CHAPTER 77

THE ATLANTIC COAST OF LONG ISLAND

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SUMMARY

The south shore of Long Island, located on the northeast coast of the United States, consists of 120 miles of headlands and barrier beach which is breached by inlets that interconnect the coastal bays with the Atlantic Ocean. The shore is subject to severe changes due to constant attack of the ocean, rising level of the ocean and severe storms. The predominant, east to west littoral drift moves from 300,000 to 600,000 cubic yards of sand along the shore annually. The affected area encompasses a million people and is valued at $2.5 billions. Improvements have been authorized for 110 miles of shore, and involve sandfill, feeder beaches, groins, jetties, sand bypassing, and inlet barriers The estimated cost for the entire shore improvement is $188 million. The annual charges are about $10 million. The annual benefits are $16 million. The implementation of the authorized work includes the design and model testing of several sections and the completed work in several sections, such as sandfill, feeder beaches, and groins. The completed work shows considerable effect on shore processes. Overall evaluation must await completion of the total improvement in an integral section of the shore.

GENERAL

Location. Long Island is a long, narrow island at a significant indentation of the northeastern coast of the United States, and is bounded on the south and east by the Atlantic Ocean and on the north and west by the mainland, Figure 1.

Objective is to present the history, the problems, the constructive actions and current results dealing with the critical condition of shore recession and erosion, unstable inlets, and coastal inundation.

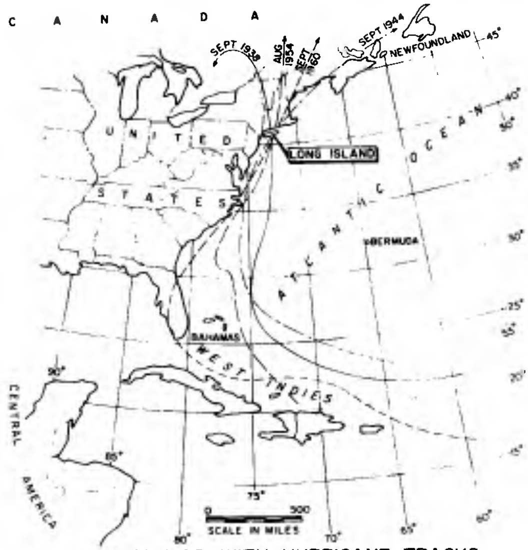
GEOMORPHOLOGY

The island is part of the Atlantic Coastal Plain province. Glaciation and the attendant effects of ice cover and ice movement mask the original topography. The island consists of glaciated deposits of sand and gravel to depths of over 100 feet. These deposits rest on the remnants of an old, submerged coastal plain. The glacial outwash plain slopes southward from an altitude of about 200 feet above mean sea level at the north shore of Long Island and occupies the entire width of the island, Figure 2. Rising above the plain are two belts of terminal moraine deposits of a later glacial stage. The southernmost, the Ronkonkoma moraine, located in the middle of the island, forms the crest of the southern peninsula, and terminates in the cliffs of Montauk Point. Southward of this moraine and superimposed on the basal outwash plain is a second outwash plain of the same age as the Ronkonkoma moraine. This plain consists of a thin sheet of sand and gravel and slopes to the south. Originally, the south shore of the mainland of Long Island was determined by the intersection of this gently sloping outwash plain with the ocean.

The submerged extension of the coastal plain forms the continental shelf with a width of 80 to 100 miles and with a gentle slope that dips to the southwest, Figure 3. The shelf surface shows characteristic features of underwater erosion, wave formed shores and coarse grain material, as are found close to low water shorelines. Crossing the continental shelf to the southwest is the submarine valley of the Hudson River and Hudson Canyon and to the southeast is the Block Canyon.

PHYSIOGRAPHY

Significant sections. The south shore of Long Island is divided into two



VICINITY MAP WITH HURRICANE TRACKS

OBLIQUE LOOKING GENERALLY EASTWARD

FIG. I LONG ISLAND, NEW YORK, U.S.A.

