, NUMBER OF PEOPLE, MILEAGE COST, TRAVEL TIME AND COST PER HOUR ARE BASED ON ACTUAL PRESENT CONDITIONS WHICH ARE NOT EXPECTED TO CHANGE. COST PER HOUR IS ABOUT ONE THIRD OF THE PREVAILING WAGE RATE FOR SUFFOLK COUNTY.

TABLE 19

SHINNECOCK INLET

INCREASED COSTS BY GOING THROUGH MORICHES INLET

MILEAGE	number of boat trips	round trip MILES	fuel cost per mile	total mileage costs
	31,500 x	32 x	\$0.30 =	\$302,400

TIME COST	number of people	Round trip Travel time (Hours)	Cost per hour	total time cost
	151,830 x	4 x	\$3.00 =	\$1,821,960

TOTAL TRAVEL COST	total mileage costs	total time cost	INCREASED TRAVEL COSTS
	\$302,400 +	\$1,821,960	= \$2,124,360

MILEAGE, NUMBER OF BOATS, NUMBER OF PEOPLE, MILEAGE COST, TRAVEL TIME AND COST PER HOUR ARE BASED ON ACTUAL PRESENT CONDITIONS WHICH ARE NOT EXPECTED TO CHANGE. COST PER HOUR IS ABOUT ONE THIRD OF THE PREVAILING WAGE RATE FOR SUFFOLK COUNTY.

Shinnecock Inlet originate east of the Ponquogue Bridge. The distance from Ponquogue Bridge to Moriches Inlet is approximately 16 miles or 2 hours of travel time through Shinnecock Bay and Moriches Bay, for a round trip total of 4 hours. The 4 hours represents the additional time recreators would spend traveling to the fishing site. The value of \$3.00 per hour (detailed above) was used to quantify the cost of time.

Based on the size of the boats going through Shinnecock Inlet, an average of less than 3 miles per gallon was determined. Fuel costs are approximately \$.90 per gallon, therefore fuel costs are \$.30 per mile. Increased travel costs using Moriches Inlet for boats based in Shinnecock Bay approaches \$2,124,400 per year. Operating out of Montauk, with costs of \$1,439,200 per year, is the least costly alternative. Therefore, recreational operation out of Montauk is used in this analysis of without project conditions.

With Project Conditions - Under the with project conditions, specialized recreational boats would have no problem going through Shinnecock Inlet under calm and normal conditions. The recreational vessels will have no reason to relocate out of the Shinnecock Inlet area.

Future Recreational Fleet - The future specialized recreational fleet is expected to maintain its size under with project conditions. The demand for recreational boating is increasing slightly according to the New York State Comprehensive Outdoor Recreation Plan. Marina facilities are being maintained and most of the Shinnecock area is well developed.

In many shore front areas, marinas have been taken over and replaced with high density waterside residential development. However, the marina facilities at Shinnecock are being maintained due to strong local support and the Town of Southampton's Planning Board policies. Southampton zoning regulations prevent marinas from being replaced with waterside development or any other non-water related construction. Increases over existing recreational boating are not projected in this analysis, however, because the Shinnecock Bay shoreline is well developed, and, room for new sizable marinas is minimal.

Benefit Analysis - Benefits are the difference between costs incurred under the with project conditions and those incurred

in the without project conditions. Benefits accrued by specialized recreational fishing vessels are the avoided increased travel costs which would be incurred by traveling to Montauk Point. The increased travel costs associated with the movement of all specialized recreational fishing is approximately \$1,439,200 annually.

VII. Benefit Summary

Benefit Summary - Total annual benefits for the recommended plan of improvement at Shinnecock Inlet are estimated at \$5,063,100 per year. Benefits for the proposed plan of improvement include those from commercial fishing, income due to head boats, income from charter boats, and cost savings to recreational deep sea fishing vessels. They are summarized in Table 20. Annual costs are \$3,480,500 per year. The benefits to cost ratio is 1.5, using a project interest rate of 8 7/8%. Net benefits for the recommended plan of improvement are \$1,582,600.

TABLE 20

SHINNECOCK INLET

SUMMARIZATION OF BENEFITS

PROJECT INTEREST RATE 8.875 %
50 YEAR LIFE, 1986 PRICE LEVEL
1991 BASE YEAR

BENEFIT CATEGORY

AMOUNT

COMMERCIAL FISHING

\$2,361,300

HEAD BOATS

\$755,900

CHARTER BOATS

\$506,700

RECREATIONAL DEEP SEA FISHING

\$1,439,200

TOTAL BENEFITS

\$5,063,100

ANNUAL COSTS

/
\$3,480,500

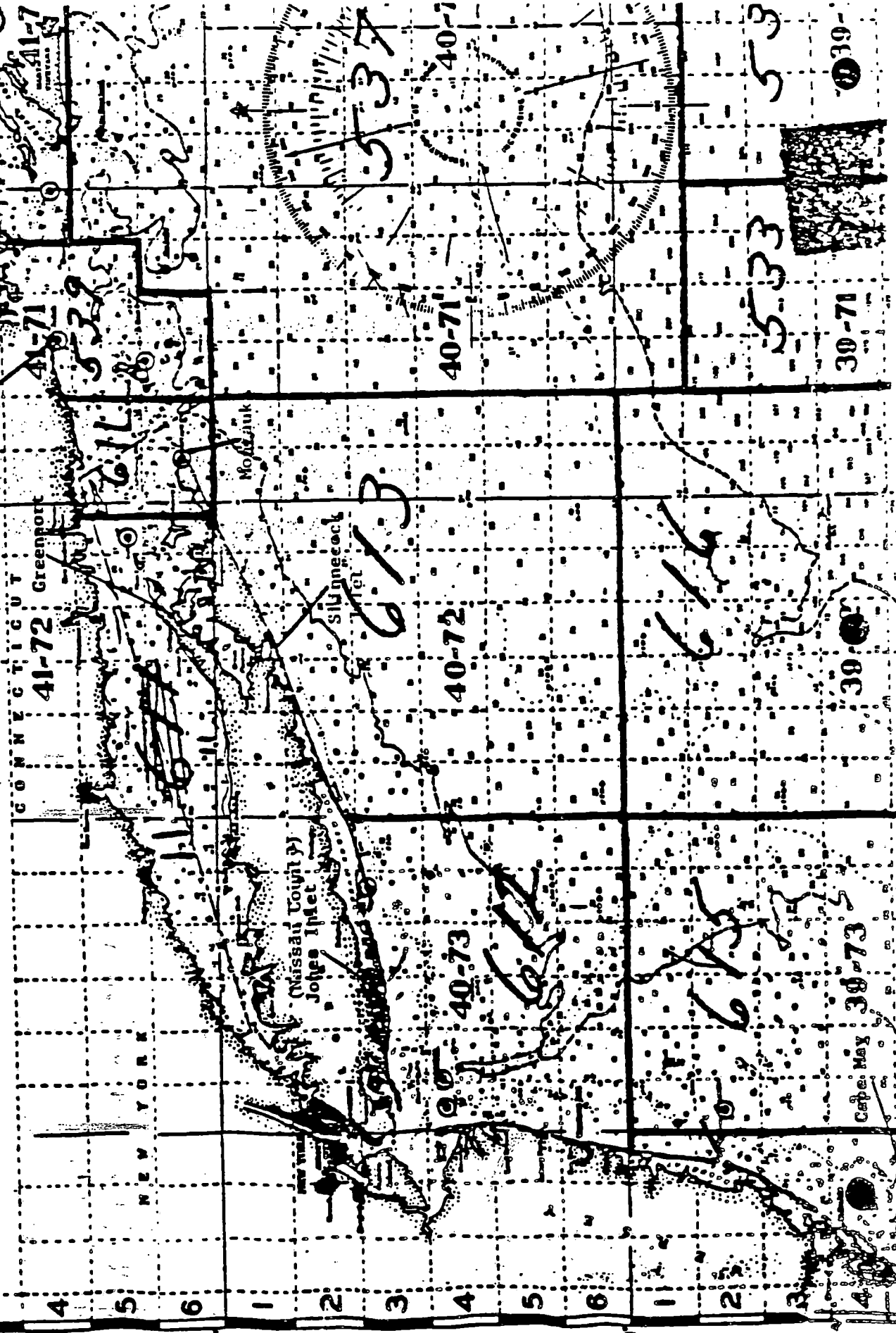
BENEFIT COST RATIO

=
1.5

E F A B C D E F A P D E F A B C D E F A J C
1 2 3 4 5 6 1 ~ 4 5 6

2 SOUTHERN NEW ENGLAND BANKS

3 U.S. FISH AND WILDLIFE SERVICE



APPENDIX F
Fish and Wildlife Resource Inventory

FISH AND WILDLIFE RESOURCE INVENTORY
FOR
SHINNECOCK INLET, SUFFOLK COUNTY, NEW YORK

-FINAL-

U.S ARMY CORPS OF ENGINEERS
NEW YORK DISTRICT
April 1985

I. INTRODUCTION.

Shinnecock Inlet is the easternmost of five inlets through the barrier beach system that extends along the south shore of Long Island, New York. It is located in the Town of Southampton, Suffolk County, 95 miles by water east of the Battery, New York City and 37 miles west of Montauk Point. Tiana Beach, a commercial fishery facility, two marinas and several restaurants lie on the west side of the inlet; Southampton Beach and scattered houses lie on the east side. The Tiana Beach area is part of Shinnecock West County Park; Shinnecock East County Park is part of the study area on the east side of the inlet. The inlet is bordered on the south area by the Atlantic Ocean and on the north by Shinnecock Bay.

Records of Long Island from the colonial period on note the occasional presence of natural openings through the barrier beach to Shinnecock Bay. Openings are known to have been present in 1770, 1829 and 1850-1890. The present opening of Shinnecock Inlet occurred as a result of wave action and extreme high tides caused by the hurricane of 21 September 1938.

The inlet is approximately 1,500 feet long and 800 feet wide. A sandbar exposed at low water is located just north of the inlet, with navigable channels on its east and west sides. A second sandbar is located oceanward of the inlet. Tidal range in the inlet is 2.9 feet. The spring tide is 3.5 feet; the neap tide range is 2.1 feet. Mean tidal range in the bay is 0.7 feet.

Shinnecock Bay is a shallow, bar-built estuary about 9 miles long, with widths ranging up to 2.8 miles and a total water surface area of about 16 square miles. It drains about 20 square miles of land area, extending from the Village of Southampton on the east to the Village of Quogue on the west. On the north side the Bay is connected to Great Peconic Bay through Shinnecock Canal. On the west, Quogue Canal and Quantuck Canal connect Shinnecock Bay with Moriches Bay. Twenty drainage basins and streams enter the bay. The Bay is divided into east and west sections by Ponquogue Point, a spit of land which extends southward from the mainland at about the center of the bay and connects the mainland with the barrier island via Ponquogue Bridge. Depths in the Bay range from approximately 2-7 feet in the west section, and from approximately 3-10 feet in the east section.

Water quality in Shinnecock Bay historically has been regulated by tidal flushing through the inlet. Prior to the opening of the present inlet in 1938, seawater entered Shinnecock Bay through Shinnecock Canal from Great Peconic Bay and through Quogue Canal from Moriches and Great South Bays. During this period salinity was very low, except near Shinnecock Canal. Today water quality in the study area is considered excellent. The New York State Department of Environmental Conservation has classified the area as SA, or suitable for shellfishing for market purposes and primary and secondary contact recreation. This high water quality is largely due to the tremendous flushing action that occurs through the inlet. Salinity data obtained by the Suffolk County Department of Health Services indicate that salinity levels in most of Shinnecock Bay are close to ocean levels.

The Long Island Intracoastal Waterway, a Federally authorized channel completed in 1940, extends from the Great South Bay Channel to Shinnecock Bay, providing a navigable channel 100 feet wide and 6 feet deep at Mean Low Water for a distance of 33.6 miles. The waterway enters Shinnecock Bay via the Quantuck and Quoque Canals, after entering Moriches Bay from Great South Bay through Narrow Bay. In Shinnecock Bay the Intracoastal Waterway turns north at a point just east of the Ponquoque Bridge to terminate at the southern end of Shinnecock Canal.

Various navigational improvements have been constructed in the area of the inlet since its formation. In 1943 the Corps of Engineers dredged a channel in the Bay six feet deep and 100 feet wide from the north end of the inlet to the Long Island Intracoastal Waterway. The most important work was installation of stone revetments and jetties on either side of the inlet. The jetties were built in 1952-1954; the revetments were constructed either before the jetties (west side, in 1947) or at the same time as the jetties. The total length of the east jetty at completion was 1,363 feet and the west jetty was 946 feet.

The jetties, revetments and beaches on either side of the inlet have been subjected to severe wave action from hurricanes and other storms. Shoaling of the inlet has also become a problem, resulting in navigational hazards for vessels using the inlet. In 1956 the Suffolk County Department of Highways restored the dune on the east side of the inlet by placing 343,000 cubic yards of sand on the eroded area. Most recently, the Corps of Engineers performed an emergency dredging action in the project area in April 1984, which removed approximately 162,000 cubic yards of sand from portions of the inlet, from a shoal that extended approximately one-fourth mile southwest from the east jetty, and from an offshore bar south of the inlet. The material was placed in the surf zone of Tiana beach, adjacent to the west jetty, at the -7 ft. contour. Considerable amounts of the deposited material subsequently washed shoreward to extend the width of the beach in this area.

