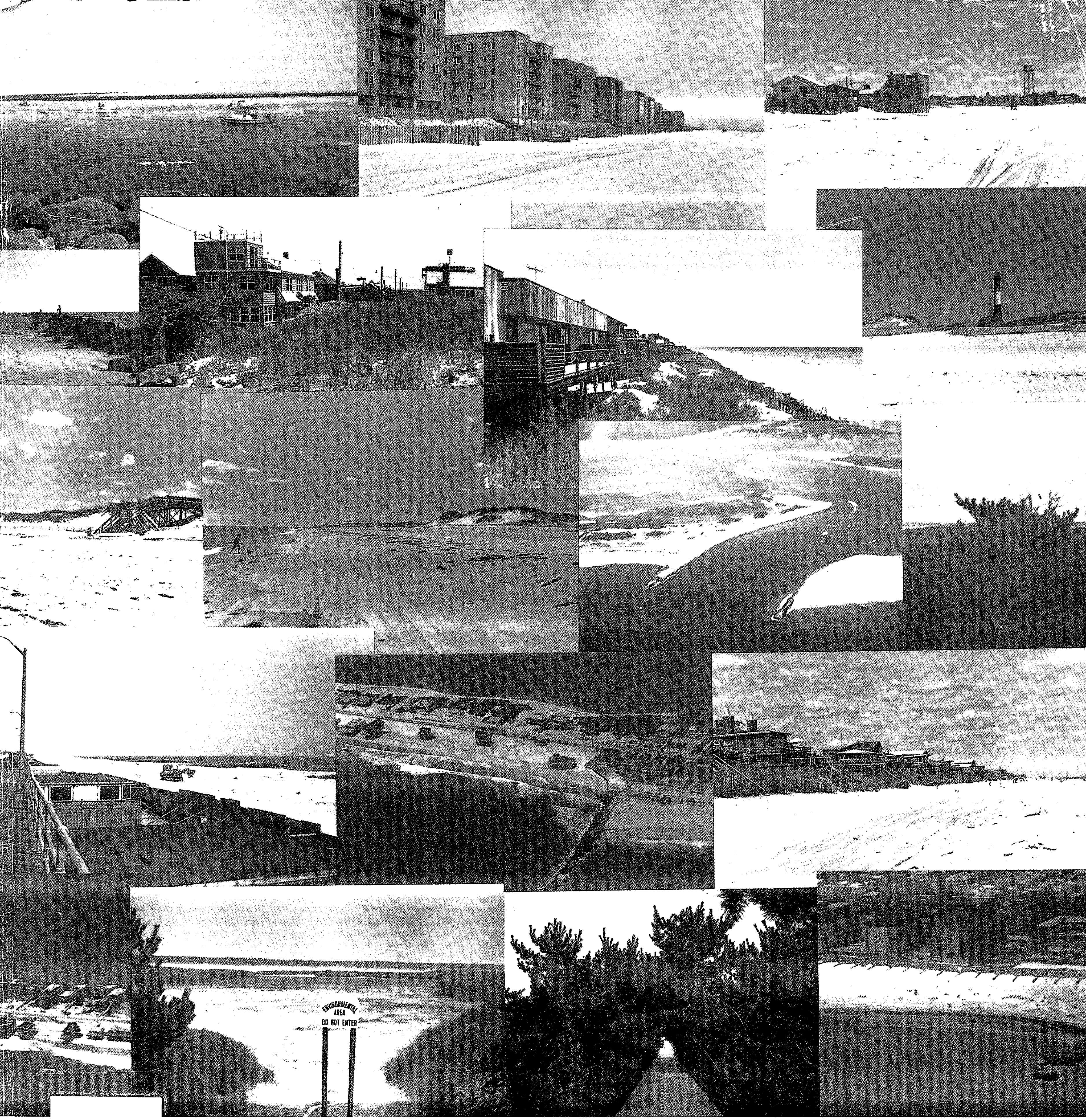


of
and Suffolk
rk

Prepared by:
Long Island Regional Planning Board

PROPOSED
LONG ISLAND SOUTH SHORE
HAZARD MANAGEMENT PROGRAM

Proposed
Long Island South Shore
Hazard Management Program

PROPOSED LONG ISLAND SOUTH SHORE HAZARD MANAGEMENT PROGRAM

Dr. Lee E. Koppelman
Project Director

DeWitt S. Davies
Project Coordinator

December 1989

Long Island Regional Planning Board
H. Lee Dennison Office Building
Veterans Memorial Highway
Hauppauge, New York 11788-5401

in cooperation with the

New York Coastal Program
Division of Coastal Resources and
Waterfront Revitalization
New York Department of State

This report was prepared for the New York State Department of State, Division of Coastal Resources and Waterfront Revitalization, with financial assistance from the Office of Ocean and Coastal Resource Management, National Oceanic and Atomospheric Administration, provided under the Coastal Zone Management Act of 1972, as amended (Grant-in-Aid Award No. NA-82-AA-D-CZ068; New York Comptroller's Contract Numbers C005563, C005564 and C005565).

State of New York

Long Island Regional Planning Board

Dear Reader:

Nowhere is the conflict between nature and man more evident than along our developed ocean shoreline. Navigational and safety hazards in inlets, homes on stilts in the surf zone, rising sea levels, and massive storm-induced destruction, as evidenced by Hurricane Hugo attest to the severity of this conflict. On Long Island's South Shore alone, thousands of lives and approximately $10 billion worth of property are at risk. Therefore, the Department of State and the Long Island Regional Planning Board identified the need for a comprehensive and coordinated response to flooding and erosion problems occurring along Long Island's South Shore.

Several public objectives guided the direction of this investigation. First, government has an obligation to protect the health and safety of the public and to reduce the risk to life and property. Second, public responsibility for and subsidy of continued private exposure to risks from erosion and flooding must be reduced, if not eliminated. Third, the south shore headlands and barrier islands constitute a dynamic, interrelated system, which must be treated as such. An action proposed at one section of the shoreline must be considered in light of its impacts on adjacent areas.

The recommendations set forth in this document will be discussed with municipal officials, scientists and citizen groups, keeping in focus the several public objectives listed above. Through this interaction among agencies and the public, it is our goal to arrive at a consensus on the most effective management techniques to resolve these issues.

Sincerely,

Gail S. Shaffer
Secretary of State
New York State

Lee E. Koppelman
Executive Director
Long Island Regional Planning Board

STUDY PARTICIPANTS

Project Director
Dr. Lee E. Koppelman

Report Preparation
DeWitt S. Davies
Lauretta R. Fischer
Ronald Verbarg
Christine Viladesau
Michael Volpe

Technical Advisors
New York Sea Grant Program
Jay Tanski
Marine Sciences Research Center
SUNY Center @ Stony Brook
Dr. Henry Bokuniewicz

Support Staff
Sandy Martin
Jeanne Widmayer

Cartographic and Publication
Anthony Tucci
Carl Lind
Thomas Frisenda

Accounting
Lucille Gardella

Acknowledgements

Numerous individuals from both the public and private sectors contributed to the preparation of this report. Personnel from the New York State Dept. of State, Division of Coastal Resources and Waterfront Revitalization provided extensive input during the entire course of this project. Special thanks are extended to George Stafford, Charles McCaffrey, Paul Bjorklund, and Sally Ball for their expertise and counsel.

The teams of coastal experts that participated in the workshops convened by the New York Sea Grant Program added invaluable technical insight to the conduct of the work. The team of coastal engineers consisted of Dr. Robert G. Dean, *Dept. of Coastal and Oceanographic Engineering, University of Florida, Gainesville, FL;* Dr. Craig Everts, *Moffatt and Nichol, Engineers, Long Beach, CA*; Dr. Nicholas C. Kraus, *U. S. Army Engineers Waterways Experiment Station, Coastal Engineering Research Center, Vicksburg, MS;* and Dr. Choule J. Sonu, *Tekmarine, Inc., Pasadena, CA.* Members of the coastal geologist team included Dr. Timothy W. Kana, *Coastal Science & Engineering, Inc., Columbia, SC;* Dr. Stephen P. Leatherman, *Laboratory for Coastal Research, University of Maryland, College Park, MD;* Dr. Larry McCormick, *Natural Sciences Division, Long Island University, Southampton, NY;* and Dr. Gary Zarillo, *Dept. of Oceanography, Florida Institute of Technology, Melbourne, FL.*

The staff of the Long Island Regional Planning Board also acknowledges the assistance of the following people who contributed data/information and/or views on various aspects of the project:

John Bennett	- *Town of Southampton*
Silvio Calesi	- *U. S. Army Corps of Engineers, NY District*
Larry Cantwell	- *Village of East Hampton*
Schuyler Corwin	- *Suffolk County Dept. of Parks, Recreation and Conservation*
Larry Cocchieri	- *U. S. Army Corps of Engineers, NY District*
Dick Curry	- *Fire Island Association*
William Daley	-*NYS Dept. of Environmental Conservation*
Edward Davida	- *Suffolk County Dept. of Public Works*
Randall Davis	- *NYS Emergency Management Office*
Thomas Doheny	- *Town of Hempstead*
Edward Eaton	- *City of Long Beach*
Ronald Foley	- *NYS Office of Parks, Recreation and Historic Preservation*
Jean Gilman	- *Town of Babylon*
George Gorman, Jr.	- *NYS Office of Parks, Recreation and Historic Preservation*
Nathan L. Halpern	- *East Hampton Beach Preservation Society, Inc.*
George Hill	- *Village of Saltaire*
Clifford Jones	- *U. S. Army Corps of Engineers, NY District*
Jeffrey Kassner	- *Town of Brookhaven*