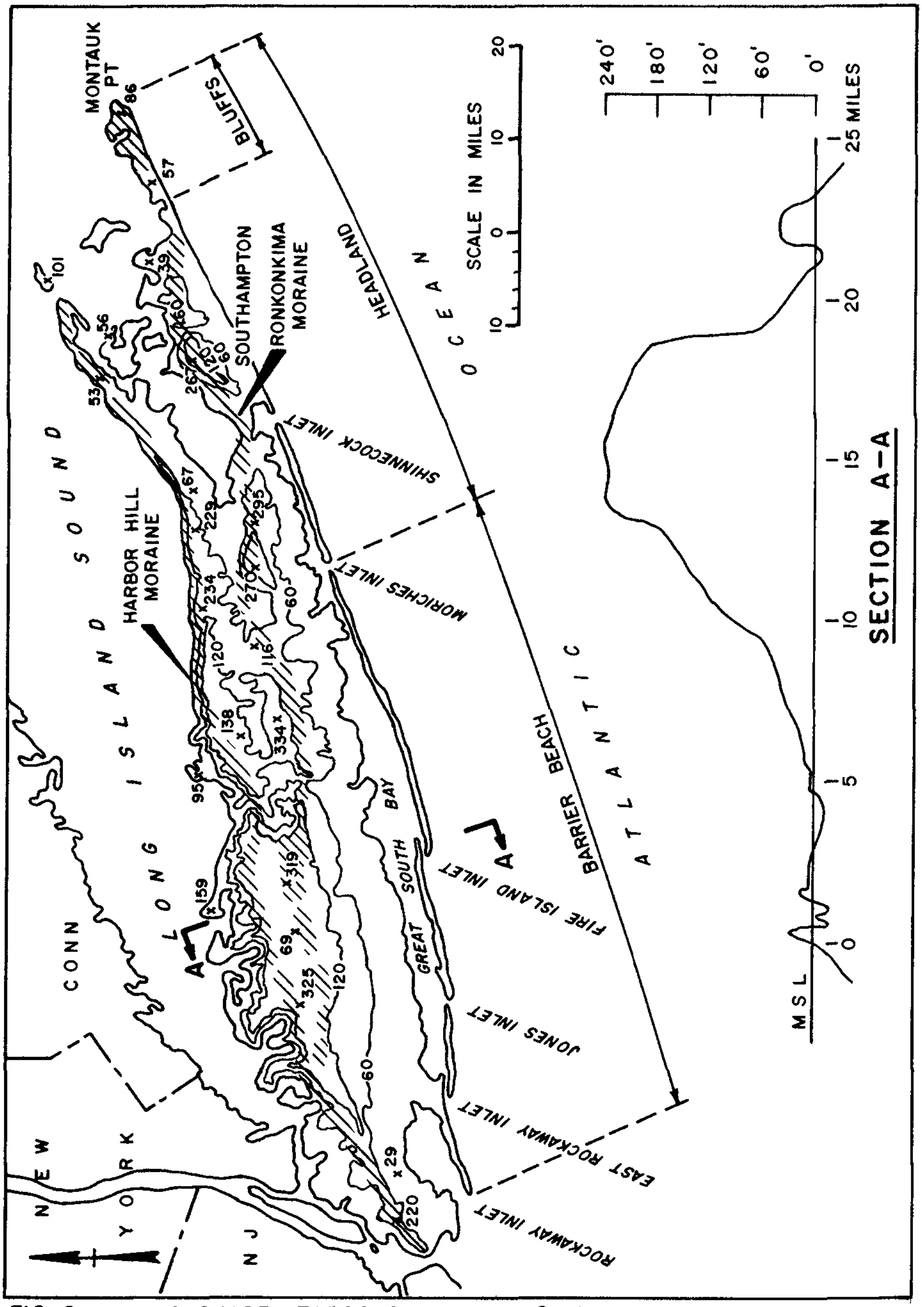


FIG. 2 ONSHORE TOPOGRAPHY — LONG ISLAND, NEW YORK

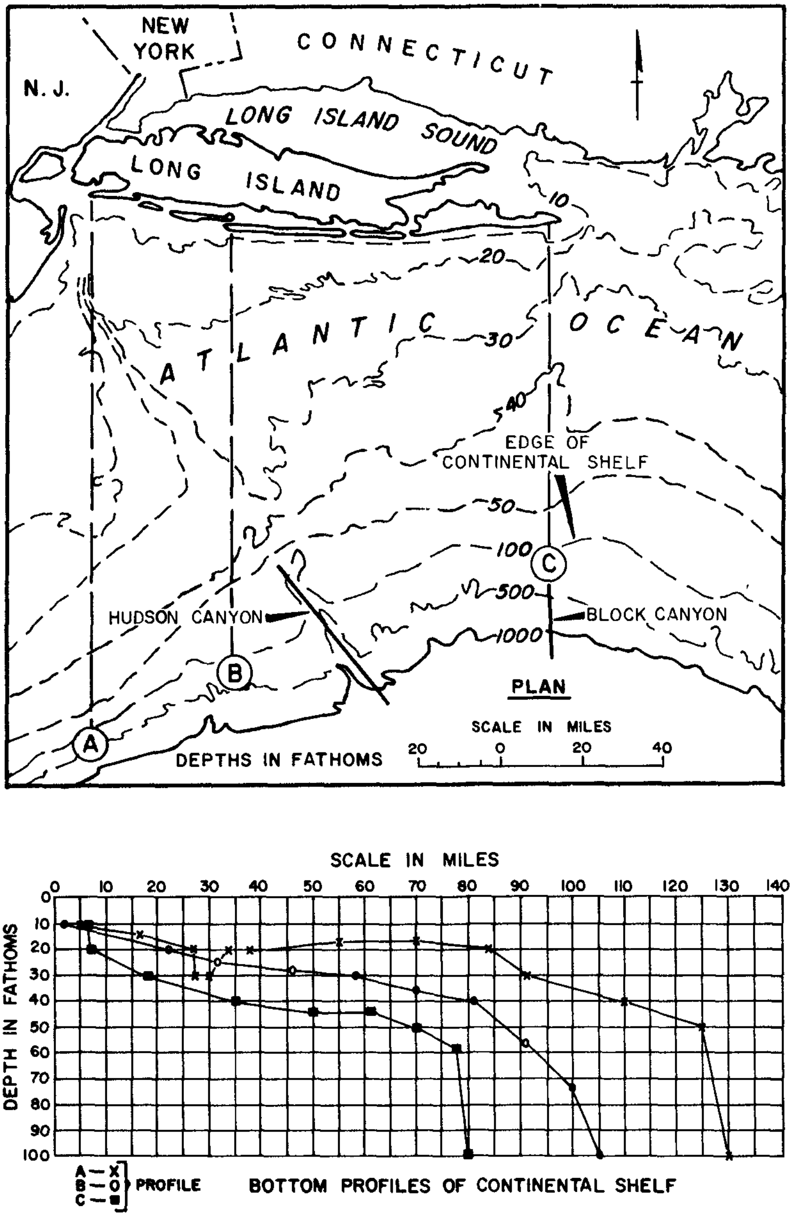


FIG 3 OFFSHORE HYDROGRAPHY – LONG ISLAND, NEW YORK

sections, Figure 2. The headland section extends 33 miles from Montauk Point, the most easterly point of Long Island, to Southampton. The barrier beach section covers the remaining 87 miles from the main island at Southampton to Rockaway Inlet, the most westerly point of Long Island.

Headland section. Submarine shoals lying about two miles off Montauk Point indicate that the land may have extended farther eastward. Westward from Montauk Point, ten miles of bluff lands, formed by the erosion of the southerly face of the Ronkonkoma moraine, rise abruptly from scanty beaches of coarse sand and gravel to 60 feet or more above mean sea level. From this point westward to Southampton, there are four miles of low, narrow sandy beach, often awash under hurricane tides and waves, and 19 miles of sandy beach with abutting continuous dunes reaching to over 20 feet above mean sea level. Included in this section are several small ponds and bays which have been cut off from the ocean by littoral drift material moving westward and forming barrier beaches.

Barrier Beach section consists of four islands, two peninsulas, and six inlets, and separates the shallow interconnected tidal bays to the north from the Atlantic Ocean. These bays vary from a few hundred feet to five miles in width and are separated from each other by promontories except for Jamaica Bay which is not joined to the bays to the east. The long and narrow barrier islands and peninsulas were probably formed as westward growing spits and as wave built barrier bars rising above the submerged portion of the gently sloping outwash plain. These barrier bars and peninsulas are paralleled by a submerged offshore bar.

The barrier islands and peninsulas with widths from one quarter of a mile to more than a mile, are breached by six inlets. The ocean beaches with an average width of 100 to 200 feet, vary in width from none at the eastern end of Long Island to over 500 feet in localized areas. On the landside of the beach from Southampton to Fire Island Inlet is an interrupted belt of eroded dunes with crests up to 30 feet above mean sea level. Westward to Rockaway Inlet the natural dune physiography has been greatly altered by extensive recreational, commercial, and residential developments.