The authorized proposal currently under consideration by the Corps provides for a 0.6 mile-long entrance channel 200 feet wide and 10 feet deep at Mean Low Water, from the Atlantic Ocean to Shinnecock Bay and thence a channel to the Long Island Intracoastal Waterway 6 feet deep and 100 feet wide; for rehabilitation of the existing stone jetties and revetments; for seaward extension of the west jetty by 900 feet and extension of the east jetty to the 12-foot contour. The plan also includes installation of a fixed by-passing plant to transfer sand from the east side of the inlet to a feeder beach on the west side, provided it is determined by further study that the costs of sand transfer by means of such a plant would be lower than the costs of operation of a proposed shallow-draft hopper dredge which would accomplish the same results.

Several previous studies exist for parts or all of the Shinnecock Inlet project area. For example, the Department of the Interior (USDOI), U.S. Fish and Wildlife Service collected data on finfish and benthic fauna, terrestrial fauna and terrestrial flora as part of fish and wildlife resource studies for the Fire Island Inlet to Montauk Point, New York beach erosion control and hurricane protection project reformulation study. The Suffolk County Department of Public Works collected biological information as part of the documentation prepared for the construction of the commercial fishery facility

at the inlet. Specific data on colonial waterbird colonies in the study area were available through the Long Island tern survey being conducted by the New York State Department of Environmental Conservation and Cornell University. The information in this report has been compiled from these studies and other reports relevant to the study area, personal communications with individuals knowledgeable about the area and its resources, and field observations. One complete, intensive study of the area is not available. However, with the specific information known about the area and knowledge of what is likely to occur in such an area, it has been possible to form a reasonably accurate picture of area resources.

The EQ (Environmental Quality) Resources of the project area have been identified as Shinnecock Inlet; portions of Shinnecock Bay; the nearshore portions of the Atlantic Ocean; the barrier island; and the Warner Islands with adjacent sandbar area, located north and northwest of the inlet. The five areas were chosen because of the importance of their ecological and aesthetic attributes.

II. MATERIALS AND METHODS.

Methods and sources for the preparation of this report were as follows:

<u>Methods</u>	<u>Dates</u>	<u>Material Source</u>
Literature Search	Mar.-Sept. 1984	U.S. Army Corps of Engineers, N.Y. District library and files, New York, New York
		U.S. Fish and Wildlife Service library, Long Island Sub Office, Upton, New York
		New York State Department of Environmental Conservation
		Long Island Regional Planning Board, Hauppauge, New York
		The Town of Southampton Planning Board, Southampton, New York
		Suffolk County Department of Parks, Recreation and Conservation, Southampton, New York
		Suffolk County Department of Health Services, Water Quality Unit

A list of references is included at the end of the report.

Persons Contacted

Philip Briggs	New York Department of Environmental Conservation (NYSDEC), Finfish and Crustaceans
Thomas Hart	NYS Department of State, Coastal Zone Management Program
Chet Zawicki	NYSDEC, Finfish and Crustaceans
Richard Fox	NYSDEC, Shellfisheries
Pieter Vanholkenburgh	NYSDEC, Shellfisheries
James Redman	NYSDEC, Shellfisheries
Warren Schlickerrieder	NYSDEC, Water Quality
Michael Scheibel	NYSDEC, Fish and Wildlife
Steven Sanford	NYSDEC, Fish and Wildlife
Lawrence Brown	NYSDEC, Significant Habitat Program
Robert Cerrato	State University of New York (SUNY), Marine Science Research Center
Jay Tansky	SUNY, Marine Science Research Center
Bud Brinkhouse	SUNY, Marine Science Research Center
Gilbert Raynor	New York State Breeding Bird Atlas
Michael Ludwig	National Marine Fisheries Service
Estyn Mead	U.S. Fish and Wildlife Service
Paul Buckley	National Park Service
William Norton	National Park Service, Jamaica Bay Wildlife Refuge
Lawrence Little	Biology Dept., Southampton College of Long Island University
J.R. Welker	Biology Dept., Southampton College of Long Island University
A. Churchill	Biology Dept., Adelphi University
David Peterson	Seatuck Research Program, Laboratory of Ornithology, Cornell University
Samuel Sadove	Research Director, Okeanos Ocean Research Foundation
Robert Nuzzi	Suffolk County Department of Health Services, Water Quality Unit

This report was prepared by:
Michele M. Farmer

B.A., Biology,
University of
Pennsylvania

M.S., Natural Resources
University of Michigan.
Four years with the U.S.
Army Corps of Engineers,
New York District

III. RESULTS.

The study area and project area, with EQ Resources identified, are shown on Figure 1 and Figure 2.

A. Ecological Attributes.

Vegetation. Terrestrial vegetation in the project area consists of typical plants of intertidal salt marsh, high salt marsh, and sand dunes in the northeast.

Shinnecock Bay and its tributaries have approximately 637 acres of wetlands, as designated by the Town of Southampton, and about 550 of these acres are located on the south side of Shinnecock Bay. (Marine Science Research Center, 1972). Approximately 175 acres of tidal wetlands are found within the project area.

Detrital production from salt marshes is critical to the survival and growth of several species of juvenile fish. Roots and rhizomes of marsh vegetation are eaten by waterfowl and several species of birds nest in marshes. In the project area salt marsh vegetation is found along the bay on both sides of the inlet and on the Warner Islands within Shinnecock Bay (Figure 3). Smooth cordgrass (Spartina alterniflora) dominates the intertidal zone. Higher marsh areas contain a mixture of saltmarsh hay (Spartina patens), salt grass (Distichlis spicata), glasswort (Salicornia spp.) common reed (Phragmites australis), marsh-elder (Iva frutescens), and groundsel-tree (Baccharis halimifolia).

Dune plants are less productive than the marsh plants. However, they provide habitat for certain small mammals (see Mammals, p.) and nesting habitat for several bird species (see Birds, p.). American beachgrass (Ammophila breviligulata) and seaside goldenrod (Solidago sempervirens) dominate the dunes of the study area. Northern bayberry (Myrica pensylvanica), beach plum (Prunus maritima), poison ivy (Toxicodendron radicans), false heather (Hudsonia tomentosa) sumac (Rhus sp.), groundsel-tree (Baccharis halimifolia), salt-spray rose (Rosa rugosa) and various domestic grasses occur in more limited amounts.

Aquatic macrophytes in the project area consist of eelgrass (Zostera marina) and various species of algae. No eelgrass occurs in the immediate area of the inlet. However, beds are located offshore of the marsh area west of the inlet and may also exist in the vicinity of the Warner Islands and marshes east of the inlet. Among other functions eelgrass provides food and shelter for invertebrates, small fish and waterfowl, and acts as a source of detritus.

Algae are found attached to the jetties and revetments, and pilings and other structures associated with the commercial fishing facility and marinas. Three species of rockweed (Fucus) have been identified in the rocky intertidal habitat of the small "cove" that has formed behind the break at the northern end of the east jetty: Fucus vesiculosus, F. edentatus and F. distichus. These plants are not uncommon on the east coast--in fact, F. vesiculosus is the most common and widespread species of rockweed on the Atlantic coast-- but they are uncommon on the south shore of Long Island due to the scarcity of rocky intertidal habitat.

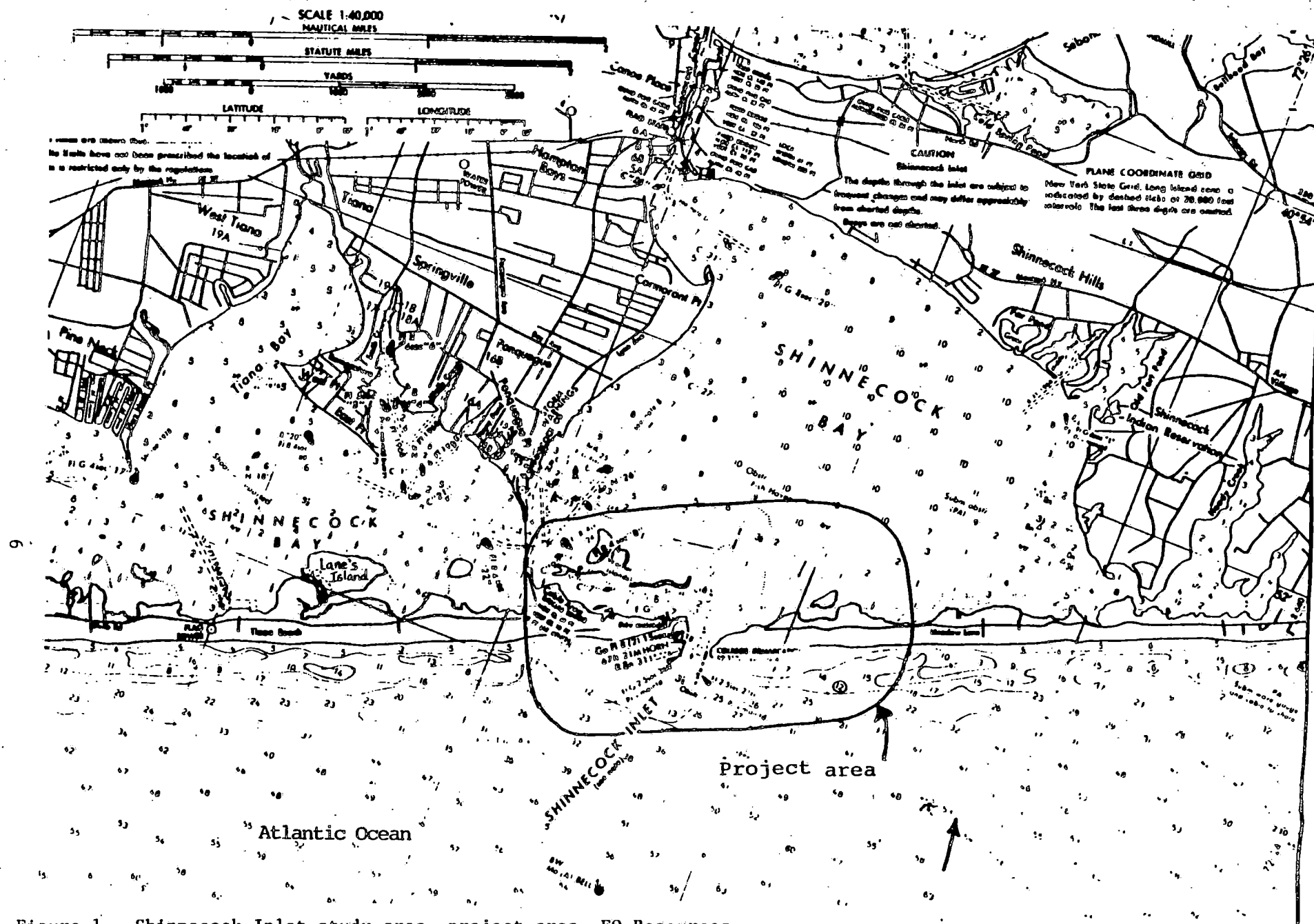


Figure 1. Shinnecock Inlet study area, project area, EQ Resources.

CORPS OF ENGINEERS

DEPARTMENT OF THE ARMY

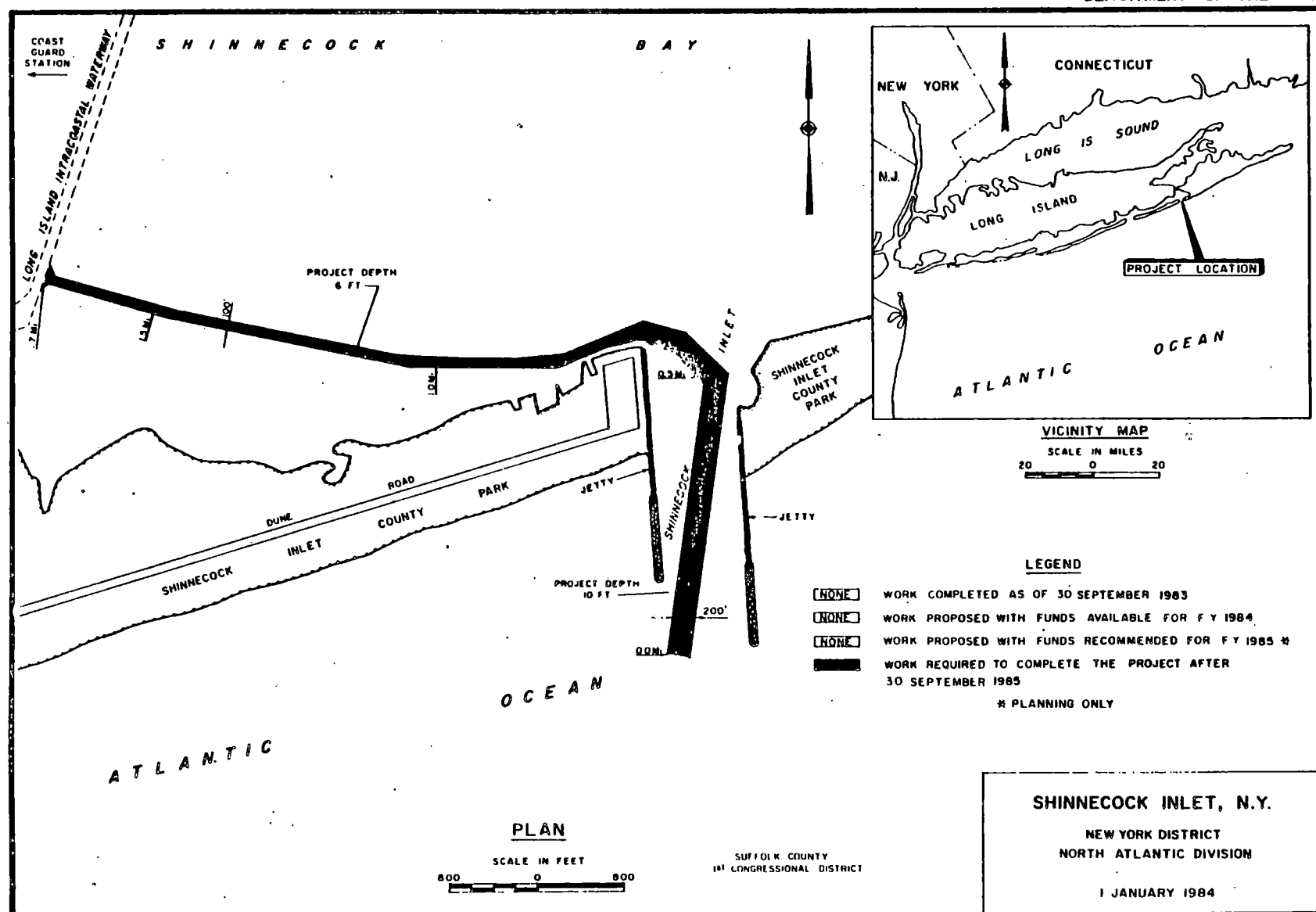


Figure 2. Shinnecock Inlet project.