Jim Kelley	- *NYS Department of Environmental Conservation*
Nancy Nagle Kelley	- *Group for the South Fork*
Jerry Kemp	- *Village of Southampton*
Joan Kesner	- *Town of Oyster Bay*
Darrel Kost	- *NYS Dept. of Transportation*
Lisa Liquori	- *Town of East Hampton*
Kevin McDonald	- *Group for the South Fork*
Blair McCaslin	- *Town of Southampton*
Julia Noeldechen	- *Town of Islip*
T. Decker Orr	- *Village of Quogue*
Noel Pachta	- *Fire Island National Seashore*
Larry Penny	- *Town of East Hampton*
Glenn Pisano	- *Town of Brookhaven*
Crouse Powell	- *Village of Ocean Beach*
John Sheridan	- *Suffolk County Dept. of Parks, Recreation and Conservation*
Gerard Stoddard	- *Fire Island Association*
Thomas Thorsen	- *Town of Southampton*
Anthony Tohill	- *Village of Westhampton Beach*
Ivan Vamos	- *NYS Office of Parks, Recreation and Historic Preservation*
Paul Weberg	- *Federal Emergency Management Agency, Region II*
Deanna Weiss	- *Village of Atlantic Beach*

In addition the staff would like to acknowledge the assistance rendered by New York State Disaster Preparedness Commission, Scientific Advisory Committee:

Dr. Peter J. R. Buttner *(Chairman)*	- *Director of Environmental Management; NYS Office of Parks, Recreation and Historic Preservation*
Dr. Nicholas K. Coch	- *Department of Geology; Queens College*
Dr. Robert Fakundiny	- *NYS Museum and Science Service Education Dept; Cultural Education Center*
Robert Fickies	- *NYS Museum and Science Service Education Dept; Cultural Education Center*
Frances A. Hyland, P.E	- *L.I. State Park, Recreation and Historic Park Preservation*
Dr. Robert Johnson	- *Department of Biology; Hofstra University*
Gilbert K. Nersesian, P.E.	- *U.S. Army Corps of Engineers, New York District*
Dr. John E. Sanders	- *Columbia University; Barnard College*
Dr. Manfred P. Wolff	- *Department of Geology; Hofstra University*

Preface

The exposure and vulnerability of Long Island's south shore to the ravages of severe storms were clearly documented in the Long Island Regional Planning Board's *Hurricane Damage Mitigation Plan* published in October 1984. That report, which contains strategies to reduce erosion- and flood-related damage, indicated that Long Island has the potential to become the next site of the Nation's costliest hurricane disaster.

Less than a year later, Hurricane Gloria scored a direct hit on Long Island. However, as a result of fortuitous circumstances, the intensity and forward speed of the storm decreased as it approached the south shore, and it hit near the time of low tide at noon on 27 September 1985. While damages in coastal areas were minimal, wind damage throughout Long Island was severe. Gloria caused an estimated $530 million in damages and losses in Nassau and Suffolk Counties.

At about midnight on 21 September 1989, Hurricane Hugo slammed into Charleston, South Carolina packing 135 mph winds and a storm surge of over 17 feet. Damage to shoreline resort development, suburban and urban areas and natural resources was devastating and could amount to more than $5 billion when final estimates are tallied. One need not wonder about the havoc that a storm like Hugo would wreak on Long Island.

The need for improved management of Long Island shoreline areas is clearly evident. The proposed recommendations in this hazard management program address the long-term concerns associated with shoreline stability and flooding problems, which have the potential of becoming even more severe, should the rate of global sea level rise accelerate. The recommendations are driven by land use and hazard planning policies, and are based on an assessment of available data/information on coastal processes and the forces that cause coastal change. Implementation will result in a decrease in the possible loss of life which may result from severe storms; reduced cost to the public for various forms of disaster assistance; a basis for providing better predictability of public costs associated with attempts to maintain the barrier islands and inlets; protection of natural resources; protection of the mainland; an overall reduction in the intensity of shoreline use; and an increase in public open space and access opportunity.

Table of Contents

Chapter Page

1 Introduction . . . 1-1

1.0 Geographic Setting and Scope . . . 1-1
1.1 Study Components . . . 1-1
1.2 New York Sea Grant Program Workshops . . . 1-2
1.3 South Shore Erosion and Flooding-related Problems . . . 1-3

2 South Shore Coastal Processes and Natural Resources . . . 2-1

2.0 Introduction . . . 2-1
2.1 Coastal Processes . . . 2-1
2.1.1 Trends in Shoreline Migration . . . 2-1
2.1.2 Shoreline Changes Due to Storms . . . 2-3
2.1.3 Volumetric Shoreline Changes/Sediment Budgets . . . 2-3
2.1.4 Dune Morphology and Dynamics . . . 2-3
2.1.5 Effects of Structures . . . 2-3
2.1.6 Wave Climate . . . 2-8
2.1.7 Sea Level Rise . . . 2-11
2.1.8 Storm Surges and Tides . . . 2-11
2.1.9 Longshore Sediment Transport . . . 2-11
2.1.10 Cross-shore Sediment Transport . . . 2-14
2.1.11 Inlet Processes . . . 2-14
2.1.12 Overwash Processes . . . 2-16
2.1.13 Bluff Erosion . . . 2-16
2.2 Natural Resources Inventory . . . 2-16
2.2.1 West, Middle and East Hempstead Bays and Oyster Bay Natural Resources . . . 2-18
2.2.2 Great South Bay Natural Resources . . . 2-18
2.2.3 Moriches Bay Natural Resources . . . 2-19
2.2.4 Shinnecock Bay Natural Resources . . . 2-19
2.2.5 Coastal Poncs Natural Resources . . . 2-19
2.2.6 Napeague Natural Resources . . . 2-20
2.2.7 Montauk Natural Resources . . . 2-20
2.2.8 Colonial Waterbird and Piping Plover Populations . . . 2-20

3 Hazard Management Program . . . 3-1

3.0 Introduction . . . 3-1
3.1 South Shore Land Use Plan Maps . . . 3-1
3.2 Coastal Hazard Planning Policies . . . 3-1
3.3 Assessment of Erosion Management Options . . . 3-1
3.4 Generic Hazard Management Recommendations - Longshore Transport, Inlet Management and . . . 3-1
Closure of New Inlets . . . 3-4
3.5 Coastal High Risk Zone . . . 3-5
3.6 Sea Level Rise and Natural Resource Protection . . . 3-6
3.7 Bulkhead Construction and Armoring of Coastal Bluffs . . . 3-7
3.8 Detailed Recommendations by Shoreline Segment . . . 3-9

Chapter Page

3.8.1 Atlantic Beach/Long Beach Segment . . . 3-9
3.8.1.1 Existing Land Use and Shore Protection Structures . . . 3-9
3.8.1.2 Land Use Plan Goals . . . 3-9
3.8.1.3 Coastal Hazard Planning Policies . . . 3-9
3.8.1.4 Policy Justification . . . 3-9
3.8.1.5 Preferred Erosion Management Options . . . 3-13
3.8.2 Jones Inlet Segment . . . 3-13
3.8.2.1 Existing Land Use and Shore Protection Structures . . . 3-13
3.8.2.2 Land Use Plan Goals . . . 3-13
3.8.2.3 Coastal Hazard Planning Policies . . . 3-13
3.8.2.4 Policy Justification . . . 3-13
3.8.2.5 Preferred Erosion Management Options . . . 3-15
3.8.3 Gilgo Beach Segment . . . 3-15
3.8.3.1 Existing Land Use and Shore Protection Structures . . . 3-15
3.8.3.2 Land Use Plan Goals . . . 3-19
3.8.3.3 Coastal Hazard Planning Policies . . . 3-19
3.8.3.4 Policy Justification . . . 3-19
3.8.3.5 Preferred Erosion Management Options . . . 3-19
3.8.4 Fire Island Inlet Segment . . . 3-20
3.8.4.1 Existing Land Use and Shore Protection Structures . . . 3-20
3.8.4.2 Land Use Plan Goals . . . 3-20
3.8.4.3 Coastal Hazard Planning Policies . . . 3-20
3.8.4.4 Policy Justification . . . 3-20
3.8.4.5 Preferred Erosion Management Options . . . 3-20
3.8.5 Ocean Beach Segmen . . . 3-22
3.8.5.1 Existing Land Use and Shore Protection Structures . . . 3-22
3.8.5.2 Land Use Plan Goals . . . 3-22
3.8.5.3 Coastal Hazard Planning Policies . . . 3-22
3.8.5.4 Policy Justification . . . 3-22
3.8.5.5 Preferred Erosion Management Options . . . 3-24
3.8.6 Central Fire Island Segment . . . 3-25
3.8.6.1 Existing Land Use and Shore Protection Structures . . . 3-25
3.8.6.2 Land Use Plan Goals . . . 3-25
3.8.6.3 Coastal Hazard Planning Policies . . . 3-25
3.8.6.4 Policy Justification . . . 3-25
3.8.6.5 Preferred Erosion Management Options . . . 3-25
3.8.7 Fire Island National Seashore Wilderness Segment . . . 3-25
3.8.7.1 Existing Land Use and Shore Protection Structures . . . 3-25
3.8.7.2 Land Use Plan Goals . . . 3-27
3.8.7.3 Coastal Hazard Planning Policies . . . 3-27
3.8.7.4 Policy Justification . . . 3-27
3.8.7.5 Preferred Erosion Management Options . . . 3-27
3.8.8 Moriches Inlet Segment . . . 3-27
3.8.8.1 Existing Land Use and Shore Protection Structures . . . 3-27
3.8.8.2 Land Use Plan Goals . . . 3-30
3.8.8.3 Coastal Hazard Planning Policies . . . 3-30
3.8.8.4 Policy Justification . . . 3-30
3.8.8.5 Preferred Erosion Management Options . . . 3-30