Inlets. The inlets from east to west, Figures 1 and 2, are Shinnecock, Moriches, Fire Island, Jones, East Rockaway, and Rockaway. The latter four inlets predate the earliest available surveys of 1825 and 1835, Table 2. The remaining two inlets were recently formed. All inlets migrated until arrested by jetties and revetments and by navigation dredging, Table 2. The jetties offered temporary relief in stabilizing the inlet until the compartments updrift of the jetties became filled. Then, drift bypassed the jetties and built up within the inlets so as to affect not only navigability of the channel but also downdrift feeding of the shore.

LITTORAL FORCES

Waves. Along the south shore of Long Island from the south-southwest through the east quadrants, fetches of great length would permit the development of large deep water waves. A statistical study of deep water wave height, frequency of occurrence and direction of approach for a station off the entrance to New York Harbor, based on hindcasting technique and use of synoptic weather charts for the period of 1948-1950, showed that about 72 percent of all deep water waves approach from the directions east-northeast through south-southeast. The largest computed waves were between 25 and 30 feet in height.

In general, wave height is lessened as the water shoals across the continental shelf and the offshore. Study of the hydrographic charts of the shore and continental shelf, indicates that the refraction coefficients for a given deep water wave period and direction should generally be about the same for any point along the shore from Rockaway Inlet to Montauk Point. Hence, the wave action will be generally the same for the entire south shore of Long Island, although local conditions may be expected to introduce differences at particular points.

The important factor for the design of shore protection structures is the size of the maximum wave height that can occur within a certain time period. Calculations

TABLE 1 - VARIATION OF LITTORAL MATERIALS AT MID-TIDE FOR SOUTH SHORE OF LONG ISLAND

Values	M_d Individual	M_d Cluster	S_o Individual	S_o Cluster	S_k Individual	S_k Cluster
			MONTAUK POINT TO SHINNECOCK INLET			
High	2.00	1.79	1.99	1.77	4.30	1.26
Low	0.33	0.38	1.17	1.19	0.90	0.90
Mean	0 54	0.59	1.32	1.30	1.43	1.02
			SHINNECOCK INLET TO MORICHES INLET			
High	1.22	0.53	1.51	1.43	1.24	0.99
Low	0.41	0.35	1.13	1.27	0.95	0.91
Mean	0.68	0.47	1.35	1.37	1.10	0.95
			MORICHES INLET TO FIRE ISLAND INLET			
High	0.78	0.53	1.68	1.59	1.21	1.24
Low	0.32	0.29	1.12	1.21	0.82	0.87
Mean	0.42	0.41	1.30	1.35	1 00	1.06
			FIRE ISLAND INLET TO JONES INLET			
High	0.30	0.48	1.26	1.59	1.01	1.28
Low	0.30	0.21	1.26	1.14	1.01	0.95
Mean	0.30	0.33	1.26	1.32	1.01	1.05
			JONES INLET TO EAST ROCKAWAY INLET			
High	0.26	0.28	1.50	1.28	1.25	1 04
Low	0.13	0.26	1.25	1.25	0.50	0.99
Mean	0 20	0.27	1.36	1.27	0.94	1.02
			EAST ROCKAWAY INLET TO ROCKAWAY INLET			
High	-	0.62	-	2.21	-	1.62
Low	-	0.28	-	1.25	-	0.83
Mean	-	0.42	-	1.68	-	1.12

M_d = Median diameter is 50 percent point by weight on accumulative size distribution curve.

$S_o = (Q_1/Q_3)^{\frac{1}{2}}$ = Sorting coefficient.

$S_k = \left[Q_1Q_3/(M_d)^2\right]^{\frac{1}{2}}$ = Skewness coefficient.

where: Q_1 = first quartile diameter equal to 25 percent point by weight on accumulative size distribution curve.

Q_3 third quartile diameter equal to 75 percent point by weight on accumulate size distribution curve.

TABLE 2 - WESTERLY MIGRATION OF THE EASTERN SIDES OF INLETS, LONG ISLAND, NEW YORK

Shinnecock Inlet	1829-1839 Inlet Open	1839-1850 Inlet Closed	1850-1890 Inlet Open	1890-1938 Inlet Closed	1938-1951(a) 60 feet	1951-1955 -130 feet	1955-1968 -
	Total Migration West feet years 60 13	feet/yr. 4.6	Littoral Drift cubic yards/yr. 300,000			Jetties Built 1952-1954	
Moriches Inlet	1829-1839 Inlet Open	1839-1931 Inlet Closed	1931-1933(b) 220 feet	1933-1949 3880 feet	1949-1955 150 feet	1955-1968	
	Total Migration West feet years 4250 24	feet/yr. 177	Littoral Drift cubic yards/yr. 350,000		Jetties Built 1952-1954		
Fire Island Inlet	1825-1834 3050 feet	1834-1873 5625 feet	1873-1909 5175 feet	1909-1924 6775 feet	1924-1934 2030 feet	1934-1940 1670 feet	1940-1968 -
	Total Migration West feet years 24325 115	feet/yr. 212	Littoral Drift cubic yards/yr. 600,000			Jetty Built 1939-1944	
Jones Inlet	1835-1879 -2880 feet	1879-1909 3390 feet	1909-1926 2900 feet	1926-1934 1540 feet	1934-1953 2500 feet	1953-1968 -	
	Total Migration West feet years 10720 74	feet/yr. 135	Littoral Drift cubic yards/yr. 550,000			Jetty Built 1953-1959	
East Rockaway Inlet	1835-1879 7920 feet	1879-1909 5130 feet	1909-1926 3620 feet	1926-1934 400 feet	1934-1968 -		
	Total Migration West feet years 17070 99	feet/yr. 172	Littoral Drift cubic yards/yr. 400,000	Jetty Built 1933-1934			
Rockaway Inlet	1835-1877 10030 feet	1877-1902 5190 feet	1902-1928 2740 feet	1928-1934 2450 feet	1934-1968 -		
	Total Migration West feet years 20410 99	feet/yr. 206	Littoral Drift cubic yards/yr. 400,000	Jetty Built 1931-1933			

(a) Break through barrier peninsula during storm of 12 September 1938.
(b) Break through barrier peninsula during storm of 31 March 1931.
Minus indicates easterly migration.

involving sand movement and littoral drift are best correlated with the amount of potential energy transmitted forward and onto the beach by the wave. Calculations of this energy for the station at the entrance to New York Harbor indicate that 50 percent of the energy comes from waves from the east-northeast, 25 percent from the east and the remainder from the quadrant between east and south.