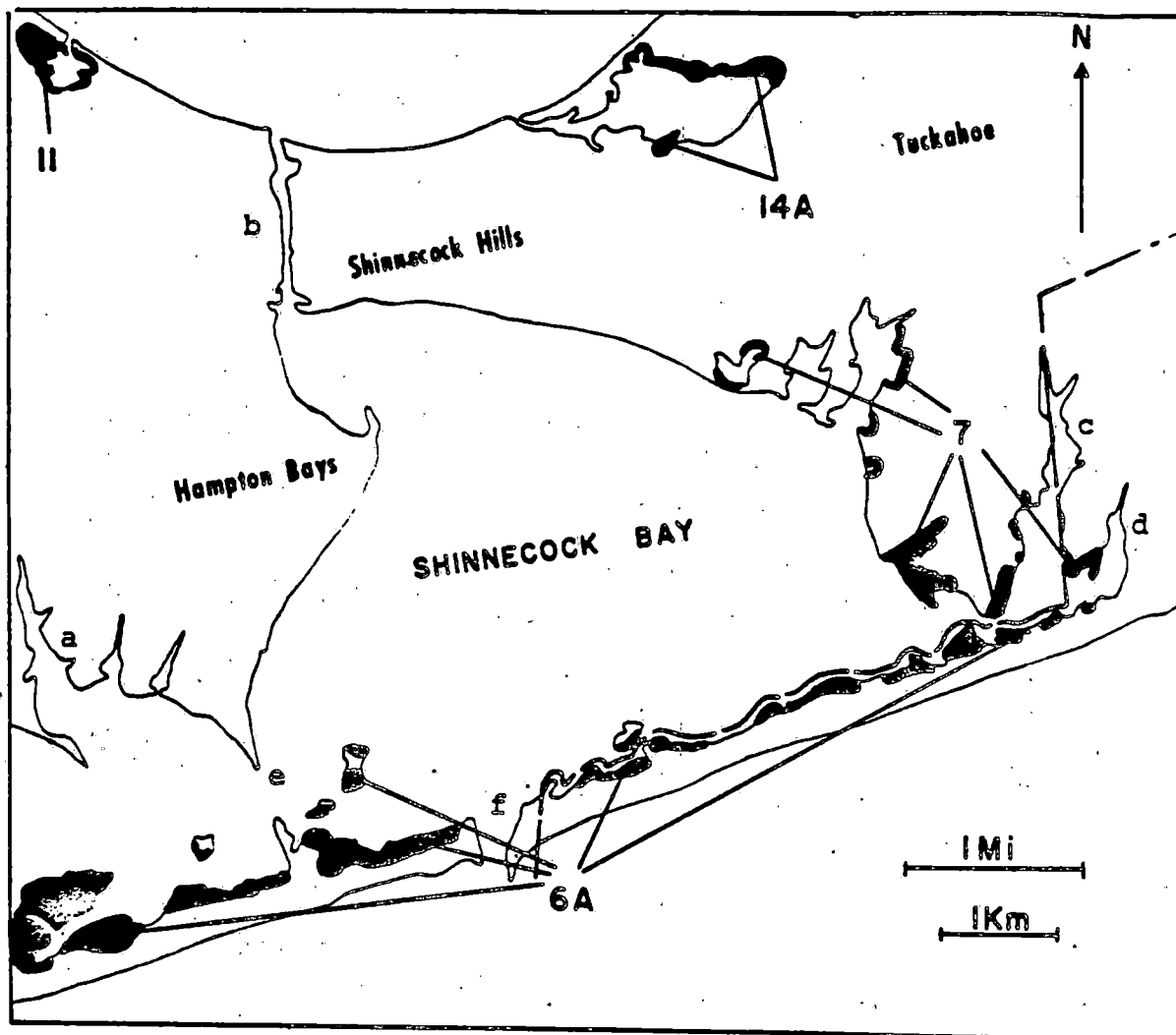


Figure 3. Town of Southampton wetlands within project area (from Marine Science Research Center, 1972).

Benthic fauna.

The most important commercial invertebrate species in the project area is the surf clam (Spisula solidissima), found in the ocean from the surf zone to depths as great as 250 feet. Lobsters (Homarus americanus) are also found in the ocean portion of project area, in the vicinity of the two rock jetties. Squid (Loligo pealei, (Ilex illecebrosus) and deep - sea scallop (Placopecten magellanicus) are harvested commercially from deeper waters offshore, but would not be expected to occur within the relatively shallow depths of the project area.

The main part of Shinnecock Bay is open for shellfishing, and the bay supports some commercial shellfish harvesting in addition to recreational harvesting. However, the shellfish resources of Shinnecock Bay are considered much less productive than those of Great South Bay or Moriches Bay, probably due, at least in part, to the higher salinities of Shinnecock Bay. Hard clams (Mercenaria mercenaria) are the most important commercial species harvested within the bay. Limited quantities of soft-shelled clams, Mya arenaria; blue mussels, Mytilus edulis (known beds within the project area are located in the intertidal zone of marshes west of the inlet and in the vicinity of the Warner Islands); razor clams, Ensis directus; and conches, Busycon spp., are also marketed. Bay scallop (Aequipecten irradians) does not occur in any quantity.

The natural population of oysters (Crassostrea virginica) in Shinnecock Bay is at present very low. Prior to the opening of the present Shinnecock Inlet in 1938 there were also relatively few oysters, because the low salinity levels of bay waters were not conducive to rapid oyster growth or fattening. Oyster larvae which did manage to set survived well, however, because of the absence of oyster drills. The opening of Shinnecock Inlet caused salinities in the bay to increase, with consequent increases in the oyster population. Oyster drill and Forbes seastar populations, favored by the higher bay salinities, unfortunately also increased, and oyster populations in Shinnecock Bay then declined. Today, the salinity level of the bay is at the upper limit of the oyster's salinity tolerance levels. This and oyster drill/seastar predation appear responsible in large part for the current low levels of the wild oyster population (an apparently successful oyster cultivation operation is being conducted by the Shinnecock Indians in Heady Creek).

Table 1 lists benthic species known or expected to occur within the project area. Only organisms capable of adapting to constantly shifting sands will be found within the inlet itself.

Table 1. Benthic fauna known or expected to occur within the Shinnecock Inlet project area. O = Atlantic Ocean, B = Shinnecock Bay,

<u>CLASS/SPECIES</u>	<u>COMMON NAME</u>	<u>TYPICAL HABITAT</u>
NEMERTEA		
Nemerteans (unidentified)	Nemerteans	B, O
NEMATODA		
Nematodes (unidentified)	Nematodes	B, O
POLYCHAETA		
<u>Ampharete</u> and related genera	Ampharetid worms	O
<u>Glycera</u> spp.	Blood worms	B
<u>Magelona riojai</u> and related spp.	Rosy magelonas	B
<u>Nephtys</u> spp.	Red-lined worms	B, O
<u>Orbinia</u> and related genera	Orbiniid worms	B, O
<u>Sthenelais</u> and related genera	Burrowing scale worms	B
<u>Spio</u> and related genera	Mud worms	B
<u>Harmothoe</u> spp.	Fifteen-scaled worms	B
<u>Lepidonotus squamatus</u> and related genera	Twelve-scaled worms	B
<u>Spirorbis</u> and related genera	Hard tube worms	B
<u>Capitella capitata</u> and related spp.	Capitellid thread worms	B, O
<u>Chaetozone</u> and related genera	Fringed worms	B
<u>Goniadella</u> and related spp.	Chevron worms	B, O
<u>Ophelia</u> and related spp.	Opheliid worms	B, O
<u>Lumbrineris</u> spp.	Lumbrinerid thread worms	B, O

Table 1, continued

POLYCHAETA, cont.

<u>Clymenella torquata</u> and related spp.	Bamboo worms	B
<u>Spiochaetopterus oculatus</u> and related spp.	Parchment worms	B
<u>Syllis</u> and related genera	Syllid worms	B,0
<u>Nereis</u> spp.	Clam worms	B,0
<u>Platynereis dumerilii</u>	Dumeril's clam worm	B
<u>Arabella iricolor</u>	Opal worm	B,0
<u>Diopatra cuprea</u>	Plumed worm	B

GASTROPODA

<u>Lunatia heros</u>	Northern moon snail	B,0
<u>Nassarius trivittatus</u> and related spp.	Mud snails	B
<u>Cerithiopsis greeni</u>	Green's cerith	B,0
<u>Urosalpinx cinereus</u>	Oyster drill	B
<u>Eupleura caudata</u>	Thick-lipped oyster drill	B
<u>Busycon canaliculatum</u>	Channeled whelk	B,0
<u>Busycan carica</u>	Knobbed whelk	B,0
<u>Crepidula fornicata</u> and related spp.	Slipper shells	B,0
<u>Littorina</u> spp.	Periwinkles	B,0

BIVALVIA

<u>Spisula solidissima</u>	Surf clam	0
<u>Tellina agilis</u>	Dwarf tellin	B,0
<u>Tellina versicolor</u>	DeKay's dwarf tellin	B,0
<u>Astarte castanea</u>	Chestnut astarte	0
<u>Lyonsia hyalina</u>	Glassy lyonsia	B
<u>Mytilus edulis</u>	Blue mussel	B
<u>Nucula proxima</u>	Near nut shell	0

Table 1, continued

BIVALVIA cont.

<u>Ensis directus</u>	Razor clam	B,0
<u>Corbula contracta</u>	Common basket clam	B
<u>Crassostrea virginica</u>	Common oyster	B
<u>Mya arenaria</u>	Soft-shelled clam	B
<u>Mercenaria mercenaria</u>	Hard-shelled clam, quahog	B,0
<u>Anomia sp.</u>	Jingle shell	0
<u>Gemma gemma</u>	Gem shell	B,0
<u>Modiolus demissus</u>	Ribbed mussel	B,0
<u>Macoma sp.</u>	Macoma clam	B

CRUSTACEA

<u>Crangon septemspinosus</u>	Sand shrimp	B,0
<u>Mysis</u> and related genera	Mysid shrimps	B,0
<u>Caprella</u> and related genera	Skeleton shrimps	B,0
<u>Palaemonetes</u> spp.	Shore shrimps	B,0
<u>Edotea</u> and related genera	Isopods	B,0
<u>Calanus</u> and related spp.	Copepods	B,0
<u>Acanthohaustorius</u> and related genera	Amphipods	B,0
<u>Oxyurostylis</u> and related genera	Peracarid crustaceans	B,0
<u>Leptognatha caeca</u>	Tanaid crustacean	B
<u>Pagurus longicarpus</u> and related spp.	Hermit crabs	B,0
<u>Ovalipes ocellatus</u>	Lady crab	B,0
<u>Cancer irroratus</u>	Rock crab	B,0

Table 1, continued

CRUSTACEA, cont.

<u>Cancer borealis</u>	Jonah crab	B,0
<u>Libinia emarginata</u>	Common spider crab	B,0
<u>Balanus</u> spp.	Barnacles	B,0
<u>Homarus americanus</u>	American lobster	0
<u>Callinectes sapidus</u>	Blue crab	B,0
<u>Carcinus maebas</u>	Green crab	B,0
<u>Neopanope</u> and related genera	Black-fingered mud crabs	B
<u>Uca pugilator</u> , <u>U. pugnax</u>	Fiddler crabs	B
<u>Emerita talpoida</u>	Mole crab	0

ARACHNIDA

<u>Limulus polyphemus</u>	Horseshoe crab	0
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ASCIDIACEA

<u>Molgula manhattensis</u> and related spp.	Tunicates	B,0
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ASTEROIDEA

<u>Asterias forbesi</u>	Forbes seastar	B,0
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ECHINOIDEA

<u>Echinarachnius parma</u>	Sand dollar	0
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Finfish. Shinnecock Bay provides productive habitat for many fish species. For example, fifty-one species of finfish were captured in Shinnecock Bay by the U.S. Fish and Wildlife Service during the 1981 sampling performed for the Corps of Engineers' Fire Island Inlet to Montauk Point, New York, Beach Erosion Control and Hurricane Protection Project Reformulation Study. The bay is considered a prime nursery area for winter flounder and marsh areas east and west of the inlet provide shelter and feeding habitat for juvenile bluefish (Pomatomus saltatrix), striped bass (Morone saxatilis) and northern kingfish (Menticirrhus saxatilis).

The lack of significant aquatic vegetation in the inlet and ocean portions of the project area suggest that these areas are used primarily for feeding grounds rather than for shelter, with the exception of the immediate vicinity of the jetties. The jetties provide feeding and/or shelter for such species as tautog (Tautoga onitis), black sea bass (Centopristus striata) and cunner (Tautoglabrus adspersus). The ocean portion of the project area is part of the approximately 60 miles of barrier beach from Jones Inlet to Shinnecock Inlet that provide some of New York's best surf fishing. Northern puffer (Spheroides maculatus), striped bass, northern kingfish and bluefish are commonly caught.