Chapter	Page
3.8.1 Atlantic Beach/Long Beach Segment	3-9
3.8.1.1 Existing Land Use and Shore Protection Structures	3-9
3.8.1.2 Land Use Plan Goals	3-9
3.8.1.3 Coastal Hazard Planning Policies	3-9
3.8.1.4 Policy Justification	3-9
3.8.1.5 Preferred Erosion Management Options	3-13
3.8.2 Jones Inlet Segment	3-13
3.8.2.1 Existing Land Use and Shore Protection Structures	3-13
3.8.2.2 Land Use Plan Goals	3-13
3.8.2.3 Coastal Hazard Planning Policies	3-13
3.8.2.4 Policy Justification	3-13
3.8.2.5 Preferred Erosion Management Options	3-15
3.8.3 Gilgo Beach Segment	3-15
3.8.3.1 Existing Land Use and Shore Protection Structures	3-15
3.8.3.2 Land Use Plan Goals	3-19
3.8.3.3 Coastal Hazard Planning Policies	3-19
3.8.3.4 Policy Justification	3-19
3.8.3.5 Preferred Erosion Management Options	3-19
3.8.4 Fire Island Inlet Segment	3-20
3.8.4.1 Existing Land Use and Shore Protection Structures	3-20
3.8.4.2 Land Use Plan Goals	3-20
3.8.4.3 Coastal Hazard Planning Policies	3-20
3.8.4.4 Policy Justification	3-20
3.8.4.5 Preferred Erosion Management Options	3-20
3.8.5 Ocean Beach Segmen	3-22
3.8.5.1 Existing Land Use and Shore Protection Structures	3-22
3.8.5.2 Land Use Plan Goals	3-22
3.8.5.3 Coastal Hazard Planning Policies	3-22
3.8.5.4 Policy Justification	3-22
3.8.5.5 Preferred Erosion Management Options	3-24
3.8.6 Central Fire Island Segment	3-25
3.8.6.1 Existing Land Use and Shore Protection Structures	3-25
3.8.6.2 Land Use Plan Goals	3-25
3.8.6.3 Coastal Hazard Planning Policies	3-25
3.8.6.4 Policy Justification	3-25
3.8.6.5 Preferred Erosion Management Options	3-25
3.8.7 Fire Island National Seashore Wilderness Segment	3-25
3.8.7.1 Existing Land Use and Shore Protection Structures	3-25
3.8.7.2 Land Use Plan Goals	3-27
3.8.7.3 Coastal Hazard Planning Policies	3-27
3.8.7.4 Policy Justification	3-27
3.8.7.5 Preferred Erosion Management Options	3-27
3.8.8 Moriches Inlet Segment	3-27
3.8.8.1 Existing Land Use and Shore Protection Structures	3-27
3.8.8.2 Land Use Plan Goals	3-30
3.8.8.3 Coastal Hazard Planning Policies	3-30
3.8.8.4 Policy Justification	3-30
3.8.8.5 Preferred Erosion Management Options	3-30

Chapter **Page**

3.8.9 Westhampton Beach Segment 3-31
3.8.9.1 Existing Land Use and Shore Protection Structures 3-31
3.8.9.2 Land Use Plan Goals 3-31
3.8.9.3 Coastal Hazard Planning Policies 3-31
3.8.9.4 Policy Justification 3-31
3.8.9.5 Preferred Erosion Management Options 3-35
3.8.10 Shinnecock Inlet Segment 3-35
3.8.10.1 Existing Land Use and Shore Protection Structures 3-35
3.8.10.2 Land Use Plan Goals 3-37
3.8.10.3 Coastal Hazard Planning Policies 3-37
3.8.10.4 Policy Justification 3-37
3.8.10.5 Preferred Erosion Management Options 3-37
3.8.11 Coastal Ponds Segment 3-37
3.8.11.1 Existing Land Use and Shore Protection Structures 3-37
3.8.11.2 Land Use Plan Goals 3-38
3.8.11.3 Coastal Hazard Planning Policies 3-38
3.8.11.4 Policy Justification 3-38
3.8.11.5 Preferred Erosion Management Options 3-38
3.8.12 Napeague Segment 3-40
3.8.12.1 Existing Land Use and Shore Protection Structures 3-40
3.8.12.2 Land Use Plan Goals 3-40
3.8.12.3 Coastal Hazard Planning Policies 3-40
3.8.12.4 Policy Justification 3-41
3.8.12.5 Preferred Erosion Management Options 3-41
3.8.13 Montauk Segment 3-41
3.8.13.1 Existing Land Use and Shore Protection Structures 3-41
3.8.13.2 Land Use Plan Goals 3-41
3.8.13.3 Coastal Hazard Planning Policies 3-41
3.8.13.4 Policy Justification 3-41
3.8.13.5 Preferred Erosion Management Options 3-41

4 Implementation Needs 4-1
4.0 Introduction 4-1
4.1 Erosion Monitoring Element 4-1
4.1.1 Technical Data and Information Needs 4-3
4.1.1.1 Characterization of Coastal Features and Changes 4-3
4.1.1.2 Physical Forcings Affecting Coastal Change 4-4
4.2 Recommended Changes in Government Programs 4-4
4.2.1 The National Flood Insurance Program 4-4
4.2.2 New York State Coastal Erosion Hazard Areas Act 4-6
4.2.3 Coordination of Erosion Management Activities 4-7
4.2.4 Eliminate Casualty Loss Deductions 4-7
4.2.5 Disclosure of Flooding and Erosion Hazards 4-8
4.2.6 Federal and State Disaster Assistance 4-8
4.2.7 Exclusion of Sensitive Areas in Local Setbacks 4-8
4.2.8 State Coastal Barrier Resources Act 4-8
Glossary G-1
References R-1

List of Figures

Figure		Page
2-1	Annualized long-term rates of shoreline recession (-) and accretion (+)	2-2
2-2	Maximum and average annual variations in the mean sea level intercept based on surveys at selected locations	2-4
2-3	Annualized net longshore transport rates and net shoreline volume changes for period 1955 - 1979 from sediment budget study	2-5
2-4	Annualized net shoreline volume changes by lens and total net change	2-6
2-5	Locations, dates of construction and approximate lengths of groins and jetties in the study area	2-7
2-6	Annualized fill placement and net volume change (1955 - 1979)	2-9
2-7	Significant wave heights based on Wave Information Study 20-year shallow-water wave hindcast data	2-10
2-8	Estimates of annualized net sediment loss by a lens due to sea level rise and total observed net volume changes for the period 1955 - 1979	2-12
2-9	Mean tidal ranges and storm surge water level elevations for 10, 50, and 100-year storms	2-13
2-10	Location of historical inlets based on data from Leatherman and Allen (1985) for the area east of Fire Island Inlet and Taney (1961) for the area west of Fire Island	2-15
2-11	Annualized volume losses due to washovers for the period 1955 - 1979.	2-17
3-1	General location of South Shore shoreline segments	3-2

List of Tables

Table		Page
1-1	South Shore Coastal Erosion-related Problems	1-3
2-1	Estimates of Inlet Bypassing.	2-14
2-2	Natural Resources Map Series Ebayment/Area, Natural Resources Map Number(s) and Shoreline Segment Name(s).	2-19
3-1	Shoreline Segment Names, Boundaries and Land Use Plan Map Reference Number(s)	3-3
3-2	Long Beach Barrier Island: Partial Shoreline Construction History	3-12
3-3	Pay Quantity and Disposal Area for Maintenance Dredging of the Jones Inlet Federal Navigation Channel	3-16
3-4	Suffolk County Dredging and Construction Projects at Moriches Inlet	3-30
3-5	Westhampton Barrier Island: Shoreline Construction History	3-34
3-6	Government Projects at Shinnecock Inlet.	3-38