Wave height observation from underwater pressure gages which operated intermittently from 1950-1954 between Fire Island and Jones Inlets, showed a mean wave height of 1.2 feet, a maximum height of 13.4 feet, and an occurrence of 2 feet or greater waves for 20 percent of the time and of 10 feet or more for 1 percent of the time. Visual observations at Jones Inlet from 1954 to 1957, showed that the predominant wave direction was from the southern quadrants with 99 percent of the surf wave height below 6 feet. The maximum observed surf wave height was less than 10 feet even though waves as high as 20 feet were reported in the deeper water offshore. This demonstrates that as storm waves approach the shore, the characteristics are modified by friction along bottom, change in water depth, and local hydrographic conditions.

Tides are semi-diurnal and vary with a mean range of 4.7 feet at Rockaway Inlet, the westerly end of the island, 4.1 feet at East Rockaway Inlet, 4.2 feet at Jones and Fire Island Inlets, and 2.0 feet at Montauk Point, the easterly end of the island. The tide in the interconnected bays have a range of 1.0 to 2.0 feet except Jamaica Bay where the range is 4.9 to 5.4 feet.

Sea level changes. The relative position of land to sea level in this area since the retreat of the last glacier, about 10,000 years ago, shows that the level of the sea has risen about 25 feet or 0.25 feet per century. However, since the early 1930's, the rate of rise in the sea level has been at the average rate of 2 feet per century.

Winds. The prevailing winds along the south shore are from the northwest to the southwest quadrants. At sea, the winds from the westerly quadrants prevail. Wind velocities, approaching 100 miles per hour, have been reported at points along the island with gust winds reported to 135 miles per hour.

Storms. The south shore of Long Island lies in the Atlantic Ocean storm belt, Figure 1. The most severe storms are hurricanes originating in the equatorial calms during the months of August, September, and October. In most cases tropical storms have moderated considerably before reaching the south shore of Long Island with a few notable exceptions. Records show that about 239 storms of all types have affected the area since 1635. Of these storms, five storms were unusually severe, 19 storms were severe, 50 storms were moderate and 64 storms threatened the area. On this basis the frequency of the unusually severe storm is 3 per 100 year, the severe storms is 22 per 100 year, moderate storms is 81 per 100 year and storms threatening the area is 103 per 100 year.

LITTORAL MOVEMENTS

Shore effects. High water shoreline changes in recent years indicate a fairly stable shore east of East Hampton, a shore eroding from 6 to 10 feet per year from East Hampton to Fire Island Inlet and about 3.5 feet per year from Fire Island Inlet to Jones Inlet, a transition shore from Jones Inlet to East Rockaway Inlet with accretion adjacent to the inlets and erosion in-between up to 7 feet per year, and a shore accreting at a rate of about 10 feet per year from East Rockaway Inlet to Rockaway Inlet. The shore movement west of Jones Inlet has been modified by groins, breakwaters and sandfill. Profile slopes from mean low water in the foreshore vary from 1 on 8 to 1 on 35 and in the offshore from 1 on 25 to 1 on 600.

Littoral drift varies with seasons of the year but is predominantly from east to west. This predominance is evident from the impoundment of littoral material on the east side of groins and jetties, westward migration of spits and inlets, the dominant westerly alongshore components of wave energy as developed by refraction studies and the progressive decrease in grain size and mineral content of sediments from east to west. The computed annual littoral drift to the west in cubic yards increases from 300,000 up to as high as 600,000, Table 2.

Littoral sediments. Along the entire south shore, the littoral sediments are generally coarse to fine sand with varying mineral content. These sediments are subject to variations of particle size distribution laterally along the shore and onshore and offshore as measured by the descriptive parameters of median diameter, the coefficient of sorting and skewness. The median diameter (M_d) identifies the middle size of cumulative particle sizes. The coefficient of sorting (S_o) is a measure of the dispersion of the particle sizes. The skewness (S_k) describes the symmetry of the cumulative particle size distribution with respect to the median diameter. The variation in size of littoral sediment laterally along the shore is demonstrated by the tabulation in Table 1 of these comparative parameters for samples taken at midtide.

Inlet migration. The general position, size, and number of inlets have remained constant since 1834, although for a long period of time, the two most easterly inlets were closed. There is a pattern to inlet migration downdrift along an offshore bar or barrier island. Not all of the littoral drift is deposited on the updrift side of the barrier bar. Some of the drift is drawn through the inlet and forms the inner bar or shoal and is thus removed from the littoral flow. Another portion of the drift forms the outer inlet bar or shoal. The remainder of the drift finds its way across the inlet by transport across the outer bar or by gradual transfer from updrift to downdrift side of the inlet by tidal action. During storms, sudden updrift shift in position of channel through the outer bar transfers a large volume of sediment across the inlet. Such a drift regime results in the growth of the updrift side in a downdrift direction and a retreat of the downdrift side in the same direction.

If the volume of sediment feeding the updrift side is sufficiently great and the tidal exchange small, so that the updrift side grows more rapidly than the downdrift side retreats, the inlet will close naturally. Shinnecock, Moriches and Jones Inlets are representative of this regime, Figure 4. The more complex inlet migration involves the continued growth of the updrift side until it overlaps the downdrift side while the inlet remains open and forces the tidal exchange to flow parallel to the barrier beach before entering the ocean. Fire Island, East Rockaway and Rockaway Inlets are examples of this regime, Figure 4. In this type of inlet the migration is complicated by the size of tidal prism through the inlet, volume of littoral drift at the inlet, and natural bypassing of littoral sediments. A history of the migration at each inlet are given in Table 2.

ECONOMIC CONSIDERATIONS

Development on the barrier beaches and mainland vary from heavy to scarce settlement for residential to recreational use. The ownership of the shore is 37 percent private, 45 percent non-Federal, and 18 percent Federal. The people affected by shore erosion and inundation are estimated at up to two million The real value of the affected property is estimated at about $2½ billions. Damages for the largest flood levels experienced in either the hurricane of September 1938 or the hurricane of September 1960 amount to over $175 million with an average annual damage of about $10 million.