Table 2 lists fish species likely to be found in the study area on a relatively consistent basis. Most species listed use the inlet for ingress or egress and therefore can be found in the inlet itself on occasion, but would be found more typically in the ocean or bay. Additional species, not listed, can be found in the project area on an occasional or rare basis, as transients or as a result of storms or abnormal water temperatures.

The Shinnecock Inlet area and ports of call reached through the inlet have collectively developed into the largest commercial landing port in New York State. Commercial fishing occurs primarily in the ocean. Recreational fishing, however, is popular in both the bay and the ocean. In the study area fishing occurs from boats, from the jetties on either side of the inlet, and in the surf zone along the ocean side of the barrier beach.

Table 2. Finfish likely to occur in the Shinnecock Inlet study area on a consistent basis. O = Atlantic Ocean, B = Shinnecock Bay.

<u>Family Name/Common Name</u>	<u>Scientific Name</u>	<u>Habitat</u>
ODONTASPIDIDAE - Sand tigers		
Sand tiger	<u>Odontaspis taurus</u>	O
CARCHARHINIDAE - Requiem sharks		
Sandbar shark	<u>Carcharhinus milberti</u>	O
Dusky shark	<u>Carcharhinus obscurus</u>	O
Smooth dogfish	<u>Mustelus canis</u>	B,O
Spiny dogfish	<u>Squalus acanthias</u>	O
RAJIDAE - Skates		
Clearence skate	<u>Raja eglanteria</u>	O
Barndoor skate	<u>Raja laevis</u>	O
Little skate	<u>Raja erinacea</u>	B,O
Winter skate	<u>Raja ocellata</u>	B,O
DASYATIDAE - Stingrays		
Roughtail stingray	<u>Dasyatis centroura</u>	O
Atlantic stingray	<u>Dasyatis sabina</u>	O
ANGUILLIDAE - Freshwater eels		
American eel	<u>Anguilla rostrata</u>	B,O
Conger eel	<u>Conger oceanicus</u>	B,O
CLUPEIDAE - Herrings		
Atlantic menhaden	<u>Brevoortia tyrannus</u>	B,O
Blueback herring	<u>Alosa aestivalis</u>	B,O
Alewife	<u>Alosa pseudoharengus</u>	B,O
American shad	<u>Alosa sapidissima</u>	B,O
Round herring	<u>Etrumerus teres</u>	O
Atlantic herring	<u>Clupea harengus</u>	B,O
ENGRAULIDAE - Anchovies		
Striped anchovy	<u>Anchoa hepsetus</u>	B,O
Bay anchovy	<u>Anchoa mitchilli</u>	B,O
SYNODONTIDAE - Lizardfishes		
Inshore lizardfish	<u>Synodus foetens</u>	B
BATRACHOIDIDAE - Toadfishes		
Oyster toadfish	<u>Opsanus tau</u>	B
LOPHIIDAE - Goosefishes		

Table 2, continued

Goosefish	<u>Lophius americanus</u>	0
GADIDAE - Codfishes		
Pollock	<u>Pollachius virens</u>	0
Silver hake	<u>Merluccius bilinearis</u>	B,0
Atlantic tomcod	<u>Microgadus tomcod</u>	B
Red hake	<u>Urophycis chuss</u>	B,0
White hake	<u>Urophycis tenuis</u>	B,0
OPHIDIIDAE - Cusk-eels		
Striped cusk-eel	<u>Ophidion marginatum</u>	B
ZOARCIDAE - Eelpouts		
Ocean pout	<u>Macrozoarces americanus</u>	0
BELONIDAE - Needlefishes		
Atlantic needlefish	<u>Strongylura marina</u>	B
CYPRINODONTIDAE - Killifishes		
Mummichog	<u>Fundulus heteroclitus</u>	B
Striped killifish	<u>Fundulus majalis</u>	B
Sheepshead minnow	<u>Cyprinodon variegatus</u>	B
ATHERINIDAE - Silversides		
Atlantic silverside	<u>Menidia menidia</u>	B
Tidewater silverside	<u>Menidia peninsulae</u>	B
GASTEROSTEIDAE - Sticklebacks		
Fourspine stickleback	<u>Apeltes quadracus</u>	B
Threespine stickleback	<u>Gasterosteus aculeatus</u>	B
Blackspotted stickleback	<u>Gasterosteus wheatlandi</u>	B
SYNGNATHIDAE - Pipefishes, seahorses		
Northern pipefish	<u>Syngnathus fuscus</u>	B
Lined seahorse	<u>Hippocampus erectus</u>	B
PERCICHTHYIDAE - Temperate basses		
Striped bass	<u>Morone saxatilis</u>	B,0
White perch	<u>Morone americana</u>	B
SERRANIDAE - Sea basses		
Black sea bass	<u>Centropristus striata</u>	B,0

Table 2 continued

POMATOMIDAE - Bluefishes

Bluefish

Pomatomus saltatrix

B,0

CARANGIDAE - Jacks

Blue runner (rare regular)
 Crevalle jack (rare regular)
 Banded rudderfish
 Mackerel scad (rare regular)
 Bigeye scad (rare regular)
 Rough scad (rare regular)

Caranx crysos
Caranx hippos
Seriola zonata
Decapterus macarellus
Selar crumenophthalmus
Trachurus lathami

B,0
 B,0
 0
 B,0
 B,0
 B,0

SPARIDAE - Porgies

Scup (Porgy)

Stenotomus chrysops

B,0

SCIAENIDAE - Drums

Weakfish
 Northern kingfish
 Silver perch
 Spot

Cynoscion regalis
Menticirrhus saxatilis
Bairdiella chrysoura
Leiostomus xanthurus

B,0
 B,0
 B
 B

LABRIDAE - Wrasses

Tautog (blackfish)
 Cunner

Tautoga onitis
Tautoglabrus adspersus

B,0
 B,0

MUGILIDAE - Mulletts

Striped mullet
 White mullet

Mugil cephalus
Mugil curema

B,0
 B,0

SPHYRAENIDAE - Barracudas

Northern sennet (rare regular)

Sphyraena borealis

B

BLENNIDAE - Combtooth blennies

Striped blenny
 Feather blenny

Chasmodes bosquianus
Hypsoblennius hentzi

B
 B

PHOLIDAE - Gunnels

Rock gunnel

Pholis gunnellus

B,0

AMMODYTIDAE - Sand lances

American sand lance

Ammodytes americanus

B,0

GOBIIDAE - Gobies

Naked goby
 Seaboard goby

Gobiosoma boscii
Gobiosoma ginsburgi

B
 B

Table 2, continued

SCOMBRIDAE - Mackerels, tunas

Atlantic mackerel	<u>Scomber scombrus</u>	B,0
Atlantic bonito	<u>Sarda sarda</u>	0

STROMATEIDAE - Butterfishes

Butterfish	<u>Peprilus triacanthus</u>	B,0
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TRIGLIDAE - Searobins

Northern searobin	<u>Prionotus carolinus</u>	B
Striped searobin	<u>Prionotus evolans</u>	B

COTTIDAE - Sculpins

Grubby	<u>Myoxocephalus aeneus</u>	B
Longhorn sculpin	<u>Myoxocephalus octodecemspinosus</u>	B
Shorthorn sculpin	<u>Myoxocephalus scorpius</u>	B

BOTHIDAE - Lefteye flounders

Summer flounder	<u>Paralichthys dentatus</u>	B,0
Fourspot flounder	<u>Paralichthys oblongus</u>	B,0
Windowpane flounder	<u>Scophthalmus aquosus</u>	B,0
Whiff	<u>Citharichthys sp.</u>	B
Smallmouth flounder	<u>Etropus microstomus</u>	B

PLEURONECTIDAE - Righteye flounders

Winter flounder	<u>Pseudopleuronectes americanus</u>	B,0
Yellowtail flounder	<u>Limanda ferruginea</u>	0

SOLEIDAE - Soles

Hogchoker	<u>Trinectes maculatus</u>	B
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BALISTIDAE - Triggerfishes, filefishes

Planehead filefish	<u>Monacanthus hispidus</u>	0
Orange filefish	<u>Aluterus schoepfi</u>	0
Gray triggerfish	<u>Balistes capriscus</u>	0

TETRAODONTIDAE - Puffers

Northern puffer	<u>Spheroides maculatus</u>	B,0
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Amphibians.

The only terrestrial amphibian species that has been recorded in the vicinity of the project site is Fowler's toad (Bufo woodhousei fowleri) (USDOI, 1983), the most common amphibian species along the south shore of Long Island. This species appears to be fairly tolerant of occasional salt spray or overwash. However, it does require the presence of at least ephemeral fresh-water ponds for breeding purposes (USDOI, 1983). The scarcity of ephemeral freshwater ponds in the vicinity of Shinnecock Inlet probably limits its abundance in the area. Adult Fowler's toads, however, will be found in the project area. No other amphibian species are likely to be present in the project area, probably due to the lack of permanent freshwater ponds.

Reptiles.

The northern diamondback terrapin (Malaclemys terrapin terrapin) is the only reptile likely to reside in the project area. Although no sightings of northern diamondback terrapins are known from the area, the species does occur in coastal marshes and inner edges of barrier beaches and is known to occur in Shinnecock Bay (Bill Norton, Jamaica Bay Wildlife Refuge, pers. comm., March 1985). It may, therefore, very well be found in the wetlands east and west of the inlet, on the bay side of the project area.

The Atlantic green sea turtle (Chelonia mydas), Atlantic hawksbill sea turtle (Eretmochelys imbricata), Atlantic loggerhead sea turtle (Caretta caretta), Atlantic Ridley sea turtle (Lepidochelys kempii) and Atlantic leatherback sea turtle (Dermochelys coriacea) may also occur within the project area, but would be present only as transients or accidental strandings.

Birds.

Shinnecock Bay is part of the Atlantic Flyway and, as such, is used by over 25 species of migrating waterfowl. The greatest use of the project area by migrating birds occurs during the fall migration, but hundreds of waterbirds and shorebirds rest and feed in the project area during the winter months as well. These species include black duck (Anas rubripes), mallard (Anas platyrhynchos), gadwall (Anas strepera), canvasback (Aythya valisineria), common goldeneye (Bucephala clangula), greater scaup (Aythya marila), herring gull (Larus argentatus), Bonaparte's gull (Larus philadelphia), blackheaded gull (Larus ridibundus), and northern gannet (Sula bassanus) (Table 3). The intertidal flats and sandbar in the bay north and west of the outlet are used by thousands of birds in the fall and winter for feeding and resting. Most of the hawks, falcons, and harriers that migrate through the project area and the wintering owls use the interdune and primary back dune grasslands and swales for feeding habitat.

The immediate area of Shinnecock Inlet provides important feeding habitat for many birds. Indeed, inlets are well known as focal points for concentrations of marine shore birds. This generally has been attributed to increased primary and secondary productivity of well-oxygenated inlet waters. Buckley and Buckley (1980) hypothesized that the occurrence of large colonies of terns at suitable, undeveloped inlets such as Jones, Fire Island, Moriches, and Shinnecock was directly related to the prey-fish productivity of

Table 3. Birds of the Shinnecock Inlet project area. PO = Possible Breeder; PR = Probable Breeder, CO - Confirmed Breeder. A = Abundant, C = Common, U = Uncommon, R = Rare.

Family/Species	Habitat	Habitat Utilization			Seasonal Abundance				Principal Occurrence in the Project Area
		Breeding	Migration	Wintering	Winter	Spring	Summer	Fall	
Gaviidae - Loons									
Common Loon <u>Gavia immer</u>	Ocean and Bays	X	X	C	C	R	C		Fall and Spring Migrant.
Red-throated Loon <u>Gavia stellata</u>	Ocean and Bays	X	X	C	C		C		Fall and spring Migrant.
Podicipedidae - Grebes									
Red-necked Grebe <u>Podiceps grisegena</u>	Ocean	X	X	R			U		Winter Visitor.
Horned Grebe <u>Podiceps auritus</u>	Ocean and Bays	X	X	C	U		C		Winter Resident.
Sulidae - Gannets and Boobies									
Northern Gannet <u>Sula bassanus</u>	Ocean	X	X	U			C		Winter Visitor.
Phalacrocoracidae - Cormorants									
Great Cormorant <u>Phalacrocorax carbo</u>	Ocean and Bays	X	X	C			U		Winter Resident
Double-crested Cormorant <u>Phalacrocorax auritus</u>	Ocean and Bays	X		R	C	C	A		Fall Migrant.
Ardeidae - Herons and Bitterns									
Great Blue Heron <u>Ardea herodias</u>	Salt Marsh	X	X	C	C	U	C		Summer Non-breeder;

Table 3, cont.