List of Photographs

Photo		Page
3-2	City of Long Beach, May 1989. Recently constructed dunes immediately east of boardwalk	3-10
3-3	City of Long Beach, May 1989. Dunes constructed immediately west of boardwalk	3-10
3-4	Village of Atlantic Beach, May 1989. Removal of windblown sand adjacent to cabanas and concession stands	3-11
3-5	City of Long Beach, May 1989. Man-made dunes fronting high density residential use east of boardwalk.	3-11
3-6	Point Lookout, May 1989. Town of Hempstead recreation pavilion damaged by erosion of feeder beach west of Inlet	3-14
3-7	Point Lookout, May 1989. Sand starved feeder beach	3-14
3-8	Eroded portion of Gilgo Beach, July 1989	3-17
3-9	Gilgo Beach, March 1973. View looking west with Gilgo pavilion in background Photo courtesy of LISPC	3-17
3-10	Tobay Beach, May 1989. Recently reconstructed pavilion located seaward of Ocean Parkway	3-18
3-11	Jones Beach State Park, December 1974. Erosion and subsequent abandonment of Parking Field #9.Photo courtesy of LISPC	3-18
3-12	Overlook Beach, July 1989. Excessive accretion of sand and ponding rendered beach unsafe for bathers	3-21
3-13	Fire Island Inlet, July 1989. Accretion of sand at Democrat Point and shoaling in Inlet	3-21
3-14	Village of Ocean Beach, June 1989. Partially constructed rubble-core dunes	3-23
3-15	Dunewood, June 1989. Lack of protective dune	3-23
3-16	Fire Island Pines, June 1989. Note housing and pools in what once was the primary dune line	3-26
3-17	Fire Island National Seashore Wilderness Area, July 1989. Dunes up to 25 feet in height and extensive wetland areas	3-26
3-18	Moriches Inlet, July 1989. Note scour area immediately west of the Inlet	3-28
3-19	Cupsogue County Park, July 1989. Facility is currently inaccessible due to severe erosion west of the Westhampton Beach groin field	3-28
3-20	Smith Point County Park, July 1989. Note dune blow-outs	3-29
3-21	Smith Point County Park, July 1989. Looking east at former site of Forge River Coast Guard Station. Note extremely low dune profile and close proximity of Ocean and Bay	3-29
3-22	Area west of the Westhampton Beach Groin Field, July 1989. Barrier at this point is only 300-500 ft. wide and has been subject to repeated washover	3-32
3-23	Westhampton Beach, July 1989. Note severe erosion down drift of westernmost groin	3-32
3-24	Eastern portion of Westhampton Beach groin field, July 1989. Note extensive beach width and medium and high density development	3-33
3-25	Eastern portion of Westhampton Beach groin field, July 1989.	3-33
3-26	Shinnecock Inlet, July 1989. Note accretion and erosion on east and west sides of Inlet respectively	3-36

Photo **Page**

3-27 Southampton Barrier Spit, July 1989. Note extensive beach width immediately updrift of Shinnecock Inlet and newly constructed mansions located in CBRA designated area 3-36

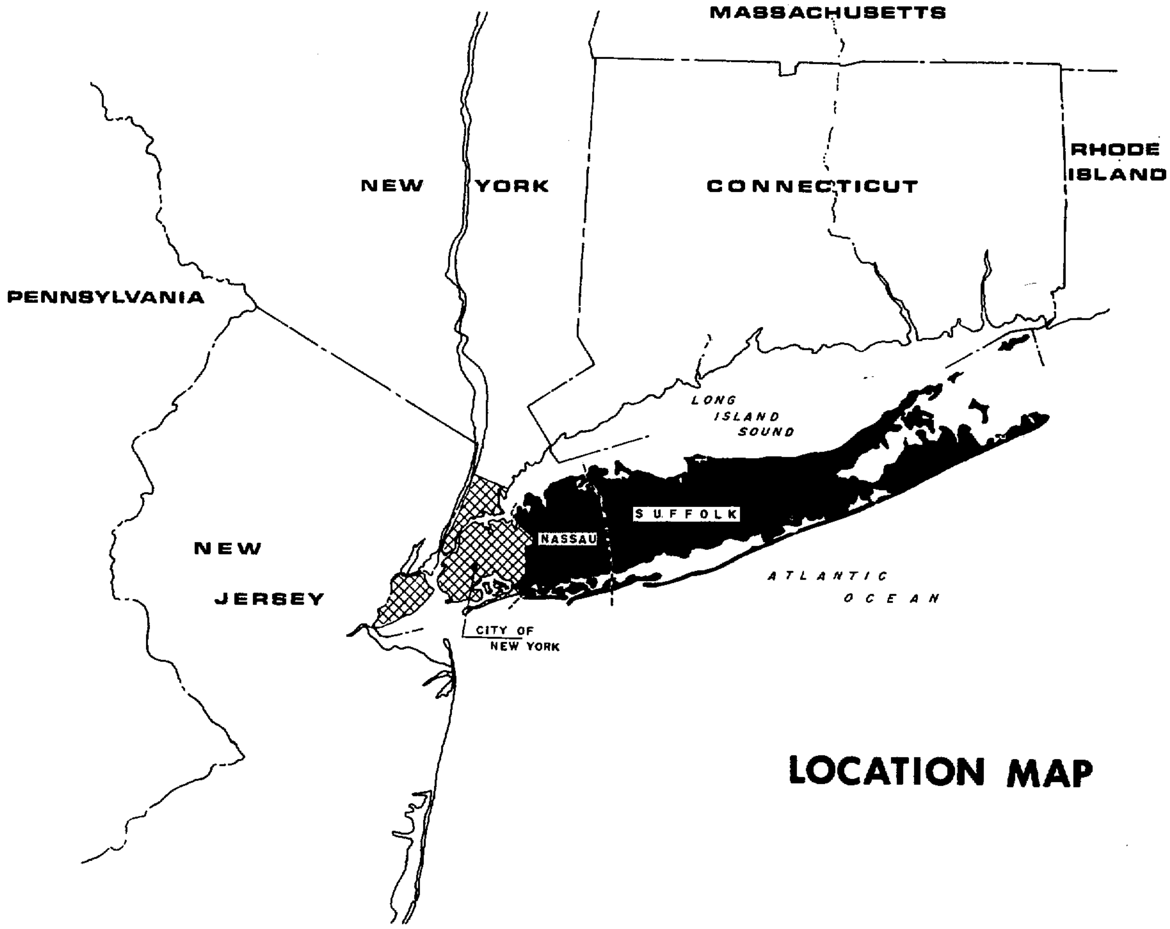
3-28 Sagaponack Lake, July 1989. Typical coastal pond surrounded by low density residential use. Note flood tidal delta in lake 3-39

3-29 Bluffs at Montauk, July 1989 3-39

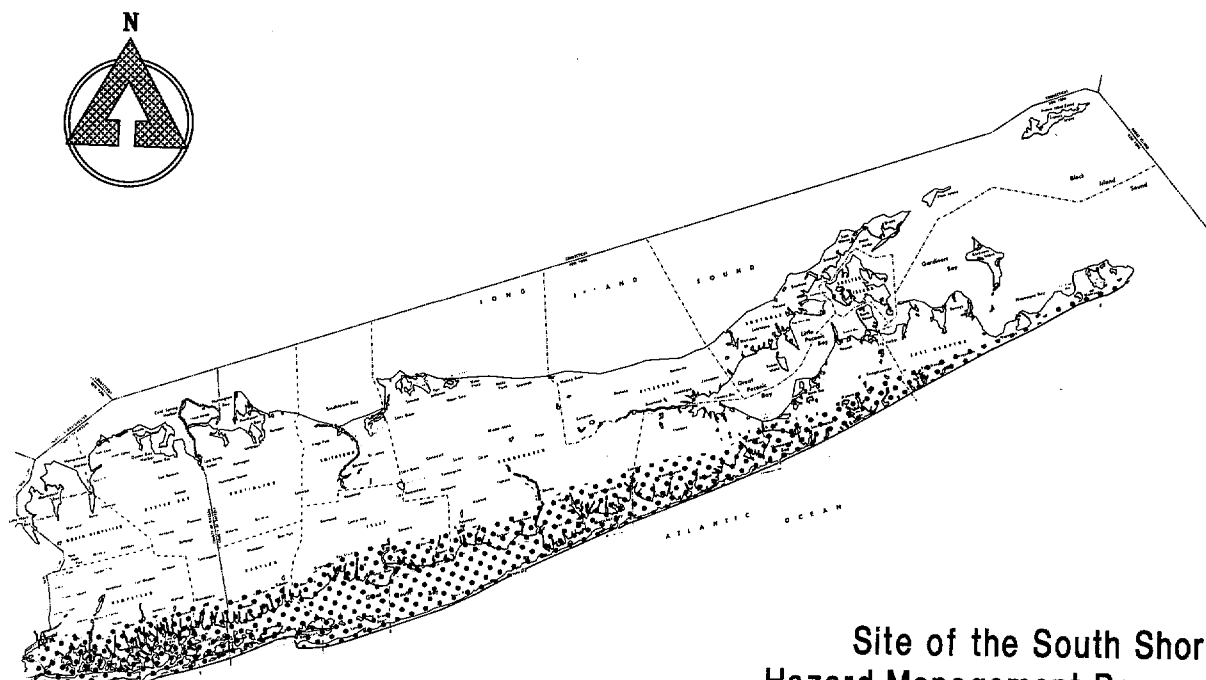
List of Maps

Map

Natural Resources
Waterbird Colonies
Land Use Plan



LOCATION MAP



Site of the South Shore
Hazard Management Program

Executive Summary

The need for a comprehensive, coordinated, long-term response to the erosion and flooding problems occurring along Long Island's south shore is clearly evident. The proposed structural and non-structural recommendations contained in this hazard management report address this need, and should be used in discussions to develop a consensus for support of a positive response to south shore development, erosion control and flooding problems.