PROTECTIVE MEASURES

Involvement by the Federal Government in beach erosion protection started with the Congressional Act of 1930, and in hurricane protection with the Congressional Act of 1955 Under these authorities, the 120 mile ocean coastline of Long Island was Federally studied Beach erosion and hurricane projects have been approved for 95 miles of the shore from Fire Island Inlet to Montauk Point and from East Rockaway Inlet to Rockaway Inlet; and a beach erosion project for 15 miles of shore from Fire Island Inlet to Jones Inlet. A beach erosion and hurricane study is underway for the 10 miles of shore from Jones Inlet to East Rockaway Inlet

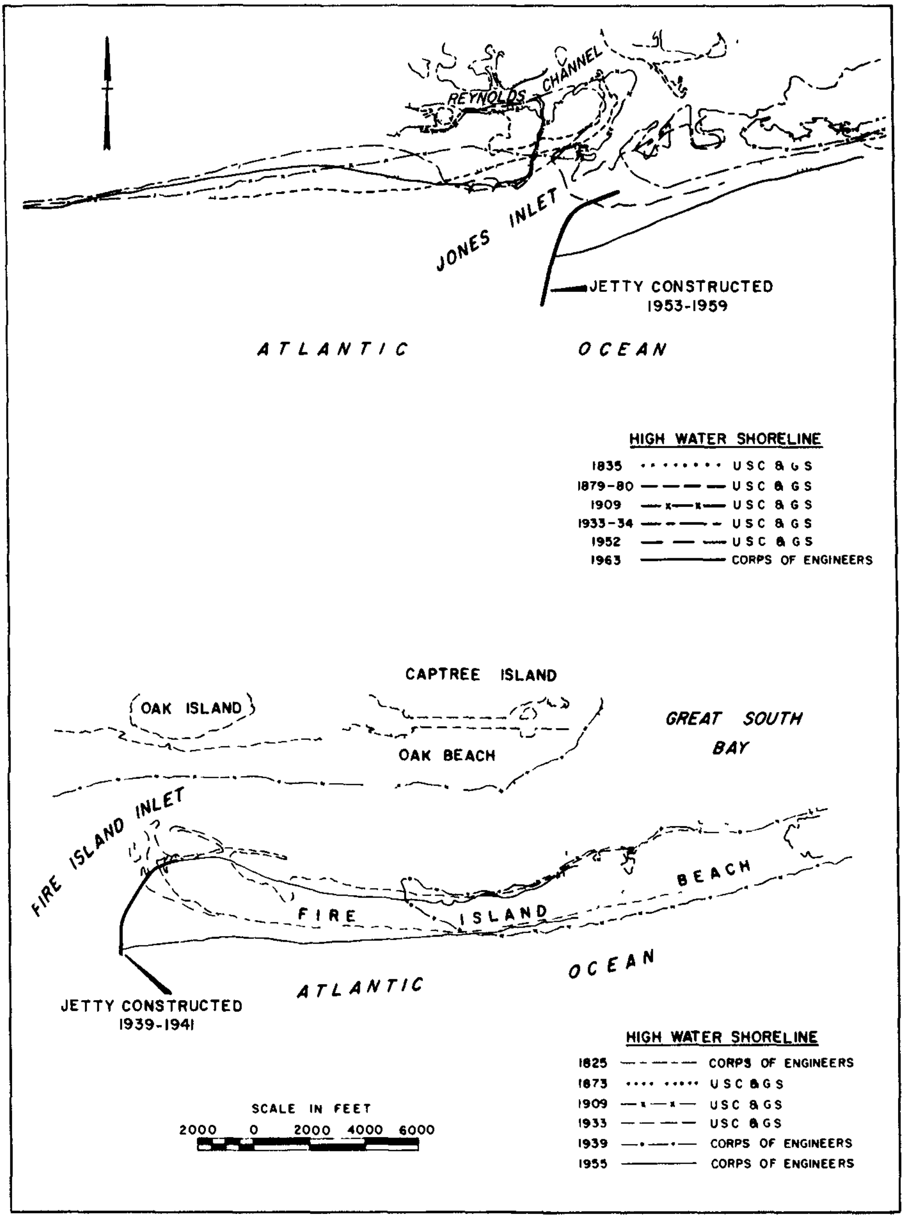


FIG 4 TYPICAL MIGRATION OF INLETS – LONG ISLAND, NEW YORK

Description. The authorized projects consist of sandfill and dunes, feeder beaches, groins, levees, jetties, sand bypassing, and barriers across inlets, Figure 5. The projects as currently estimated will cost about $188 million of which $110 million is Federal cost and $78 million is non-Federal cost. The allocation of costs to Federal and non-Federal interests is based on separable costs between beach erosion and hurricane and equitable division of the joint costs in accordance with the benefits The apportionment of cost is based on Federal law and policy governing beach erosion and hurricane protection. The projects would have annual charges of about $10 million and would return annual benefits of about $16 million.

DESIGN CRITERIA

Hurricane surge is built up as the hurricane passes over the open water of the ocean not only by the force of the wind and the forward movement of the storm wind field but also by differences in atmospheric pressure accompanying the storm. The storm surge is further increased by a gradually shoaling ocean bottom and by the counterclockwise spiraling of the hurricane winds.

Storm levels were computed based on transposition of the highest energy hurricanes having occurred in the area to critical paths with critical wind speed, central pressures, radius of storm and forward speed. The September 1944 hurricane so transposed with a maximum wind speed of 116 miles per hour, with a central pressure range from 27.55 to 27.95 inches of mercury, with a normal pressure of 30.12 inches, with a radius to maximum winds of 30 nautical miles, and with a forward speed of 40 knots per hour, produced a standard project hurricane surge of 12.3 feet for the westerly half of Long Island and 13.1 feet for the easterly half of Long Island.

Based on similar parameters except for a wind of 135 miles per hour and central pressure variation of 27.0 to 27.45 inches of mercury, a maximum probable hurricane surge was computed as 15.3 feet for the entire south shore. Transposition of the September 1938 storm to a critical path produced a surge of 8.9 feet. The maximum surge recorded in the westerly half of Long Island was 8.2 feet for the extra-tropical storm of November 1950.

Design elevations. The optimum practical design level for ocean protective structures was taken as the maximum surge of a standard project hurricane of 12.3 feet on mean sea level plus a wave runup of 5.2 feet for a total of 17.5 feet rounded to 18.0 feet above mean sea level for the shore west of Fire Island Inlet. For the shore, east of Fire Island Inlet, the standard project surge for ocean protective structures was taken as 13.1 feet on a mean high tide of 1.6 feet above mean sea level plus a wave runup of 5.3 feet for a total of 20 feet above mean sea level.