Family/Species	Habitat	Habitat Utilization			Seasonal Abundance				Principal Occurrence in the Project Area	
		Breeding	Migration	Wintering	Winter	Spring	Summer	Fall		
Ardeidae - Herons and Bitterns, cont.										
Green-backed Heron <u>Butorides striatus</u>	Salt Marsh		X			C	C		Fall Migrant.	
Great Egret <u>Casmerodius albus</u>	Salt Marsh		X			C	C		Fall Migrant.	
Snowy Egret <u>Egretta thula</u>	Salt Marsh		X			C	C		Fall Migrant.	
Black-crowned Night-Heron <u>Nycticorax nycticorax</u>	Salt Marsh		X			C	C		Fall Migrant.	
Threskiornithidae - Ibises										
Glossy Ibis <u>Plegadis falcinellus</u>	Salt Marsh		X			C	C		Fall Migrant.	
Anatidae - Waterfowl										
Tundra Swan <u>Olor columbianus</u>	Bays and Ponds			X		R			Winter Visitor.	
Mute Swan <u>Cygnus olor</u>	Bays, Estuaries, Ponds, and Lakes		X	X		U	U	U	Resident.	
Canada Goose <u>Branta canadensis</u>	Bays and Ponds		X	X		A	C	U	A	Resident.
Atlantic Brant <u>Branta bernicla</u>	Bays		X	X		C	C		C	Winter Resident.
Snow Goose <u>Chen caerulescens</u>	Bays		X						U	Fall Migrant.
Mallard <u>Anas platyrhynchos</u>	Salt Marsh, Estuaries, and Bays	PR	X	X		C	C	C	C	Resident.

Table 3, cont.

Family/Species	Habitat	Habitat Utilization			Seasonal Abundance				Principal Occurrence in the Project Area
		Breeding	Migration	Wintering	Winter	Spring	Summer	Fall	
Anatidae - Waterfowl, cont.									
Black Duck <u>Anas rubripes</u>	Salt Marsh, Estuaries, and Bays	X	X	A	C	U	A		Resident.
Gadwall <u>Anas strepera</u>	Salt Marsh	X	X	C	U	U	A		Resident.
Pintail <u>Anas acuta</u>	Salt Marsh	X	X	C			C		Winter Resident.
Green-winged Teal <u>Anas crecca</u>	Salt Marsh	X	X	U			C		Fall Migrant.
Blue-winged Teal <u>Anas discors</u>	Creeks and Ponds	X				U	R		Summer Migrant.
American Wigeon (Baldpate) <u>Anas americana</u>	Salt Marsh and Bays	X	X	C			C		Winter Resident.
Northern Shoveler <u>Anas clypeata</u>	Salt Marsh and Bays	X	X	U			U		Winter Resident.
Redhead <u>Aythya americana</u>	Bays and Ponds	X	X	C			C		Winter Resident.
Ring-necked Duck <u>Aythya collaris</u>	Large Ponds	X	X	U	U		U		Winter Resident.
Canvasback <u>Aythya valisineria</u>	Bays and Ponds	X	X	C			U		Winter Resident.
Greater Scaup <u>Aythya marila</u>	Bays	X	X	A	C		C		Winter Resident.
Common Goldeneye <u>Bucephala clangula</u>	Bays	X	X	A			C		Winter Resident.

Table 3, cont.

Family/Species	Habitat	Habitat Utilization			Seasonal Abundance				Principal Occurrence in the Project Area
		Breeding	Migration	Wintering	Winter	Spring	Summer	Fall	
Anatidae - Waterfowl, cont.									
Bufflehead <u>Bucephala albeola</u>	Bays	X	X	A	C		C		Winter Resident.
Oldsquaw <u>Clangula hyemalis</u>	Ocean and Bays	X	X	A	C		C		Winter Resident.
Harlequin Duck <u>Histrionicus histrionicus</u>	Ocean; Jetties		X	R					Winter Visitor.
Common Eider <u>Somateria mollissima</u>	Ocean		X	U					Winter Visitor.
King Eider <u>Somateria spectabilis</u>	Ocean		X	R					Winter Visitor.
White-winged Scoter <u>Melanitta deglandi</u>	Ocean	X	X	A	C		A		Winter Resident.
Surf Scoter <u>Melanitta perspicillata</u>	Ocean	X	X	C	C		C		Winter Resident.
Black Scoter <u>Melanitta nigra</u>	Ocean	X	X	C	U		C		Winter Resident.
Ruddy Duck <u>Oxyura jamaicensis</u>	Bays	X	X	C	C		C		Winter Resident.
Common Merganser <u>Mergus merganser</u>	Lakes	X	X	R			U		Winter Visitor.
Red-breasted Merganser <u>Mergus serrator</u>	Bays	X	X	A	C		C		Winter Resident.

Table 3, cont.

Family/Species	Habitat	Habitat Utilization			Seasonal Abundance				Principal Occurrence in the Project Area
		Breeding	Migration	Wintering	Winter	Spring	Summer	Fall	
Accipitridae - Hawks, Eagles, and Harriers									
Sharp-shinned Hawk <u>Accipiter striatus</u>	Barrier Beach	X					C		Fall Migrant.
Cooper's Hawk <u>Accipiter cooperii</u>	Barrier Beach	X					R		Fall Migrant.
Red-tailed Hawk <u>Buteo jamaicensis</u>	Deciduous Woods		X	U	U		U		Fall Migrant.
Rough-legged Hawk <u>Buteo lagopus</u>	Barrier Beach		X	R					Winter Visitor.
Bald Eagle <u>Haliaeetus leucocephalus</u>	Cosmopolitan		X	R					Winter Visitor.
Northern Harrier <u>Circus cyaneus</u>	Barrier Beach	X	X	C	C	U	A		Fall Migrant.
Pandionidae - Ospreys									
Osprey <u>Pandion haliaeetus</u>	Bays, Ponds, and Creeks	X			R	U			Fall Migrant.
Falconidae - Falcon									
Peregrine Falcon <u>Falco peregrinus</u>	Barrier Beach	X					R		Fall Migrant.
Merlin <u>Falco columbarius</u>	Barrier Beach	X	X	U			C		Fall Migrant
American Kestrel <u>Falco sparverius</u>	Barrier Beach; Meadows	X	X	C	U	U	A		Resident.

Table 3, cont.

Family/Species	Habitat	Habitat Utilization			Seasonal Abundance				Principal Occurrence in the Project Area
		Breeding	Migration	Wintering	Winter	Spring	Summer	Fall	
Phasianidae - Pheasants and Quail									
Ring-necked Pheasant <u>Phasianus colchicus</u>	Barrier Beach; Old Fields	PO	X	C	C	C	C		Resident
Rallidae - Rails, Gallinules, and Coots									
Clapper Rail <u>Rallus longirostris</u>	Salt Marsh		X	U		R	U		Resident.
Virginia Rail <u>Rallus limicola</u>	Salt and Freshwater Marsh	X	X	R	R	R	R		Resident.
American Coot <u>Fulica americana</u>	Estuaries and Ponds		X	C					Winter Resident.
Haematopodidae - Oystercatchers									
American Oystercatcher <u>Haematopus palliatus</u>	Salt Marsh	CO	X		U	C	C		Fall Migrant.
Charadriidae - Plovers									
Semipalmated Plover <u>Charadrius semipalmatus</u>	Tidal Mud Flats		X		U	U	C		Fall Migrant.
Killdeer <u>Charadrius vociferus</u>	Barrier Beach; Old Fields		X		R		U		Fall Migrant.
Piping Plover <u>Charadrius melodus</u>	Sandy Beach	CO	X		U	C	U		Fall Migrant.
Lesser Golden Plover <u>Charadrius dominica</u>	Agricultural Fields		X		R		R		Fall and Spring Migrant.
Black-bellied Plover <u>Pluvialis squatarola</u>	Tidal Mud Flats		X	X	R		C		Fall and Spring Migrant.

Table 3, cont.

Family/Species	Habitat	Habitat Utilization			Seasonal Abundance				Principal Occurrence in the Project Area	
		Breeding	Migration	Wintering	Winter	Spring	Summer	Fall		
Scolopacidae - Sandpipers										
Hudsonian Godwit <u>Limosa haemastica</u>	Tidal Mud Flats		X				U		Fall and Spring Migrant.	
Marbled Godwit <u>Limosa fedoa</u>	Tidal Mud Flats		X			R		U	Fall Migrant.	
Whimbrel <u>Numenius phaeopus</u>	Salt Marsh; Tidal Mud Flats		X			U		U	Fall and Spring Migrant.	
Greater Yellowlegs <u>Tringa melanoleuca</u>	Salt Marsh; Tidal Mud Flats		X	X		R		C	Fall Migrant.	
Lesser Yellowlegs <u>Tringa flavipes</u>	Salt Marsh; Tidal Mud Flats		X					C	Fall Migrant.	
Solitary Sandpiper <u>Tringa solitaria</u>	Ponds; Freshwater Marshes		X					U	Fall and Spring Migrant.	
Willet <u>Catoptrophorus semipalmatus</u>	Salt Marsh	CO	X	X		R		C	C	Resident.
Spotted Sandpiper <u>Actitis macularia</u>	Ocean Beach	PO	X					U	U	Fall Migrant.
Ruddy Turnstone <u>Arenaria interpres</u>	Ocean Beach; Tidal Mud Flats		X					C	R	Fall and Spring Migrant.
Common Snipe <u>Capella gallinago</u>	Tidal Mud Flats; Wet Meadows and Fields		X						R	Fall Migrant.
Short-billed Dowitcher <u>Limnodromus griseus</u>	Tidal Mud Flats		X	X				C		Fall and Spring Migrant.
Long-billed Dowitcher <u>Limnodromus scolopaceus</u>	Ponds; Tidal Mud Flats		X					R		Fall and Spring Migrant.

Table 3, cont.

Family/Species	Habitat	Habitat Utilization			Seasonal Abundance				Principal Occurrence in the Project Area
		Breeding	Migration	Wintering	Winter	Spring	Summer	Fall	
Scolopacidae - Sandpipers, cont.									
Red Knot <u>Calidris canutus</u>	Ocean Beach; Tidal Mud Flats	X		R	U		C		Fall Migrant.
Sanderling <u>Calidris alba</u>	Ocean Beach; Tidal Mud Flats	X	X	U	C		A		Fall Migrant.
Semipalmated Sandpiper <u>Calidris pusilla</u>	Tidal Mud Flats	X			C		A		Fall Migrant.
Western Sandpiper <u>Calidris mauri</u>	Tidal Mud Flats	X					R		Fall Migrant.
Least Sandpiper <u>Calidris minutilla</u>	Tidal Mud Flats	X			C	U	A		Fall Migrant.
White-rumped Sandpiper <u>Calidris fuscicollis</u>	Tidal Mud Flats	X			R		R		Fall and Spring Migrant.
Pectoral Sandpiper <u>Calidris melanotos</u>	Tidal Mud Flats	X			U		C		Fall Migrant.
Purple Sandpiper <u>Calidris maritima</u>	Rock Jetties; Inlets		X	C					Winter Resident.
Dunlin <u>Calidris alpina</u>	Salt Marsh; Tidal Mud Flats	X	X	R	C		A		Fall Migrant.
Stilt Sandpiper <u>Micropalama himantopus</u>	Tidal Mud Flats	X			R		U		Fall Migrant.
Laridae - Gulls and Terns									
Glaucous Gull <u>Larus hyperboreus</u>	Bays; Inlets		X	R					Winter Visitor.

Table 3, cont.

Family/Species	Habitat	Habitat Utilization			Seasonal Abundance				Principal Occurrence in the Project Area
		Breeding	Migration	Wintering	Winter	Spring	Summer	Fall	
Laridae - Gulls and Terns, cont.									
Iceland Gull <u>Larus glaucoides</u>	Ocean Beach		X	R					Winter Visitor.
Greater Black-backed Gull <u>Larus marinus</u>	Ocean and Bays		X	C	C	C	C		Resident.
Lesser Black-backed Gull <u>Larus fuscus</u>	Coastal; Ocean Beach		X	R					Winter Visitor.
Herring Gull <u>Larus argentatus</u>	Ocean and Bays; Fields		X	C	C	C	C		Resident.
Ring-billed Gull <u>Larus delawarensis</u>	Ocean, Bays and Freshwater Ponds; Fields	X	X	U	C	U	C		Fall and Spring Migrant.
Black-headed Gull <u>Larus ridibundus</u>	Inlets		X	R					Winter Visitor.
Laughing Gull <u>Larus atricilla</u>	Coastal; Ocean Beach	X		R		C	C		Fall Migrant.
Bonaparte's Gull <u>Larus philadelphia</u>	Bays and Inlets		X	A			C		Winter Visitor.
Little Gull <u>Larus minutus</u>	Bays		X	R					Winter Visitor.
Black-legged Kittiwake <u>Rissa tridactyla</u>	Ocean		X	R					Winter Visitor; Especially Montauk Point.
Common Tern <u>Sterna hirundo</u>	Bays; Islands; Salt Marsh	CO	X		U	A	C		Summer Breeder; Fall and Spring Migrant.

Table 3, cont.

Family/Species	Habitat	Habitat Utilization			Seasonal Abundance				Principal Occurrence in the Project Area
		Breeding	Migration	Wintering	Winter	Spring	Summer	Fall	
Laridae - Gulls and Terns, cont.									
Roseate Tern <u>Sterna dougallii</u>	Bays; Islands; Salt Marsh	CO	X		R	R	R		Summer Breeder; Fall and Spring Migrant.
Least Tern <u>Sterna albifrons</u>	Sandy Beach	CO	X		U	C	U		Summer Breeder; Fall and Spring Migrant.
Royal Tern <u>Sterna maxima</u>	Inlets		X				R		Fall Migrant.
Caspian Tern <u>Sterna caspia</u>	Inlets		X				R		Fall Migrant.
Rynchopidae - Skimmers									
Black Skimmer <u>Rynchops niger</u>	Bays; Islands	X	X			C	C		Summer Breeder; Fall Migrant.
Alcidae - Auks									
Dovekie <u>Alle alle</u>	Ocean; Inlets			X	R				Winter Visitor.
Columbidae - Pigeons and Doves									
Mourning Dove <u>Zenaidura macroura</u>	Barrier Beach; Conifers	PO	X	X	C	C	C	A	Resident.
Tytonidae - Barn Owls									
Barn Owl <u>Tyto alba</u>	Abandoned Buildings; Old Fields and Meadows		X	X	R	R		R	Fall and Spring Migrant

Table 3, cont.