The Proposed Long Island South Shore Hazard Management Program contains:

- a compilation and assessment of existing data/information on coastal features and processes; and on the physical forces, e.g., waves, that drive coastal change.
- a description and map inventory of south shore natural resources and significant fish and wildlife habitats.
- a land use plan with a planning horizon of the year 2025.
- a description of preferred management program recommendations by coastal segment that identifies areas where new development is acceptable; where development should be relocated and other non-structural actions may be needed; and where structural measures may be needed for erosion control.
- an outline of implementation needs involving the conduct of an erosion monitoring component and selected regulatory programs.

Hazard Management Recommendations Applicable to the Entire South Shore

- *Longshore Transport.* The continuity of the longshore transport of sand must be maintained along the entire south shore. Mechanisms for bypassing or restoring sand transport must be inaugurated and maintained at locations where sand transport has been (or will be) interrupted, e.g., at stabilized inlets and seaward of groin fields.
- *Inlet Management.* Inlets play a dominant role in the the processes affecting coastal change. Many of the most severe long-term erosion trends found along the south shore are associated with inlets. Effective management programs for inlets must be designed and implemented, not only to stabilize navigation channels, but also to incorporate provisions for maintaining the longshore transport of sand. Inlet bypassing is the most important erosion management strategy recommended for the south shore, and should be implemented at East Rockaway, Jones, Fire Island, Moriches and Shinnecock Inlets. Federal, State and local governments must make every effort to ensure that sand obtained from bypassing projects performed by the COE at ocean inlets not be disposed of offshore, but rather utilized as beach nourishment for downdrift beaches.
- *Closure of New Inlets.* Given the investment society has already made in the existing inlets and the magnitude and nature of the environmental changes associated with the formation of new inlets along the south shore, the creation of new inlets is unacceptable. Steps should be taken to prevent new inlets from forming. If they do form, and do not close naturally, they should be closed artificially.

Minimize Public Exposure to Financial Loss within the Coastal High Risk Zone

There is minimal public interest in making government expenditures for maintaining private development located within the Coastal High Risk Zone, which has been defined to include the Jones Beach, Fire Island and Westhampton Beach barrier islands, the Southampton spit, and that portion of the headland section of the south shore from Southampton to Montauk Point located within the **V** Zone as shown on flood insurance rate maps and/or the Coastal Erosion Hazard Area. When private structures located within the coastal high risk zone are damaged to a level greater than 50% of their replacement value due to either severe storm occurrence or long-term shoreline erosion, action should be taken to prohibit re-development in those locations and configurations that would result in recurring public costs to cover repeated damages or threaten the integrity of the barrier islands. Should regulation and other actions described in Section 4.2 when implemented fail to prevent redevelopment, government should acquire the damaged structures and private property as a last resort.

Sea Level Rise and Natural Resource Protection

Sea level rise poses a serious threat to the shoreline and associated development in low lying areas. This threat is magnified if the rate of sea level rise accelerates in the future. The policy of strategic retreat from vulnerable coastal areas is the rational approach to follow. While it is not recommended that wholesale abandonment of existing public facilities and private development located in coastal areas should occur in advance of actual sea level rise acceleration, structures should be removed from vulnerable locations over the long-term when subject to substantial damage from erosion and flooding impacts. Where engineered shoreline structures, roads, bridges, etc. are required, they should be designed with sea level rise in mind.

The generic and site specific recommendations in the program are compatible with efforts to protect natural resources and New York State Designated Significant Fish and Wildlife Habitats. Implementation over the long-term will help to stabilize south shore bay/coastal pond environments and, hence, ensure their continued use for recreational and commercial purposes.

Summary of Recommendations by Shoreline Reach

LONG BEACH REACH

The hazard management program for this highly developed barrier accepts that high density residential use will continue to be the predominant land use. Recreation and open space areas will also continue to be intensely used. It will be necessary to implement a coastal hazard policy that will serve to maintain the location of the shoreline to protect these uses. It is recommended that the existing 43 groins be maintained and possibly heightened and lengthened to create a wider and higher beach; a protective dunefield for the entire barrier island should be completed.

JONES BEACH REACH

The program recommends maintenance of the town and State recreation facilities located on Jones Beach barrier island and a phase out of leases for Town of Babylon property on the barrier and bay islands. Considering the intense use of the public recreation facilities, the tremendous public investment in beach facilities and Ocean Parkway and connecting bridges, as well as two large municipal sewage treatment plant outfall pipes that traverse the barrier island, the erosion planning policy for Jones Beach calls for maintaining the location of the shoreline and adequate beaches for recreational activities. The preferred management option for the beach erosion problem at Gilgo Beach is periodic beach nourishment and dune building utilizing sand bypassed from Fire Island Inlet. It is also recommended that the impact of removal or restoration of the Sore Thumb revetted sand dike on shoreline stability be assessed through application of suitable hydrographic/sediment transport models, and that an engineered shore hardening structure replace the concrete rubble strewn along the shore at Oak Beach.

FIRE ISLAND REACH

The program for the western portion of this barrier envisions a phase out of existing medium density, seasonal residential uses in accord with the generic recommendation for severely damaged structures located in the Coastal High Risk Zone. Robert Moses State Park should continue to serve as an intensively used recreation facility and the east-central portion of the barrier should remain as a wilderness area. Smith Point County Park should continue to serve as an intensively used recreation area near the pavilion/parking lot portion of the park.

It will be necessary to implement the following coastal hazard policies in this reach:

- Maintain adequate beaches for recreational use at Robert Moses State Park and maintain the location of the shoreline at a point that will serve to protect this facility. Since this shoreline has been accreting, no immediate intervention is envisioned.
- From Kismet to Davis Park, the coastal hazard policies are to emphasize regulation of private activity as the primary means for protecting structures and coastal features, and to maintain the continuity of the barrier.
- From Davis Park to Moriches Inlet, the policy is to maintain the existence and continuity of the barrier.

WESTHAMPTON BEACH REACH

The goal in this reach is to terminate residential occupancy of Westhampton Beach west of the westernmost groin to Cupsogue Beach, and to phase out private development on the barrier island in accord with the generic recommendation for severely damaged structures located in the Coastal High Risk Zone. It is recommended that all of the undeveloped land north of Dune Road within the Village of Quogue and stretching eastward to Tiana Beach, in addition to some of the oceanfront land within the Tiana Beach Coastal Barrier Resource System unit and immediately east, be purchased for recreation and open space. The program also reflects an expansion of the County-owned docking facility accommodating commercial fishing vessels.

The overall coastal hazard planning policy for the Westhampton Beach barrier island is to maintain the existence and continuity of the barrier island. In order to maintain the continuity of the narrow, highly eroded section between Cupsogue County Park and the groin field, it is essential that, at a minimum, the present shoreline position be maintained. The preferred approach for the area downdrift of the groin field involves the use of artificial beach fill and dune building in conjunction with a modification of the groin field in some form. It is recommended that beach nourishment in conjunction with regularly scheduled sand bypassing at Shinnecock Inlet be utilized to mitigate the erosion problem west of the Inlet.

Mainland Shoreline/Coastal Headlands Reach

The program for this primarily seasonal, low density residential reach recommends that this continue to be the predominant land use. It is recommended that government acquire some shorefront property in the vicinity of Montauk hamlet for open space purposes. The policies applicable to this reach are:

- emphasize regulation of private activity as the primary means for protecting structures and coastal features and;
- maintain the existence and continuity of barrier spits adjacent to coastal ponds.

The preferred erosion management alternative for this reach involves the retreat/relocation of structures out of the Coastal High Risk Zone. If this alternative cannot be implemented, it is recommended that shore hardening structures be built by private property owners only under special circumstances and as a last resort for protection of their property against catastrophic events. Property owners should not adversely impact coastal processes to the detriment of adjacent shoreline areas.

Erosion Monitoring Element

The data/information base on coastal processes must be improved to enable the development and selection of cost effective erosion management projects. The components of a needed erosion monitoring element (data base maintenance, beach profile surveys, aerial photography, wave gauge deployment, shoreline response modelling) are outlined in this report. The NYS Dept. of State should convene a conference attended by representatives of interested Federal, State and local agencies and noted experts in the fields of coastal engineering and geology for the purpose of preparing the specifications for the tasks to be accomplished, parties assigned to accomplish same, sources of required funding, etc.

National Flood Insurance Program

Since 1968, the Federal government has made subsidized flood insurance available to individuals in communities that adopted and enforced certain minimum floodplain management regulations. This protection has been afforded to structures located on barrier islands, and in effect encourages a cycle of repeated flood losses and policy claims. Thus, the elimination of federal flood insurance coverage for structures located on barrier islands and spits must be considered. Should Congress reauthorize the NFIP, it is recommended that section 1362 be funded to allow the purchase of storm damage structures and property and that the Upton-Jones amendment be modified so that it can be applied to the area west of the groin field in Westhampton Beach. Pursuant to the Upton-Jones amendment, NYS should take steps to identify areas of *imminent collapse.*

Coastal Erosion Hazard Areas Act

The *NYS Coastal Erosion Hazard Areas Act* (Article 34 of the Environmental Conservation Law) imposes an additional responsibility on NYS Dept. of Environmental Conservation (NYSDEC) and local communities with no additional funding to administer a coastal erosion management program. NYSDEC personnel with coastal erosion control expertise should be added to the staff of Region I on Long Island to assist local administrators of Article 34.