Beach Erosion and Hurricane Section. The need for a protective beach has been demonstrated during severe storms along the south shore of Long Island. In location where dunes were of sufficient height but the beach was of insufficient width, breaks occurred in the dunes because scour at the base of the dunes caused their collapse. In a series of experiments in a wave tank, it was developed that a minimum wave and wave runup occurred at the dune when the beach section had a foreshore slope of 1 on 20, a beach berm height above mean sea level equal to the design surge and a beach berm width of 100 feet at the base of dune having a 1 on 5 slope. With a beach berm at 14 feet above mean sea level, a surge of 14 feet produced waves of only one foot in height at the base of the dune with a runup of only five feet on the dune. This design was used along the easterly section from Fire Island Inlet to Montauk Point, Figure 5. Similar analysis was used in developing the design sections for the westerly section from Fire Island Inlet to Rockaway Inlet, Figure 5.

Barrier design. The height of the barrier was made equal to the height of coastal dunes and walls. The barrier openings were sized to produce no significant effect on tidal prism of the bays during normal times. The barrier openings were gated to

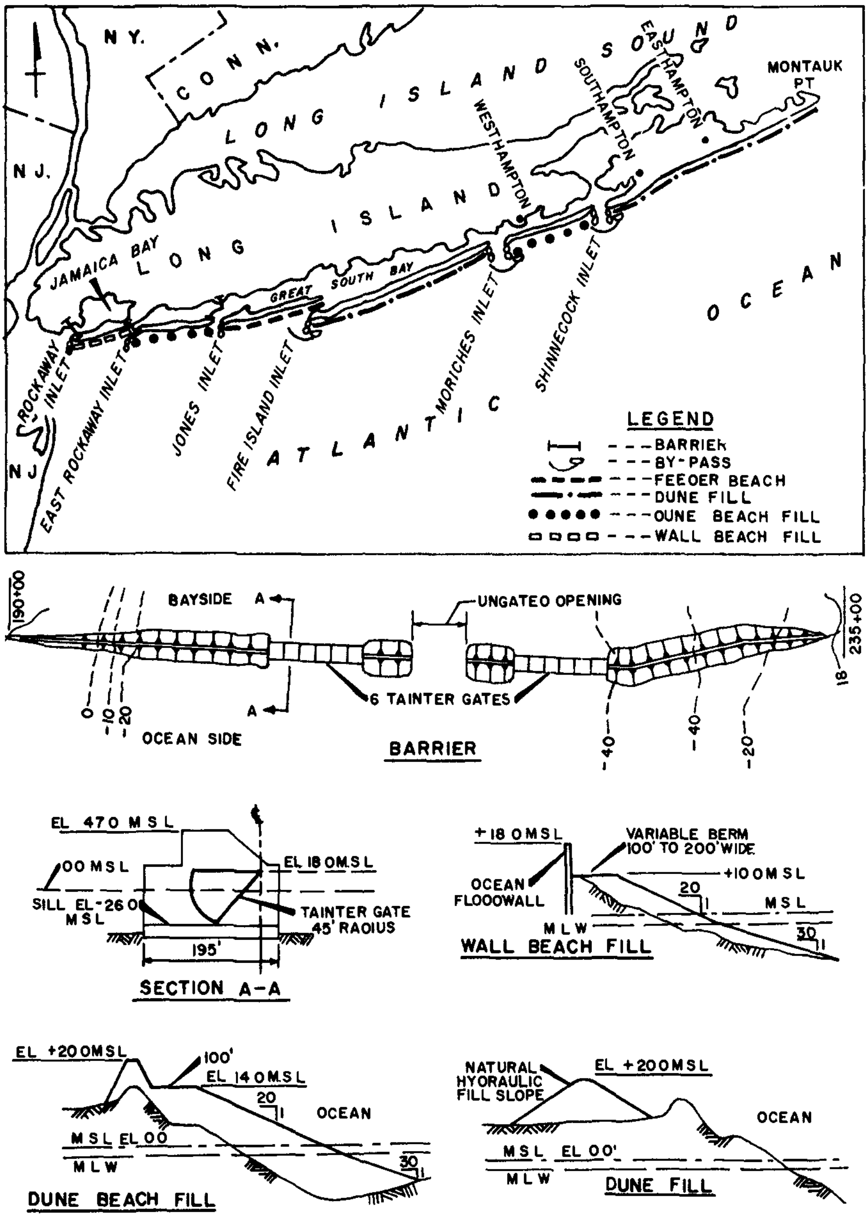


FIG. 5 PROJECTED SHORE IMPROVEMENTS, LONG ISLAND, NEW YORK

permit closing during storms so as to dampen storm surges into the bay area to the degree required to produce no significant damage to developments along the bay's shores, Figure 5.

PROJECT IMPLEMENTATIONS

Model tests are underway to develop the design for a stable navigation channel and a sand bypass system using commercial plant for Fire Island Inlet and Moriches Inlet. Model tests are underway on the barrier to be placed across Rockaway Inlet, Figure 5, to determine the widths of the fixed and gated openings so as to produce no changes in tidal prism of Jamaica Bay during normal operations and the desired changes in storm surges during storm operations.

Groins. The initial work for the beach erosion and hurricane project from Fire Island Inlet to Montauk Point was the construction of 11 groins at a critical reach of the barrier island at Westhampton, Figure 5. This reach between Moriches and Shinnecock Inlets has been frequently breached by storm action. Similarly, two groins were constructed at East Hampton between Shinnecock Inlet and Montauk Point where the dune section was being heavily eroded. From March 1965 to October 1966 the groins about 550 feet long were constructed at about 1,200 to 1,500 feet on centers along the critical sections of the shore to determine if a satisfactory beach and dune section could be developed without the need of placing the dune and beach fill.

Sand dike. To relieve pressure and heavy erosion on the north side of Fire Island Inlet, a sand dike spit was constructed in 1959 as a part of the feeder beach operation west of Fire Island Inlet, Figure 6. This dike was placed to divert the erosive inlet currents from the erodible shore on the north side of the inlet.

Beach nourishment. Beach nourishment was accomplished in 1959 and in 1964 for Fire Island Inlet to Jones Inlet reach as a beach erosion measure to offset the trapping of the littoral drift by Fire Island Inlet, Figure 6. Each time, about two million cubic yards of sand was placed on the feeder beach which was located downdrift of the nodal point of littoral drift movement. The sand was dredged from the shoal material in Fire Island Inlet and pumped about 15,000 feet to the feeder beach.