Family/Species	Habitat	Habitat Utilization			Seasonal Abundance				Principal Occurrence in the Project Area
		Breeding	Migration	Wintering	Winter	Spring	Summer	Fall	
Strigidae - Typical Owls									
Snowy Owl <u>Nyctea scandiaca</u>	Barrier Beach		X	R					Winter Visitor
Short-eared Owl <u>Asio flammeus</u>	Salt Marsh; Barrier Beach		X	C	U		U		Winter Resident.
Saw-whet Owl <u>Aegolius acadicus</u>	Barrier Beach		X	R					Winter Visitor.
Alcedinidae - Kingfishers									
Belted Kingfisher <u>Megasceryle alcyon</u>	Sand Bluffs; Ponds and Creeks		X X	R	U	C	C		Resident.
Picidae - Woodpeckers									
Red-headed Woodpecker <u>Melanerpes erythrocephalus</u>	Barrier Beach		X		R		U		Fall Migrant.
Common Flicker <u>Colaptes auratus</u>	Barrier Beach; Residential Areas		X X	U	U	C	A		Resident.
Downy Woodpecker <u>Picoides pubescens</u>	Woodlands		X X	C	C	C	C		Resident.
Tyrannidae - Flycatchers									
Eastern Kingbird <u>Tyrannus tyrannus</u>	Scrub-Shrub Fields and Meadows	PO	X		C		C		Fall and Spring Migrant.
Eastern Phoebe <u>Sayornis phoebe</u>	Bridges; Abandoned Buildings; Residential Areas						U		Summer Resident.

Table 3, cont.

Family/Species	Habitat	Habitat Utilization			Seasonal Abundance				Principal Occurrence in the Project Area
		Breeding	Migration	Wintering	Winter	Spring	Summer	Fall	
Alaudidae - Larks									
Horned Lark <u>Eremophila alpestris</u>	Barrier Beach	CO	X	X	C	C	U	C	Resident.
Hirundinidae - Swallows									
Tree Swallow <u>Iridoprocne bicolor</u>	Sand Banks and Bluffs		X			C	C		Fall Migrant.
Bank Swallow <u>Riparia riparia</u>	Sand Banks and Bluffs		X			C	C		Fall Migrant.
Rough-winged Swallow <u>Stelgidopteryx ruficollis</u>	Sand Banks and Bluffs		X			U	U		Fall Migrant.
Barn Swallow <u>Hirundo rustica</u>	Abandoned Buildings; Residential Areas	CO	X			C	A		Fall Migrant
Corvidae - Jays and Crows									
Fish Crow <u>Corvus ossifragus</u>	Barrier Beach; Bayshore		X	X	R	U	U	U	Resident.
Troglodytidae - Wrens									
Winter Wren <u>Troglodytes troglodytes</u>	Woodlands			X	R				Winter Resident.
Marsh Wren <u>Cistothorus palustris</u>	<u>Phragmites</u> Marsh					U			Summer Resident.
Mimidae - Mimic Thrushes									
Northern Mockingbird <u>Mimus polyglottos</u>	Barrier Beach; Residential Areas	PR	X		C	C	C	C	Resident.

Table 3, cont.

Family/Species	Habitat	Habitat Utilization			Seasonal Abundance				Principal Occurrence in the Project Area
		Breeding	Migration	Wintering	Winter	Spring	Summer	Fall	
Mimidae - Mimic Thrushes, cont.									
Gray Catbird <u>Dumetella carolinensis</u>	Scrub-Shrub Fields and Meadows	PO	X	X	R	U	C	C	Resident.
Brown Thrasher <u>Toxostoma rufum</u>	Interdune Woods and Thickets		X	X	R	U	C	C	Resident.
Turdidae - Thrushes									
American Robin <u>Turdus migratorius</u>	Residential Areas	CO	X	X	C	C	C	C	Resident.
Laniidae - Shrikes									
Loggerhead Shrike <u>Lanius ludovicianus</u>	Interdune Swale and Grasslands		X		R			R	Winter Visitor.
Sturnidae - Starlings									
European Starling <u>Sturnus vulgaris</u>	Residential Areas	PO	X	X	C	C	C	A	Resident.
Vireonidae - Vireos									
White-eyed Vireo <u>Vireo griseus</u>	Interdune Thickets					R			Summer Resident.
Parulidae - Wood Warblers									
Orange-crowned Warbler <u>Vermivora celata</u>	Barrier Beach		X	X		R		U	Fall and Spring Migrant.
Yellow Warbler <u>Dendroica petechia</u>	Bayberry Thickets; Pond and Salt Marsh Fringes		X			C	C	C	Summer Resident; Fall and Spring Migrant.

Table 3, cont.

Family/Species	Habitat	Habitat Utilization			Seasonal Abundance				Principal Occurrence in the Project Area
		Breeding	Migration	Wintering	Winter	Spring	Summer	Fall	
Parulidae - Wood Warblers, cont.									
Yellow-rumped Warbler <u>Dendroica coronata</u>	Barrier Beach; Bayberry Thickets		X	X	C		C		Winter Resident; Fall and Spring Migrant.
Palm Warbler <u>Dendroica palmarum</u>	Residential Areas; Lawns; Gardens		X		R		C	U	Spring Migrant.
Common Yellowthroat <u>Geothlypis trichas</u>	Interdune Thickets	PR	X		R		C	C	Summer Resident; Fall and Spring Migrant.
Ploceidae - Weaver Finches									
House Sparrow <u>Passer domesticus</u>	Residential Areas	PO	X	X	C		C	A	Resident.
Icteridae - Blackbirds and Orioles									
Eastern Meadowlark <u>Sturnella magna</u>	Interdune Swales and Grasslands			X	U		U	U	Winter Resident.
Red-winged Blackbird <u>Agelaius phoeniceus</u>	Salt and Freshwater Marsh Fringe; Shrubby Fields	CO	X	X	C		C	A	Resident.
Common Grackle <u>Quiscalus quiscula</u>	Pine Groves; Salt Marsh		X	X	R		U	C	Resident.
Brown-headed Cowbird <u>Molothrus ater</u>	Cosmopolitan; Nest Parasite		X	X	C		C	C	Resident.
Fringillidae - Finches									
House Finch <u>Carpodacus mexicanus</u>	Residential Areas	PR		X	C		C	C	Resident.
American Goldfinch <u>Carduelis tristis</u>	Thickets; Old Fields and Meadows	X	X	X	U		U	C	Resident.

Table 3, cont.

Family/Species	Habitat	Habitat Utilization			Seasonal Abundance				Principal Occurrence In the Project Area
		Breeding	Migration	Wintering	Winter	Spring	Summer	Fall	
Fringillidae - Finches, cont.									
Savannah Sparrow <u>Passerculus sandwichensis</u>	Barrier Beach		X	X				R	Winter Resident; Fall Migrant.
Sharp-tailed Sparrow <u>Ammospiza caudacuta</u>	Salt Marsh	PO	X	X			C	U	Resident.
Seaside Sparrow <u>Ammospiza maritima</u>	Salt Marsh	PO		X			U		Resident.
American Tree Sparrow <u>Spizella arborea</u>	Residential Areas			X					Winter Resident.
White-throated Sparrow <u>Zonotrichia albicollis</u>	Thickets; Residential Areas		X	X		C		A	Winter Resident; Fall and Spring Migrant.
Fox Sparrow <u>Passerella iliaca</u>	Scrub-Shrub Fields and Meadows			X					Winter Resident
Song Sparrow <u>Melospiza melodia</u>	Scrub-Shrub Fields and Meadows; Pond Edges	PR	X	X		C	C	C	Resident.
Lapland Longspur <u>Calcarius lapponicus</u>	Barrier Beach; Old Fields and Meadows			X					Winter Resident.
Snow Bunting <u>Plectrophenax nivalis</u>	Barrier Beach			X					Winter Resident.

each inlet. Small fishes fed on by common terns and other such birds are particularly abundant at inlets and their nearby mudflats. Outstanding areas for feeding in the project area are the flats on the bay side of the inlet near Ponquogue Bridge, where dabbling ducks feed on the stands of eelgrass and beds of blue mussels; and the Warner Islands and adjacent sandbar area north and northwest of the inlet (see Figure 1).

Relatively few species of birds nest in the project area. The most significant nesting areas are three colonial waterbird colonies (Figure 4). The "Shinnecock East" colony on the east side of the inlet contained 125 least terns and two piping plovers during a 1984 survey. The "Warner Islands" colony contained 450 common terns and 62 black skimmers in 1984, in addition to nesting herring gulls, black-backed gulls, willets, and oystercatchers (Buckley and Buckley, 1980; Buckley, pers. comm., 1984). Roseate terns have also been known to nest at the Warner Islands colony in past years. The "Ponquogue Beach East" site about three-fourths of a mile west of the inlet contained 80 least terns and two piping plovers in 1984 (Buckley and Buckley, 1980; Peterson, pers. comm., 1984).

Common tern colonies on Long Island were apparently larger in the past than in recent years. However, a 1984 Long Island tern survey reported a colony of 450 common terns at the Warner Islands, although no common terns were present at the Warner Islands in 1978 (Buckley and Buckley, 1980). This is consistent with Buckley and Buckley's (1980) statement that the overall number of occupied common tern colonies increased during the 1974-1978 period of their study.

Least terns may never have been more abundant on Long Island than they are at present, and populations appear to be holding their own despite intense pressure from human activities (Buckley and Buckley, 1980).

Black skimmers, which nest at the Warner Islands and on Lane's Island west of Ponquogue Bridge, apparently are also stable in population, with populations on the south shore of Long Island almost always associated with the major inlets and their common tern colonies. The still, shallow waters black skimmers require for feeding apparently are scarce away from south shore bays. Black skimmers often place their nests in patches of sand among the tidal wrack; some individuals have even placed their nests on top of the wrack (Buckley and Buckley, 1980).

The herring gull/black-backed gull breeding area at the Warner Islands is one of 11 major breeding areas on Long Island. The black-backed gull colony cluster, although much smaller than the colony at Gardiner's Island, is the second largest on Long Island (Fire Island Inlet and Jamaica Bay were third and fourth, respectively) (Buckley and Buckley, 1980).

Piping plovers appear historically never to have been common on Long Island, but were more numerous than they are today. In 1939 there were an estimated 500 pairs of piping plovers nesting on Long Island. By 1975 there were an estimated 80-100 pairs. Ninety-nine nesting pairs were recorded in 1984, so it is possible their numbers are stabilizing, although at a level much reduced from previous times.

Least terns and piping plovers are species that appear to be restricted exclusively to unvegetated sandy substrates, usually near inlets, for nesting habitat, while common tern, roseate tern, and black skimmer require predator-free islands for nesting. No roseate terns have been recorded this year in the colonies within the project area. However, they have been known to nest at the Warner Islands in the past (Erwin and Korschgen, 1979). The Lane's Island tern colony just west of Ponquogue Bridge (Figure 4) contained 50 roseate terns, in addition to 1900 common terns and 5 black skimmers, in 1984, so roseate terns probably feed within the project area. Roseate tern is considered the most threatened colonial waterbird on Long Island (Buckley and Buckley, 1980).

Twenty-two species of breeding birds were observed during field survey visits to the east side of the Shinnecock Inlet project area by the U.S. Fish and Wildlife Service for the Fire Island to Montauk study in 1982 (USDOI, 1983). The study found confirmed breeders associated with four principal habitats: open sandy beach, backdune swales and thickets, salt marsh, and residential areas. The open areas of unvegetated sandy beach supported the previously mentioned "Shinnecock East" least tern/piping plover colony. Red-winged blackbird (Agelaius phoeniceus) was the most abundant bird species in the swales and thickets of the backdune area. Horned lark (Eremophila alpestris) was also common in this habitat, and American robin (Turdus migratorius) was present in small numbers. Song sparrow (Melospiza melodia), common yellowthroat (Geothlypis trichas), ring-necked pheasant (Phasianus colchicus) and northern mockingbird (Mimus polyglottos) nested in this habitat as well. Sharp-tailed sparrow (Ammodramus caudacuta) and American oystercatcher (Haematopus palliatus) were confirmed as breeding in the bayshore beaches and adjacent salt marsh. Seaside sparrow (Ammodramus maritima) was observed in this habitat as well, and was considered a possible breeder. Willet (Catoptrophorus semipalmatus), marsh wren (Cistothorus palustris), sharp-tailed sparrow, and seaside sparrow apparently depend exclusively on bayshore salt marshes for nesting habitat.

The few residences in the project area provide nesting habitat for barn swallow (Hirundo rustica), European starling (Sturnus vulgaris), house sparrow (Passer domesticus) and house finch (Carpodacus mexicanus).

Mammals.

Nine mammalian species are known to occur in the project area on a regular basis (Table 4). With the exception of the harbor seal (Phoca vitulina) all are land mammals, and all of the land-based mammals except white-tailed deer are small mammals. The great abundance of masked shrews, meadow voles and white-footed mice provides an ample food base for the birds of prey that migrate along the barrier islands or reside in the vicinity.

A number of other mammalian species may occur in the project area, although signs of their habitation have not been observed. USDOI (1983) listed 15 species of mammals that are known to inhabit the barrier island and barrier beach ecosystems east of Moriches Inlet (Appendix A). At least some of these species probably occur in the project area on a regular basis. Right whale, finback whale, and humpback whale are not listed in Table 4, because they would be found in the study area only as accidental strandings.

Table 4. Mammalian species known to occur regularly in the Shinnecock Inlet study area.