Coordination of Erosion Management Activities

The DOS should further the Proposed South Shore Hazard Management Program by incorporating its recommendations into the New York Coastal Management Program. As a result, through the consistency provisions of the State and Federal Coastal Acts, navigation and beach erosion control projects will be evaluated for comnpatibility with the South Shore Hazard Management Program.

Chapter One

INTRODUCTION

The *New York State Department of State* (NYSDOS) identified the need for a comprehensive, coordinated response to:

- acute and chronic erosion problems occurring along Long Island's south shore as a result of severe storm events, long-term geomorphic changes, inlet stabilization programs, and erosion control projects; and
- flood hazard conditions that are exacerbated by development situated in high risk locations.

Past management efforts have been typically characterized as short-term responses to crisis situations at specific locations. NYSDOS called for the preparation of a land and water use management program containing policies and strategies for a regional coordinated response to these problems by Federal, state and local interests; and with funds provided under the *Federal Coastal Zone Management Program,* contracted the *Long Island Regional Planning Board* (Board) to address this task. This program report, prepared during the period from 30 June 1988 to 30 September 1989, constitutes the final contract product.

1.0 Geographic Setting and Scope

The Atlantic Ocean coast of Nassau and Suffolk Counties is a major physiographic feature; it extends from East Rockaway Inlet to Montauk Point — a distance of about 106 miles. The barrier island portion of this coastline from East Rockaway Inlet to Southampton is 73 miles long. The 33 mile headland portion of the south shore extends from Southampton to Montauk Point (Taney 1961).

The barrier system is composed of four separate islands (from west to east: Long Beach, Jones Beach Island, Fire Island and Westhampton Beach) bounded by five inlets (from west to east: East Rockaway Inlet, Jones Inlet, Fire Island Inlet, Moriches Inlet, and Shinnecock Inlet). A barrier spit is located between Shinnecock Inlet and the headlands in Southampton. The system has widths that range from a low of 300 feet (to the west of the westernmost groin in the groin field at Westhampton Beach) to a high of about 1 mile (at the urbanized areas of Long Beach and Jones Beach State Park). The Long Beach and Jones Beach barrier islands front an extensive lagoonal-wetland area. Such wetlands are not as extensive in the bays in back of the Fire Island and Westhampton Beach barriers (Wolff 1982).

The headland portion of the coast is comprised of eroded glacial outwash features. Brackish, shallow ponds occupying the remnants of glacial drainage channels are located in this area. Glacial till bluffs 40 to 60 feet high are found adjacent to narrow beaches along the easternmost 10 miles of this section.

The geographic scope of this investigation is limited to the south shore barrier islands and spit in the Towns of Hempstead, Oyster Bay, Babylon, Islip, Brookhaven and Southampton; and the Atlantic Ocean shoreline, inland to the nearest road, along the headlands section in the Towns of Southampton and East Hampton.

1.1 Study Components

The *Long Island South Shore Hazard Management Program* contains the following components:

- Compilation and assessment of existing data and information on south shore coastal features, processes and changes; and on the physical forces, e.g., wave climate, that drive sediment dynamics resulting in coastal change. Coastal data/information have been summarized and portrayed in formats that are amenable to policy decision-making with reference to land use, regulation and coastal protection activities.
- Identification of gaps in coastal data/information. The components of a recommended erosion monitoring program that address the data/information shortfall have been outlined.
- Description of natural resources and constraints, existing land use, activity patterns, economic factors and shore protection practices; and the identification of coastal segments having similar characteristics.
- Evaluation of applicable Federal, state and local management and regulatory programs and activities, including land use controls, impacting development and use of the south shore.
- Discussion of alternative non-structural and structural measures for coordinated and effective management of ocean and barrier island shorelines. The feasibility of employing structural erosion control techniques (e.g., shore hardening structures, shore process altering structures, beach nourishment) was based on the availability and adequacy of existing shoreline and coastal process data and information.
- Development of management program recommendations by coastal segment that identify areas where:
  - — new development would be acceptable on the basis of favorable environmental conditions, the probable success of erosion control strategies and public benefit;

— no development or re-development should occur, i.e., where the concepts of retreat (movement of structure to a less vulnerable location on the same parcel), re-location (movement of structure to a parcel located outside a high risk area), public acquisition of private property and abandonment of public facilities and infrastructure should be employed; and

— a structural program for erosion control should be implemented to maintain natural protective landforms, mitigate human interference with coastal processes, and prevent damage to intensively developed or used areas.

A land use plan at a scale of 1" = 2000' with a planning horizon of the year 2025 has been prepared. Alteratives to reduce development density in areas of high risk after catastrophic storm occurrence are discussed.

The approach used to prepare this management program distinguishes it from other investigations on Long Island south shore erosion and flooding conditions for the following reasons:

- The focus of the program is on long-term regional policy that responds to these problems on the basis of the scale and magnitude of the coastal processes occurring along the south shore. Actions can be effective only if they are applied to relatively long sections of the coast.
- The program includes an analysis of jurisdictional responsibilities, an evaluation of different management philosophies and the development of a regional approach for shoreline management based on an understanding of natural processes.
- Land use goals and related erosion planning policies constrain the choice of appropriate erosion control options. The land use recommendations are coupled with other non-structural measures and structural erosion control techniques in a management approach involving the three levels of government with authority over land use control and the implementation of shore protection projects.

This program enunciates public policy and regulatory practices to manage the use of south shore resources. It should be used to develop a consensus for support of a positive response to south shore development, erosion control and flooding problems. When that consensus is achieved, the policies of the state coastal program will be amended to reflect the agreed upon consensus. It is recognized that consensus does not imply total agreement by all parties on all aspects of the program. It is expected that opinions will diverge on issues that arise on a local scale.

1.2 New York Sea Grant Program Workshops

During the initial phase of program development, the need to supplement Board staff capability with expertise in the fields of coastal engineering and coastal geology was recognized since recommendations pertaining to coastal erosion and flooding management options must be based on an understanding of coastal processes, the forces that drive these processes, and engineering feasibility. It was of utmost importance for the Board to secure an independent, professional view of Long Island south shore coastal erosion and flooding problems and potential solutions which was unhampered by agency affiliation and political influence.

The assistance of noted experts in the fields of coastal engineering and geology was secured via a subcontract agreement between the Board and the Research Foundation of the State University of New York at Stony Brook. Under the auspices of the New York Sea Grant Program, Mr. Jay Tanski and Dr. Henry Bokuniewicz assembled a team of coastal engineers and a team of coastal geologists that participated in a series of workshops. The experts were selected on the basis of their reputation in the respective fields, as well as their familiarity with Long Island coastal conditions as a result of having conducted research and/or studies in this particular geographic area. (The names of the individuals on both teams are identified in the Acknowledgements section of this report.)

Mr. Tanski and Dr. Bokuniewicz convened a series of three workshops as described below, and documented the discussions held in three proceedings reports (Tanski and Bokuniewicz 1989a; 1989b; 1989c).

Workshop #1 - *Identification and Assessment of Technical Information Requirements for Developing Coastal Erosion Management Strategies - February 24-25, 1989.* The objectives of this workshop were to:

- define the technical information needed to identify, develop and evaluate sound erosion management strategies;
- identify the specific data required to provide the necessary information;
- and delineate why that information was needed and, to the extent possible, how it would be used.

The team of coastal engineers outlined the generic information and data needed to characterize coastal features, processes and change; and describe the physical forces, e.g., wave climate, that drive sediment dynamics. See Tanski and Bokuniewicz (1989a) and sections 3.7 and 4.1.1 of this report.

Workshop #2 - *An Overview and Assessment of the Coastal Processes Data Base for the South Shore of Long Island - April 20-21, 1989.* There were three objectives of this workshop:

- identify the basic coastal processes data that are presently available for the south shore of Long Island, based on the information needs identified in Workshop #1;

- assess the quality and coverage of the available data in terms of their utility for developing management strategies; and
- identify critical gaps in the coastal processes data base.

This workshop, attended by the team of coastal geologists, provided a regional synopsis of data and information on coastal features, processes, and physical forces keyed to locations along the south shore. The relative magnitude of coastal change attributable to different factors was also discussed. See Chapter 2 for a summary of the proceedings of Workshop #2 (Tanski and Bokuniewicz 1989b).

Workshop #3 - *A Preliminary Assessment of Erosion Management Strategies for the South Shore of Long Island, New York - June 22-24, 1989.* The objectives of this workshop were to:

- use available data to identify the most promising and appropriate regional erosion management options for the south shore;
- to identify unresolved questions that affect the selection of options; and
- to develop recommendations on technical data needs and appropriate programs to meet these needs.

This workshop was attended by both teams of coastal experts; staff from the Board and NYSDOS also actively participated in the discussions. Alternative strategies involving non-structural and structural measures for coordinated and effective management of erosion and flooding problems for different segments of the shoreline were evaluated. For details, see Chapter 3 and Tanski and Bokuniewicz (1989c).

1.3 South Shore Erosion and Flooding-related Problems

During the course of study, many coastal erosion and flooding-related management problems were noted by agency personnel, NYSDOS and Board staff, and other interested parties. Table 1-1 lists these problems without reference to relative severity or location. Generic and location-specific recommendations that address many of these problems are discussed in Chapter 3. Program implementation needs from the perspective of government activties are outlined in Chapter 4.