Sand inventory. The source of sand to construct the initial phases of the projects is the inlet shoals and inner bays. Because of the conflict with fish and wildlife interest, consideration must be given to obtaining future sources from the ocean. The current projects require 65 million cubic yards initially, and about two million cubic yards annually. Therefore, geophysical sonic surveys and core borings are being made of the offshore area along the entire south shore of Long Island to develop the availability of sand.

RESULTS TO DATE

Groin field. The shore conditions at the groin field areas were significantly affected by construction of the groins. The accretion and erosion, the advance and recession of the high and low water shorelines and the minus 12-foot contour are graphically shown on Figure 7 for Westhampton. Interesting observations are evident.

For the two years before the groin construction, the 300,000 cubic yards of littoral drift material moving predominantly from east to west showed an accreting and advancing shore except from mean low water to the minus 12-foot contour in the vicinity of what is now the location of groins 10 and 11. In the following two years including the construction period, the high water and low water shorelines became realigned so as to build up on the updrift side and to erode on the downdrift side with no advance of the average low and high water lines within the groin field because littoral drift material was being cut off at the updrift groins. But from the low water shoreline to minus 12-foot contour there was accretion and advancement due to material being diverted seaward by the groins so as to move in

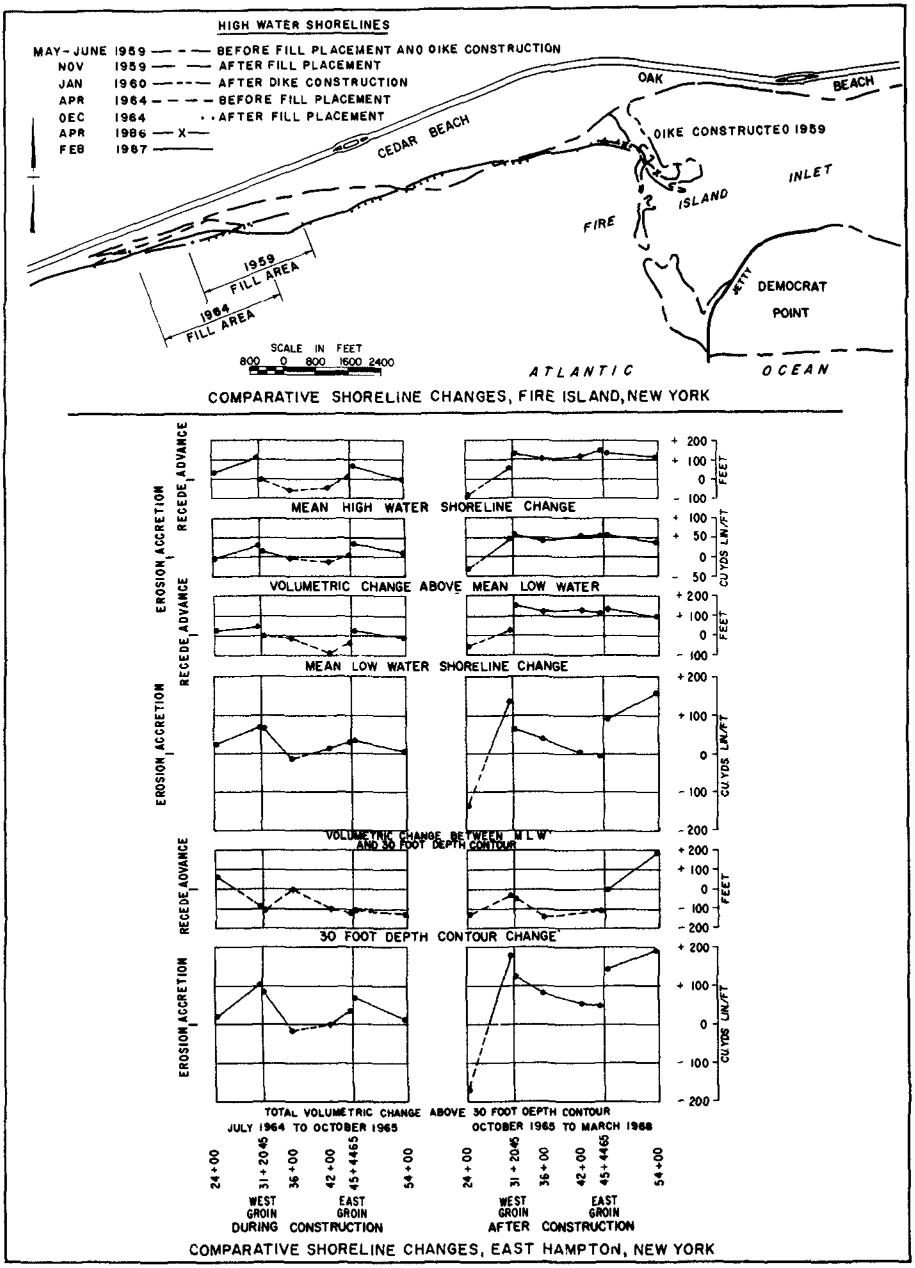


FIG 6 SHORELINE CHANGES RESULTING FROM SHORE TREATMENT
LONG ISLAND, NEW YORK

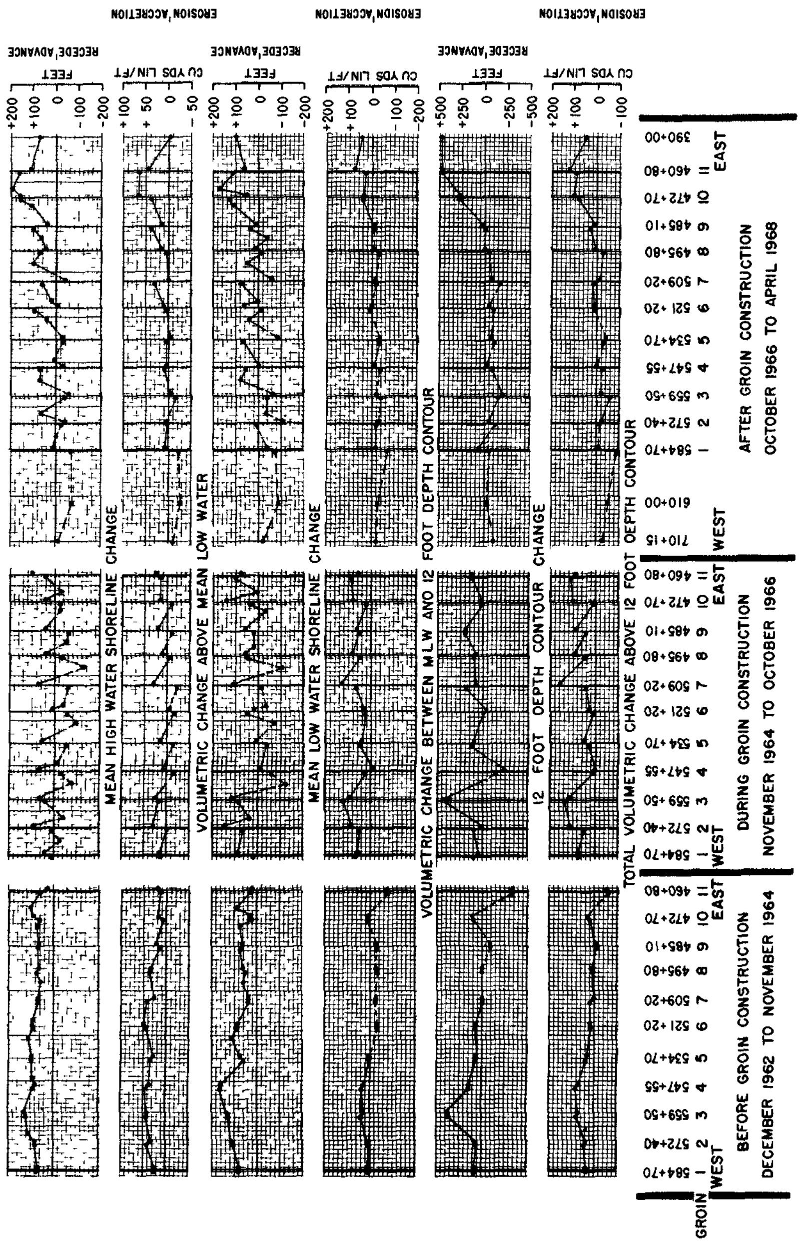


FIG 7 COMPARATIVE SHORELINE CHANGES
AT WESTHAMPTON BEACH, LONG ISLAND, NEW YORK

this zone. The total effect above the minus 12-foot contour was accretion.

For the period of 18 months after the completion of the groin field, the pattern was one of erosion and recession west of groin 8 and accretion and advance east of groin 8. The recession and erosion is most significant west of groin 1 because of the trapping of the drift by the updrift groins, Photos 1 and 2. The compartments east of groin 11 and between groins 10 and 11 are filled to capacity. The littoral drift spilling over and bypassing these compartments is moving westward and has reached as far as the compartment between groins 6 and 7.

It is apparent that the filling of all compartments and reestablishing of the east to west littoral drift is several years away and that the downdrift shores will continue to erode and recede unless protected and nourished. Within the downdrift section of the groin field, there is a reversal in the direction of the littoral drift due to trapping and filling at the updrift groins. Intermediate measurements taken since completion, show the drift to be from west to east from May through August and from east to west from September through April as shown by the comparative photographs on Photo 1.

Similar studies were made for the two groins at East Hampton, Figure 6 and Photo 1. The groin field has resulted in accretion and advancement of the shoreline. The predominance of the east to west littoral drift is small here so that the buildup on both sides of the groins is fairly equal. The downdrift erosion and shore recession is evident, but compartments between groins and east of the east groin are almost filled so that downdrift feeding west of the groins is being reestablished.