<u>Scientific Name</u>	<u>Common Name</u>
<u>Phoca vitulina</u>	Harbor seal
<u>Sorex cinereus</u>	Masked shrew
<u>Didelphis marsupialis</u>	Opossum
<u>Sylvilagus floridanus</u>	Eastern cottontail
<u>Microtus pennsylvanicus</u>	Meadow vole
<u>Peromyscus leucopus</u>	White-footed mouse
<u>Rattus norvegicus</u>	Norway rat
<u>Procyon lotor</u>	Raccoon
<u>Odocoileus virginianus</u>	White-tailed deer

Shinnecock Inlet is one of the few areas on Long Island that show a consistent (year-after-year) concentration of harbor seals. A population of 35-45 individuals can be found in the project area from approximately December through April or May of each year, fishing off the rocks in the inlet and "hauling out" on the sandbars north of the inlet at low tide. They are gone from the area by mid-late May.

Connor (1971) states that the masked shrew (Sorex cinereus) is possibly the most numerous mammal on Long Island. It has been found in almost every habitat on Long Island with sufficient groundcover, regardless of whether the area is wet or dry, or dominated by herbaceous or woody vegetation, and is known to occur all along the outer barrier beaches of the south shore. The masked shrew would be expected to occur in most of the project area, such as the marshes, grassy areas and depressions among the dunes (Connor 1971).

Opossum (Didelphis marsupialis) is probably common in the project area. Connor (1971) reported seeing opossums regularly in sandy and marsh-edge habitats on the outer barrier beach between Moriches Inlet and Shinnecock Inlet. U.S. Fish and Wildlife Service investigators (USDOI, 1983) routinely observed tracks in the project area, particularly in interdune and backdune areas and along the borders of the saltmarshes on the bay side of the barrier island.

Eastern cottontail (Sylvilagus floridanus) is common along the full length of the barrier island along Long Island's south shore, and is expected to be common in the project area. The species uses a variety of maritime habitats, including beachgrass and low shrubs among primary dunes, high and low thickets and beachgrass areas of interdune zone, and high marsh and saltmarsh fringe areas along the bay (Connor, 1971; USDOI, 1983).

Meadow vole (Microtus pennsylvanicus) is common in the project area (USDOI, 1983). It is expected to be particularly abundant in saltmarshes and marsh fringe, and in the grassy-shrub areas of the outer dunes of the barrier beach.

White-footed mouse (Peromyscus leuopus) is probably the most generally distributed mammal on Long Island (Connor, 1971), and is also common in the area (USDOI, 1983). Connor (1971) commonly found this mammal in valleys and depressions among the sand dunes and in grassy-shrubby areas that provided low cover. Fewer were found in the beachgrass of the outer dunes. Salt marsh appeared to be the least-preferred habitat (Connor, 1971; USDOI, 1983). USDOI (1983) found this mammal in all vegetative communities within the study area.

Norway rats (Rattus norvegicus) are known to live year-round among the rocks of the west jetty at the inlet, and probably occur throughout the project area, including around structures found in the area. (Connor (1971) noted that signs of rats are frequently found near inlets and ocean-front rock jetties, and specifically discussed Shinnecock Inlet in this regard.

Signs of raccoon (Procyon lotor) presence have been observed in the project area (USDOI, 1983) along the edge of the bayshore salt marshes. This mammal is widespread on Long Island and probably can be encountered in most

parts of the project study area, since it has been observed along the outer barrier beach from Moriches Inlet to Montauk Point and is known to frequent the edges of protected salt water areas (Connor, 1971), such as those found along the bay side of the barrier island.

USDOI (1983) observed sign of white-tailed deer (Odocoileus virginianus) in the project area in shrubby saltmarsh fringe communities, in interdune mixed herb-shrub communities and throughout the almost barren foredunes. At the present time deer are numerous on the eastern half of Long Island; however, their presence in the project area is probably restricted to the less developed east side of the inlet.

Endangered and Threatened Species.

Nineteen New York State and/or Federal endangered or threatened species are known to inhabit the Shinnecock Inlet project area or may occur in the area as occasional transients or strandings (Table 5). These species include five species of reptiles, nine species of birds, and five species of mammals.

The reptiles are all marine turtles that occur sporadically in the waters of Long Island, particularly in the late summer and fall. They would be expected to occur in the project area only as transients or strandings.

The piping plover (Charadrius melodus), common tern (Sterna hirundo), least tern (Sterna albifrons) and roseate tern (Sterna dougallii) are confirmed as nesting within the project area within recent years. The bald eagle (Haliaeetus leucocephalus), northern harrier (Circus cyaneus), osprey (Pandion haliaetus), peregrine falcon (Falco peregrinus) and loggerhead shrike (Lanius ludovicianus) would occur only as regular migrants.

Sei whale (Balaenoptera borealis), humpback whale (Megaptera novaeangliae) and black right whale (Balaena glacialis) occur as migrants in the coastal waters off the project area. Their presence within the study area would probably be due to accidental stranding.

B. Aesthetic Attributes.

The Shinnecock Inlet project area is important to both recreational and commercial fishing interests. People fish from boats, from the jetties, and from the beach. The land portion of the project area is a diversified landscape of barrier beach, dunes, and saltmarsh, partially county parkland and partially Town of Southampton wetlands. Visitors to the area enjoy sunbathing, swimming and surfing, as well as recreational walks and nature study.

Table 5. State and Federally listed endangered and threatened species that are either known to occur within the Shinnecock Inlet project area or may occur in the area as occasional transients or strandings. E = endangered, T = Threatened.

	Federal Status	State Status
<u>REPTILES:</u>		
Atlantic Green Sea Turtle <u>Chelonia mydas</u> T	T	
Atlantic Hawksbill Sea Turtle <u>Eretmochelys imbricata</u>	E	E
Atlantic Loggerhead Sea Turtle <u>Caretta caretta</u> T	T	
Atlantic Ridley Sea Turtle <u>Lepidochelys kempii</u>	E	E
Atlantic Leatherback Sea Turtle <u>Dermochelys coriacea</u>	E	E
<u>BIRDS:</u>		
Bald Eagle <u>Haliaeetus leucocephalus</u>	E	E
Northern Harrier <u>Circus cyaneus</u>	T	
Osprey <u>Pandion haliaetus</u>		T
Peregrine Falcon <u>Falco peregrinus</u>	E	E
Piping Plover <u>Charadris melodus</u>	Proposed T	T
Common Tern <u>Sterna hirundo</u>	T	
Roseate Tern <u>Sterna dougallii</u>		E
Least Tern <u>Sterna albifrons</u>		E

Table 5, cont.

	Federal Status	State Status
<u>BIRDS: cont.</u>		
Loggerhead Shrike <u>Lanius ludovicianus</u>		E
<u>MAMMALS:</u>		
Sperm Whale <u>Physeter catodon</u>	E	E
Finback Whale <u>Balaenoptera physalus</u>	E	E
Sei Whale <u>Balaenoptera borealis</u>	E	E
Humpback Whale <u>Megaptera novaeangliae</u>	E	E
Right Whale <u>Balaena glacialis</u>	E	E

IV. DISCUSSION AND CONCLUSIONS.

The Shinnecock Inlet project area contains a diversity of habitats: ocean, bay (estuary), sand dune, barrier beach, salt marsh, etc. The area is rich in marine resources and provides important habitat for many bird species, including nesting habitat for the State-endangered roseate and least terns and State-threatened common tern and piping plover. The area is relatively unimportant in terms of mammalian, reptilian, or amphibian habitat, with the exception of overwintering use of the area by harbor seals.

Five EQ (Environmental Quality) Resources have been identified in the project area: Shinnecock Inlet, Shinnecock Bay, the nearshore portion of the Atlantic Ocean, the barrier island, and the Warner Islands with adjacent sandbar area. Tables 6 and 7 contain a preliminary analysis of these resources and an evaluation framework for assessing project impacts upon EQ Resources.

The magnitude and nature of project impacts upon area biological resources cannot be fully assessed at this stage of project studies, since final plans have not been determined. However, the following preliminary statements can be made:

Benthic fauna.

Future with project. Benthic habitat will be disrupted by the work. Juvenile organisms and individuals of relatively non-mobile species such as polychaete worms will be destroyed. In the case of more mobile species such as American lobster, various crabs, some mollusks and the like, many individuals will be destroyed by the work; however, some will escape. Following the work, most benthic habitat areas disturbed by construction activities should be suitable for recolonization by species that are the same or similar to those present prior to the work, provided the hydrology and substrate of the dredged areas are not significantly changed by the work.

Some habitat areas will be converted to other habitat types by the project, and therefore will develop a different community of species than was present prior to the work. These areas include areas converted from shallow water habitat to intertidal habitat, or from intertidal habitat to habitat above tidal influence by placement of the dredged material in the area of Tiana Beach. Also included are the areas that would be covered or filled by rehabilitation or extension of the jetties, such as areas that would be covered by the placement of additional rocks or the small protected rocky "cove" at the northern end of the east jetty, which would be filled. The placement of additional rocks would improve habitat for American lobster, rock crabs and other organisms attracted to rocky habitat, a type of habitat uncommon the south shore of Long Island. The small cove would be converted to unvegetated sand.

Dredging should not affect benthic resources through an increase in salinity levels, since salinity levels in most of the bay are already near ocean levels.

Table 6. Identification of EQ Resources in Shinnecock Inlet Project Area

EQ Attributes				Significance		Project Impacts	
Resource	Ecological	Cultural	Aesthetic	Institutional Recognition	Public Recognition	Technical Recognition	
R ₁ Shinnecock Inlet	Tidal flushing Passage for aquatic organisms traveling between bay and ocean.		Navigational passage for commercial and recreational vessels; recreational fishing.		Provides access to largest commercial landing port in New York State.	Inlets known to attract waterfowl. Connect bay and ocean habitats	To be evaluated
R ₂ Shinnecock Bay (within project area)	Estuarine habitat (intertidal and subtidal)		Long Island Intracoastal Waterway. Recreational and commercial fishing and boating.	Long Island Intracoastal Waterway is a Federally authorized navigational channel	Acknowledged importance as recreational shell- and fin-fishery	Acknowledged importance for productive shell- and fin-fishery, waterfowl habitat	To be evaluated
R ₃ Nearshore portion of the Atlantic Ocean	Shallow subtidal habitat		Recreational shellfishing and finfishing		Popular fishing area		To be evaluated
R ₄ Barrier Island to Low Low Water (within project area)	Component of coastal ecosystem of south shore of Long Island, with dunes, beach, saltmarshes, etc.		Diversified landscape (dunes, salt-marsh, beach, etc.) Recreational area for swimming,	Shinnecock Inlet East and Shinnecock Inlet West county parks are on either side of inlet. Saltmarsh areas are designated Town of Southampton wetlands	Estuarine marshes acknowledged as important components of natural environment	Acknowledged component of littoral system, important in protecting mainland from storm damage	To be evaluated

Table 6. Identification EQ Resources in Shinnecock Inlet Project Area (continued)

Resource	EA Attributes			Significance		Project Impacts
	Ecological	Cultural	Aesthetic	Institutional Recognition	Public Recognition	Technical Recognition
R ₄ cont.			sunbathing, nature study,	Study area east of the east jetty is part of a presently designated undeveloped barrier island unit (F12) in the Coastal Barrier Resources System, under the Coastal Barrier Resources Act of 1982 (CBRA). Federal flood insurance is not available in this area for structures newly built or substantially improved on or after Oct. 1, 1983. The remainder of the study area is part of a proposed addition to the system presently under consideration by the Department of the Interior.		
R ₅ Warner Islands and adjacent sandbar	Nesting and/or resting area for shorebirds, seabirds and harbor seals			Designated Town of Southampton wetlands		Intermittent nesting area for state-endangered and state-threatened birds
						To be evaluated

Table 7. Evaluation Framework

Resource	Attributes	Indicators	Units	Guidelines	Techniques
R ₁ Shinnecock Inlet	Ecological	Water quality	NYSDEC Water Quality Classification	Maintain existing SA standard	Water quality monitoring
		Minimum width and depth	Feet	Maintain opening of sufficient size to allow continued passage of organisms presently using inlet	Hydrographic surveys
	Aesthetic	Minimum width and depth	Feet	Increase safety and navigability of inlet for vessels	Hydrographic surveys
R ₂ Shinnecock Bay	Ecological	Water quality	NYSDEC Water Quality Classification	Maintain existing SA standard	Water quality monitoring
		Size of sub-tidal area	Acres	Minimize loss of existing habitat	Hydrographic surveys
		Substrate composition	Grain size	Limit dredging to amount needed to accomplish purposes of project	Hydrographic surveys
	Aesthetic	Minimum channel width and depth in Long Island Intracoastal Waterway	Feet	Maintain or achieve authorized depth and width in Long Island Intracoastal Waterway sections of project area; avoid disturbance of remaining areas	Hydrographic surveys

Table 7, continued

Resource	Attributes	Indicators	Units	Guidelines	Techniques
R ₃ Nearshore portion of the Atlantic Ocean	Ecological	Water quality	NYSDEC Water Quality Classification	Maintain existing SA standard	Water quality monitoring
		Size of subtidal shallow area	Acres	Minimize loss of subtidal shallows	Surveys
		Substrate composition	Grain Size	Limit dredging to amount necessary for purposes of project	Hydrographic surveys
	Aesthetic	Water quality	NYSDEC Water Quality Classification	Maintain existing SA standard	Water quality monitoring
		Water depth	Feet	Achieve project depth in constructed channel; avoid disturbance of remaining areas.	Hydrographic surveys

Table 7, Continued

Resource	Attributes	Indicators	Units	Guidelines	Techniques
R ₄ Ecological Barrier Island to Low Low Water (within project area)		Size and quality of undeveloped, vegetated areas	Square feet, vegetation types	Avoid disturbance to these areas from construction work	Survey
		Size and quality of undeveloped, unvegetated areas	Square feet	Increase size of area adjacent to west jetty	Survey
		Width of barrier island	feet	Increase width of island adjacent to west jetty	Survey
		Substrate Composition	Grain size	Utilize material with grain size compatible with existing beach material	Grain-size analysis
		Water quality	NYSDEC Water Quality Classification	Maintain existing SA standard	Water quality monitoring
	Aesthetic	Area of usable beach berm	Square feet	Increase area available for recreational use	Survey
		Size of inter- tidal zone	Square feet	Minimize loss of exist- ing habitat in disposal area; avoid disturbance to existing marsh areas	Survey

Table 7, continued

Resource	Attributes	Indicators	Units	Guidelines	Techniques
R ₅ Warner Island and adjacent sandbar area	Ecological	Size and type of vegetated and unvegetated areas	Square feet, vegetation type	Avoid disturbance to existing habitat	Field investigation

Future without project. Benthic habitat in the presently dynamic/disturbed areas will continue to be disturbed by wave action. These areas may also be periodically disturbed by Federal or non-Federal remedial dredging actions in the project area. No significant change is anticipated in areas that would be affected by work on the jetties, unless the east jetty deteriorates to the point where the small cove is no longer protected from the full tidal flush and is therefore destroyed.