TABLE 1-1

South Shore Coastal Erosion-related Problems.

— Localized shoreline erosion *hot spots* due to regional coastal processes and/or human interference with same.
— Need for periodic sand-by passing at inlets, improved inlet management, and navigation project implementation on a regular basis.
— Need for on-shore as opposed to offshore disposal of material dredged from inlet navigation channels.
— Threat to development located in erosion and flood-prone areas.
— Need to maintain the position of the shoreline at some locations due to the intensity of existing development and/or recreational usage.
— Lack of coastal dunes; need for dune restoration and maintenance.
— Adverse impacts of shore protection structures on downdrift beaches; flanking of existing structures.
— Need for repair of some shore protection structures (groins, revetments, jetties).
— Coastal bluff recession.
— Need for long-term policy on infrastructure protection (highways, sewer outfall, park facilities).
— Ill-conceived shore protection strategies, e.g. disposal of concrete rubble.
— Different management philosophies of agencies having jurisdiction over various portions of the shore.
— Loss of access to public beach facilities and private homes as a result of erosion and flooding.
— Lack of post-disaster plans that address areas destroyed by storm events.
— Pressure to develop remaining vacant parcels in coastal areas for residential and commercial use; adverse impacts of bay shoreline development on marine wetlands and water quality.
— Local government action that has encouraged the occupancy of public lands in vulnerable locations.
— Illegal conversion of single family dwellings to multi-family units; change from seasonal to year-round occupancy.
— Existence of non-conforming uses in coastal communities.
— Lack of opportunity to re-locate oceanfront structures threatened by coastal recession.
— Fortification of private oceanfront property to protect structures that pre-date implementation of the FEMA flood insurance program.
— Regulation of private project construction, e.g., revetments, designed to protect coastal dunes and bluffs.
— Adverse impacts of off-road vehicle travel on beaches and dunes.

Chapter Two

SOUTH SHORE COASTAL PROCESSES AND NATURAL RESOURCES

2.0 Introduction

The first section of this chapter provides an overview of available data on south shore coastal processes and the physical forces that drive these processes; it summarizes the proceedings report prepared for New York Sea Grant Program Workshop #2 held on April 20-21, 1989 in support of this study (Tanski and Bokuniewicz 1989b). Of special interest are the figures that relate the values of various parameters to geographic locations along the south shore.

Natural resources along the south shore of Nassau and Suffolk Counties are addressed in the second section of this chapter. A map series is presented and natural resources are discussed by embayment or area. In addition, the locations of waterbird colonies and piping plover nesting sites in these coastal areas are shown on maps and discussed.

2.1 Coastal Processes

Most of the data and information on coastal processes available for the south shore of Long Island are largely the result of studies done by or for the U.S. Army Corps of Engineers as part of its hurricane protection, beach erosion, and navigation projects. Several regional studies of the geomorphology and sediments of the south shore have been performed by the *Coastal Engineering Research Center* (CERC).

For the Fire Island Inlet to Montauk Point reach, several federal projects resulted in preparation of general design memoranda and reports including the Fire Island Inlet to Montauk Point hurricane and beach erosion protection project (U.S. Army Corps of Engineers 1977), navigation projects at Shinnecock, Moriches and Fire Island Inlets, and groin construction at Westhampton and East Hampton. Quantitative data for the littoral zone is skewed to those areas where projects have been undertaken. The detailed studies that have been done were restricted to specific areas and limited time periods. Two studies of note, because of their comprehensive coverage, include a regional sediment budget analysis (Research Planning Institute, Inc. 1985) and a geomorphic analysis of the shoreline (Leatherman and Allen 1985).

Data on coastal processes west of Fire Island are less comprehensive and not as well documented in comparison to that available for the eastern section of the study area. Most of the available studies relate to the federal dredging project at Fire Island Inlet. The erosion protection plan and data on shore conditions for Jones Beach Island are contained primarily in a 1964 beach erosion study (U.S. Army Corps of Engineers 1965). Researchers from CERC have also analyzed data from monthly subaerial beach profiles taken between 1962 and 1974 (Everts 1973; Morton et al. 1986).

The only data available from the Corps for the shoreline between Jones Inlet and East Rockaway Inlet is in a draft hurricane and beach erosion protection study (U.S. Army Corps of Engineers 1966). The Corps is apparently updating and analyzing the available data and conducting a new storm protection study for this area.

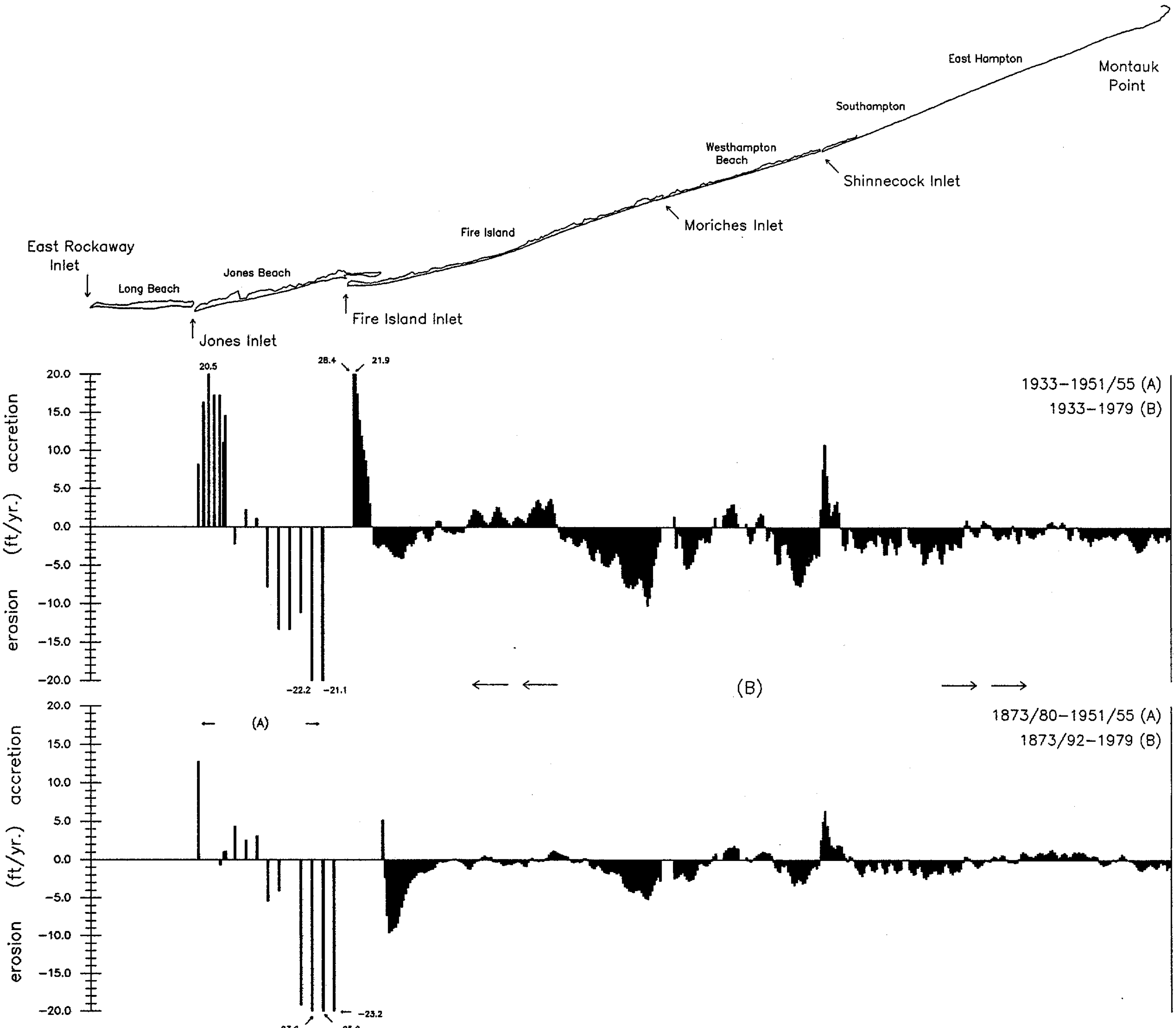
In addition to the Corps-related work, there have been a number of other studies and reports done on the south shore by various groups and individuals. For the most part, these studies focus on specific, relatively small sections of the coast during different time periods.

2.1.1. Trends in Shoreline Migration

Studies of the long-term trends in shoreline position have been conducted by Taney (1961) and Leatherman and Allen (1985). Taney compared the position of high water for various time periods using several sets of Coast and Geodetic Survey charts and U.S. Army Corps of Engineers maps and ranges dating from 1934 to 1955. Leatherman and Allen developed maps of the mean high tide shoreline based on Coast and Geodetic Survey charts and aerial photographs, and compared the shoreline position for four time periods (1834/1838, 1873/1892, 1933, and 1979) to calculate annual recession/accretion rates for the area east of Fire Island Inlet. Data from these two studies are plotted together in Figure 2-1. However, there are problems in interpreting this data on long-term shoreline position changes which are discussed in Tanski and Bokuniewicz (1989b).