Severe changes in shorelines will occur in and adjacent to a large groin field until all compartments are filled and the predominant littoral drift is reestablished so as to feed downdrift beaches. To minimize these shoreline changes, the compartments between and updrift of the groin field should be filled as soon as construction of groins allows, thus permitting an earlier reestablishment of downdrift movement. As an interim measure a large feeder beach could he placed downdrift of the groin field to minimize the shore changes in the downdrift shore. The severe shoreline changes could also be prevented if the shore was first restored with sandfill and then groins constructed within the sandfill if found necessary.

Beach nourishment. Sand dike has been successful in diverting the erosion currents from the north shore of the Fire Island Inlet. The construction of the dike modified the drift pattern on the westerly side of the inlet so that the feeding action to west from the first placement of feeder beach was not fully effective. To compensate for this, second placement of feeder beach material was moved about 2,000 feet west of the first feeder beach placement. However, periodic surveys have shown that the nodal point of the westerly drift movement is still farther west and that the feeder beach material is moving both east and west. The feeding material moving to the west is still insufficient to restore the eroding shore.

Placement of fill at spot locations along the shore and in breaks in the offshore bar have been used to try to stabilize weak spots in the shore. Future feeder beach placement is planned farther to the west. Of the material placed in the feeder beach about 25 percent moved in the first six months. About eight years after the initial placement, about 55 percent of the sand is still in place with about 50 percent above and 50 percent below mean low water.

Current observations indicate that the feeder beach must be located farther to the west to produce positive and strong downdrift movement if nourishment is to be effective. Badly eroded shores should be restored by direct sandfill placement prior to nourishment. Nourishment should be designed to maintain a sufficient flow of material downdrift so as to offset loss from shore due to littoral movement.

30 OCTOBER 1967

22 AUGUST 1968

LOOKING EAST FROM GROIN NO. 1

30 OCTOBER 1967

22 AUGUST 1968

LOOKING WEST FROM GROIN NO. 11

WESTHAMPTON – LONG ISLAND – NEW YORK
SHORELINE CHANGES RESULTING FROM LITTORAL DRIFT REVERSAL
IN FIELD OF ELEVEN GROINS

PHOTO 1

LOOKING NORTH
AT ABOUT 1,850 FEET WEST OF GROIN NO. 1

LOOKING NORTHEAST
AT ABOUT 3,300 FEET WEST OF GROIN NO. 1

WESTHAMPTON – LONG ISLAND – NEW YORK
FIELD OF ELEVEN GROINS CONSTRUCTED MARCH 1965 TO OCTOBER 1966
DATE: 20 JULY 1967 – 1:35 P.M. – ONE HOUR AFTER LOW WATER
LITTORAL DRIFT – EAST TO WEST

LOOKING EASTWARD FROM WEST GROIN

LOOKING WESTWARD FROM EAST GROIN

EAST HAMPTON – LONG ISLAND – NEW YORK
FIELD OF TWO GROINS CONSTRUCTED MARCH 1965 TO OCTOBER 1966
DATE: 22 AUGUST 1968 – LITTORAL DRIFT – WEST TO EAST

SHORELINE CHANGES DUE TO GROIN CONSTRUCTION

PHOTO 2

EVALUATION

Findings. It is too early in the project to evaluate completely the overall behavior of the treatment of a significant section of the Atlantic Ocean shoreline of the United States.

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