Finfish.

Future with project. Adverse impacts of dredging should be minor, since most fish would be able to avoid the area of impact during construction. Some individuals, particularly juveniles, would be destroyed.

Extension of the jetties would create additional rocky habitat for finfish use, at the expense of losing the existing dynamic sandy bottom. Since rocky habitat is much scarcer than sandy bottom along the south shore of Long Island, extending the jetties should have a positive effect upon finfish resources.

Future without project. No significant change is anticipated, even if periodic interim dredging should take place.

Amphibians, Reptiles.

Future with project. No significant change is anticipated.

Future without project. No significant change is anticipated.

Birds.

Future with project. Construction activity will temporarily disturb birds in the vicinity of the project. If the work is performed outside of the shorebird nesting season (approximately April 1 - June 30), no significant adverse impacts from the work are expected. If the work is performed during the shorebird nesting season, the resulting disturbance may force parental birds to abandon nesting areas for the season. Likelihood of abandonment would depend upon the magnitude of project disturbance, e.g. noise levels and the proximity of construction equipment/activity to nesting areas. Birds that abandon nesting sites in the project area might or might not subsequently be able to nest successfully at some other location. If they are unable to nest successfully, reproduction would be affected for the season.

If dredging occurs too close to the Warner Islands, some sloughing of the banks could take place, with consequent loss of nesting habitat. The potential for this will depend upon the channel alignment that is selected and the amount and location of any dredging in the channel.

Future without project. No significant change in bird species is anticipated over the short term. Least terns and piping plovers will eventually cease nesting at the Ponquogue Bridge East and Shinnecock Inlet East sites if these presently unvegetated areas become excessively vegetated. Common terns, black skimmers and probably roseate terns should continue to nest at the Warner Islands provided the islands remain free of predators.

Mammals.

Future with project. Harbor seal is probably the only mammal species of concern, since the Shinnecock Inlet study area is one of the few locations on Long Island consistently used by overwintering harbor seals. Any dredging operations conducted prior to December or after April would have limited or no impact on the harbor seals. Operations conducted during the period of harbor seal residence, however, could have a substantial impact. Some animals might be accidentally killed. In addition, the general disturbance of construction activities might cause the population to desert the area for at least the season and possibly longer.

Future without project. No significant change is anticipated, provided any interim dredging occurs outside the December-April period of harbor seal residence.

Vegetation.

Future with project. The three species of rockweed now found in the small cove area will be destroyed if the cove is filled as part of jetty construction work. However, some rockweed plants will probably colonize the jetties and revetment following completion of the work.

Future without project. No significant change is anticipated.

Rare and Endangered Species.

Future with Project. Piping plover, common tern, least tern and roseate tern could be adversely affected if work is done during the shorebird nesting season. The type of impact would be the same as that described for general shorebirds nesting in the area, i.e. potential disturbance of nesting activities, possible loss of reproduction for the season, and possible loss of nesting habitat at the Warner Islands through sloughing.

Future without project. Endangered/threatened species would be expected to continue to nest in the study area periodically, with numbers fluctuating from year to year, provided the areas presently used for nesting remain free from predators, human disturbance does not significantly increase, and least tern/piping plover nesting areas remain unvegetated. It is unlikely that structures will be built on or near the nesting areas in the future.

Water Quality.

Future with project. No significant longterm change is anticipated at this time. Minor increases in turbidity will occur during the construction period. Any increases in salinity should be negligible, since salinity levels in most of the bay are presently near ocean levels.

Future without project. No significant change is anticipated.

SUMMARY.

The Shinnecock Inlet project area provides habitat for many aquatic and terrestrial species. Nineteen New York State and/or Federally-endangered or threatened species are known to inhabit the area or may occur as occasional strandings or transients; piping plover, common tern, least tern and roseate tern have nested within the study area in recent years. Harbor seals consistently use the area for overwintering. The EQ Resources of the Shinnecock Inlet project area are identified as Shinnecock Inlet, Shinnecock Bay, the nearshore portion of the Atlantic Ocean, the barrier island, and the Warner Islands and adjacent sandbar.

References

- Briggs, P.T. 1965. The sport fishery in the surf on the south shore of Long Island from Jones Inlet to Shinnecock Inlet. N.Y. Fish and Game Journal 12: 31-47.
- _____. 1968. The sport fisheries for scup in the inshore waters of eastern Long Island. N.Y. Fish and Game Journal 15: 165-185.
- Buckley, P.A. and F.G. Buckley. 1980. Population and colony-site trends of Long Island waterbirds for five years in the mid 1970's. Transactions of the Linnaean Society of New York. Vol. IX: 23-56.
- Cerrato, R.M. 1983. Benthic borrow area investigations, south shore of Long Island, New York. Marine Sciences Research Center, State University of New York. Sponsored by the New York District, U.S. Army Corps of Engineers. 654 pp.
- Connor, P.F. 1971. The mammals of Long Island, New York. New York State Museum & Science Service Bull. 416. 78 pp.
- Erwin, R.M. and C.E. Korschgen. 1979. Coastal waterbird colonies: Maine to Virginia, 1977. An atlas showing colony locations and species composition. U.S. Fish and Wildlife Service Biological Services Program. FWS/OBS-79/08. 647 pp. and appendices.
- Franz, D.R. 1975. Distribution and abundance of inshore population of surf clam, Spisula solidissima. In M. Grant Gross, ed. 1976. Middle Atlantic Continental Shelf and the New York Bight. Proceedings of the Symposium, American Museum of Natural History, New York City, 3,4, and 5 November 1975. American Society of Limnology and Oceanography, Inc. Special Symposia Vol. 2: 404-413.
- Glancy, J.B. 1956. Biological benefits of the Moriches and Shinnecock Inlets with particular reference to pollution and the shell-fisheries. Report to the District Engineer, U.S. Army Corps of Engineers, N.Y. District. 18 pp.
- Gosner, K.L. 1971. Guide to identification of marine and estuarine invertebrates, Cape Hatteras to the Bay of Fundy. New York: John Wiley & Sons, Inc. 693 pp.
- Grosslein, M.D. and T.R. Azorovitz. 1982. Fish distribution. MESA New York Bight Atlas Monograph 15. Albany, N.Y.: New York Sea Grant Institute. 182 pp.
- Hanlon, J.R. 1981. Fish sampling, Shinnecock Bay. U.S. Department of the Interior, Fish and Wildlife Service. Unpublished data.
- Long Island Regional Planning Board. 1978. A marine fisheries subplan for Nassau and Suffolk counties. Prepared for the New York State Department of State. 105 pp.

- Marine Science Research Center. 1972. The marine wetlands of Nassau and Suffolk counties, New York. Stony Brook, NY: State University of New York at Stony Brook. 99 pp.
- McHugh, J.L. and J.J.C. Ginter. 1978. Fisheries. MESA New York Bight Atlas Monograph 16. Albany, NY: New York Sea Grant Institute. 129 pp.
- Pagenkopf, J.R. and G.N. Bigham. 1977. Water quality evaluation, Moriches Bay, Shinnecock Bay. Prepared by Tetra Tech, Inc., Smithtown, NY, for the Nassau-Suffolk Regional Planning Board, Happaage, NY. 71 pp.
- Pearce, J.B., D.J. Radosh, J.V. Caracciolo and F.W. Steimle, Jr. 1981. Benthic fauna. MESA New York Bight Atlas Monograph 14. Albany, N.Y.: New York Sea Grant Institute. 79 pp.
- Pritchard, D.W. 1983. Final report, salinity measurements in Moriches Bay. Prepared by Marine Sciences Research Center, State University of New York, Stony Brook, N.Y. for the County of Suffolk Department of Health Services, Riverhead, N.Y. 7 pp. and appendices.
- Schaefer, R.L. 1967. Species composition, size and seasonal abundance of fish in the surf waters of Long Island. New York Fish and Game Journal 14: 2-46.
- Suffolk County Department of Public Works, Long Island Regional Planning Board, Southampton Fisheries Development Committee. 1982. Additional information required by the United States Fish and Wildlife Service and Corps of Engineers in accordance with the National Environmental Policy Act for commercial fishery facility at Shinnecock Inlet. Capital Project NO. 5349P. Phase II - preliminary design report. Prepared by Holzmacher, McLendon and Murrell, P.C. 96 pp.
- U.S. Army Engineer District, New York, Corps of Engineers. 1958. Moriches and Shinnecock Inlets, Long Island, New York. Survey Report. 46 pp and appendices.
- U.S. Army Engineer District, New York, Corps of Engineers. 1974. Draft environmental impact statement, Maintenance of Great South Bay Channel and Patchogue River and Long Island Intracoastal Waterway, New York navigation projects. 22 pp.
- U.S. Army Engineer District, New York, Corps of Engineers. 1976. Draft environmental impact statement for Fire Island Inlet to Montauk Point, New York Beach Erosion Control and Hurricane Protection Project. Volume II: Appendices. 309 pp.
- United States Department of the Interior (USDOI), Fish and Wildlife Service. 1983. Fish and Wildlife resource studies for the Fire Island Inlet to Montauk Point, New York Beach Erosion Control and Hurricane Protection Project Reformulation Study: terrestrial resource component. 140 pp.

APPENDIX A

Checklist of mammals inhabiting the barrier island and barrier beach ecosystems of the Fire Inland Inlet to Montauk Point Reformulation Study project area east of Moriches Inlet, Long Island, New York. Table values indicate the relative use by each species of major geomorphological zones. A plus sign (+) denotes a high degree of utilization. An asterisk (*) indicates that the information available was insufficient to document the degree of utilization. A minus sign (-) denotes a low degree of utilization. Data are after Connor (1971). (From USDOL, 1983).

Species	Major Geomorphological Zone						
	Barrier Island			Barrier Beach			
	Primary Dune Zone	Intrerdune Zone	Bayshore Zone	Primary Dune Zone	Interdune Zone	Upland	Transition Zone
Opossum <u>Didelphis marsupialis</u>	+	+	+	+	+		+
Masked shrew <u>Sorex cinereus</u>	+	+	+	+	+		+
Short-tailed shrew <u>Blarina brevicauda</u>	*	*	*	-	-		+
Eastern mole <u>Scalopus aquaticus</u>	*	*	*	+	+		+
Little brown bat <u>Myotis lucifugus</u>	*	*	*	*	*		*
Keen's myotis <u>Myotis keenii</u>	*	*	*	*	*		*
Silver haired bat <u>Lasiurus noctivagus</u>	*	*	*	*	*		*

Species	Major Geomorphological Zone					
	Barrier Island			Barrier Beach		
	Primary Dune Zone	Interdune Zone	Bayshore Zone	Primary Dune Zone	Interdune Zone	Upland Transition Zone
Norway rat <u>Rattus norvegicus</u>	+	+	+	+	+	+
Meadow jumping mouse <u>Zapus hudsonius</u>	*	*	*	-	+	+
Red fox <u>Vulpes fulva</u>	+	+	+	+	+	+
Raccoon <u>Procyon lotor</u>	*	+	+	*	+	+
Longtail weasel <u>Mustela frenata</u>	+	+	+	+	+	+
Mink <u>Mustela vison</u>	*	-	+	*	+	+
Striped skunk <u>Mephitis mephitis</u>	*	*	*	*	+	+
Harbor seal <u>Phoca vitulina</u>	-		+	-		
White-tailed deer <u>Odocoileus virginianus</u>	+	+	+	+	+	+

Species	Major Geomorphological Zone					
	Barrier Island			Barrier Beach		
	Primary Dune Zone	Interdune Zone	Bayshore Zone	Primary Dune Zone	Interdune Zone	Upland Transition Zone
Eastern Pipistrel <u>Pipistrellis subflavus</u>	*	*	*	*	*	*
Big brown bat <u>Eptesicus fuscus</u>	+	+	+	+	+	+
Red bat <u>Lasiurus borealis</u>	+	+	+	+	+	+
Hoary bat <u>Lasiurus cinereus</u>	*	*	*	*	*	*
Eastern Cottontail <u>Sylvilagus floridanus</u>	+	+	+	+	+	+
White-footed mouse <u>Peromyscus leucopus</u>	+	+	+	+	+	+
Meadow vole <u>Microtus pennsylvanicus</u>	+	+	+	+	+	+
Muskrat <u>Ondatra zibethica</u>	-	-	+	-	-	-
House mouse <u>Mus musculus</u>	+	+	+	+	+	+