Data on the short-term fluctuations of shoreline positions have been developed for a limited number of locations where subaerial beach profiles had been surveyed at least several times per year (Jones Beach Island, Ocean Beach, Fire Island Pines, and East Hampton). An examination of the available profile data indicated that the maximum annual horizontal variations in the mean sea level intercept for individual profiles ranged from 148 feet to 270 feet (with an average value over a decade of 183

Figure 2-1 - *Annualized long-term rates of shoreline recession (-)and accretion (+) .* **(A)** *- data from Taney(1961)* **(B)** *- data from Leatherman and Allen (1985).*



feet), and the mean annual range varied from 100 feet to 169 feet (with an average value over a decade of 122 feet) at the different locations.

The uncertainty associated with the calculated long-term annual recession/accretion rates due to the interannual variations in shoreline position derived from the profile data is shown in Figure 2-2. The maximum and average range of annual shoreline position (as indicated by horizontal changes in the mean sea level intercept) divided by the number of years in the associated period of record are indicated by the boxes at the four locations. As can be seen, the average short-term variations can account for shoreline change rates of ±1 to ±7 feet per year depending on the location and time period. With the data presently available, reliable estimates of the long-term changes can only be established if they exceed the magnitude of these short-term variations.

2.1.2 Shoreline Changes Due to Storms

Quantitative data on the response of the shoreline to storm events are extremely limited due to the paucity of measurements during periods of storm activity. Morton et al. (1986) in a study on Jones Beach Island analyzed beach volume changes based on comparisons of sequential, subaerial profiles for eight storms occurring between 1968 and 1971. Although the shoreline response was variable along this stretch of the coast, they found that winter storms consistently reduced the volume of sand on the subaerial beaches with losses of sand ranging from 4 cubic yards per foot of beach to 21 cubic yards per foot. However, they also reported that these volume losses were nearly completely recovered within one month of the storm activity. DeWall (1979) reported similar results for Westhampton Beach indicating that the rapid storm recovery of the subaerial beach is typical of the south shore beaches. This phenomenon was primarily attributed to natural onshore transport of sediment and the relatively low frequency of occurrence of storm waves in the area (Morton et al. 1986).

No quantitative information on storm-induced changes of the beach below mean sea level are available due to the lack of sequential surveys extending offshore.

2.1.3 Volumetric Shoreline Changes/Sediment Budgets

A total of 135 profiles were analyzed to develop the sediment budget for the 1955-1979 period. For the area east of Fire Island Inlet, long-term data on the total net annual shore volume change and net longshore transport are plotted in Figure 2-3; Figure 2-4 shows the net annual volume changes for the portions of the shoreline above mean water, in the intertidal zone and between mean low water and -24 feet MLW. The data show, for example, that the large increase in the longshore drift at Fire Island Inlet appears to be due to the reworking of the old Fire Island Inlet ebb tidal delta to the east of the inlet. Unfortunately, similar information for comparative time periods has not been developed for the shoreline west of Fire Island Inlet.

Information on seasonal and short-term volumetric changes is limited to those few areas described previously where regular beach profile monitoring programs have been undertaken. In addition, the New York State Disaster Preparedness Commission Scientific Advisory Committee has been monitoring a portion of eastern Jones Island by surveying the position of the drift line since 1985 in connection with the emergency threat posed by shore erosion to Ocean Parkway (Lehman 1988). It is important to note that such studies have only involved measurements of the subaerial beach. As a result, they do not provide information on changes occurring below mean sea level, where most sediment transport occurs.

2.1.4 Dune Morphology and Dynamics

No systematic studies of dune morphology have been done for the area even though much of the data needed to develop this information could be obtained from available topographic maps. Changes in dune morphology could also be obtained by digitizing contours on large scale topographic maps surveyed in 1955 and 1979, but the changes are likely to be small and uncertain.

A study of the aeolian sediment budget for shores east of Fire Island Inlet was done by McCluskey et al. (1983). The volume of sediment transported by aeolian processes for the entire area was calculated to be on the order of 250,000 cubic yards per year with over 90 percent of this transport occurring seaward of the dune (or shore parallel ridge) crest and in an easterly direction. Based on sand trap data, the amount of sand transported across the crest of the dune from the seaward direction was estimated to be approximately 0.08 cubic yards per foot of dune per year. This volume comprised less than 1 percent of the bulk of a *prototype* dune having a volume of 37 cubic yards per foot.

2.1.5 Effects of Structures

The locations of 69 groins and jetties in the study area are plotted in Figure 2-5. The highest concentration of groins is on Long Beach, which has a total of 43. Impacts of concern associated with these structures include the amount of sand trapped by the structures, the amount of sand bypassing the structures, and the degree of downdrift erosion they cause.

The effects of the Westhampton Beach groin field are evident in the data on long-term shoreline changes (Figure 2-1) and the net volume changes (Figures 2-3 and 2-4). The sediment budget data indicate the coastal compartment containing the groins gained an average of 190,000 cubic yards per year (8 cubic yards/foot/year) between 1955 and 1979 with a considerable portion of this increase (about 78,000 cubic yards per year) occurring below MLW. Downdrift of these structures there was an average loss of 55,000 cubic yards per year (4 cubic yards/foot/year) with most of the loss occurring below MLW. The amount of sand actually bypassing these structures is not known. Although estimates could probably be derived from a more detailed analysis of the data used in the sediment budget

Figure 2-2 - *Maximum and average annual variations in the mean sea level intercept based on surveys at selected locations.*

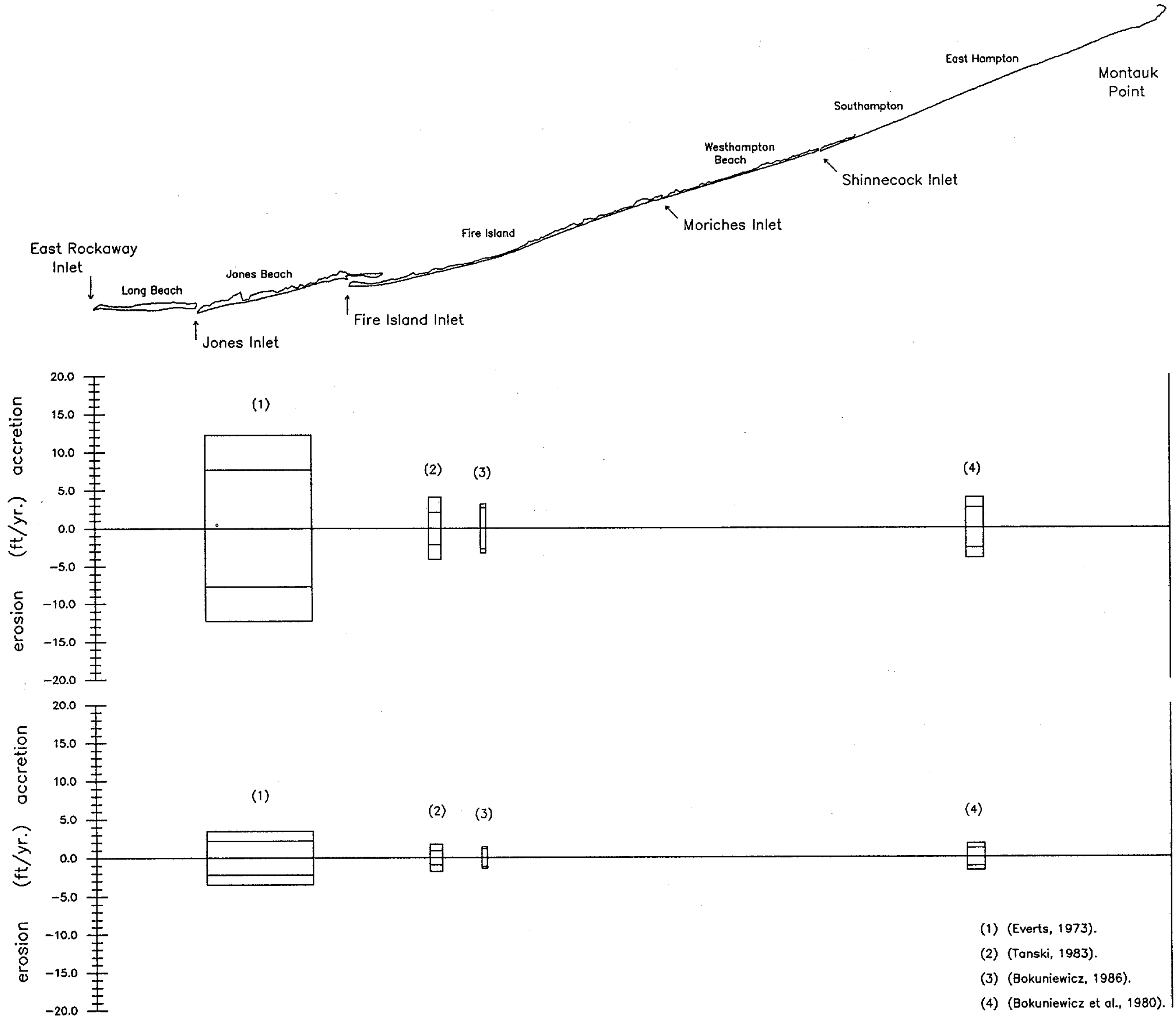


Figure 2-3 - *Annualized net longshore transport rates and net shoreline volume changes for period 1955 -1979 from sediment budget study (Research Planning Institute Inc. 1985).*

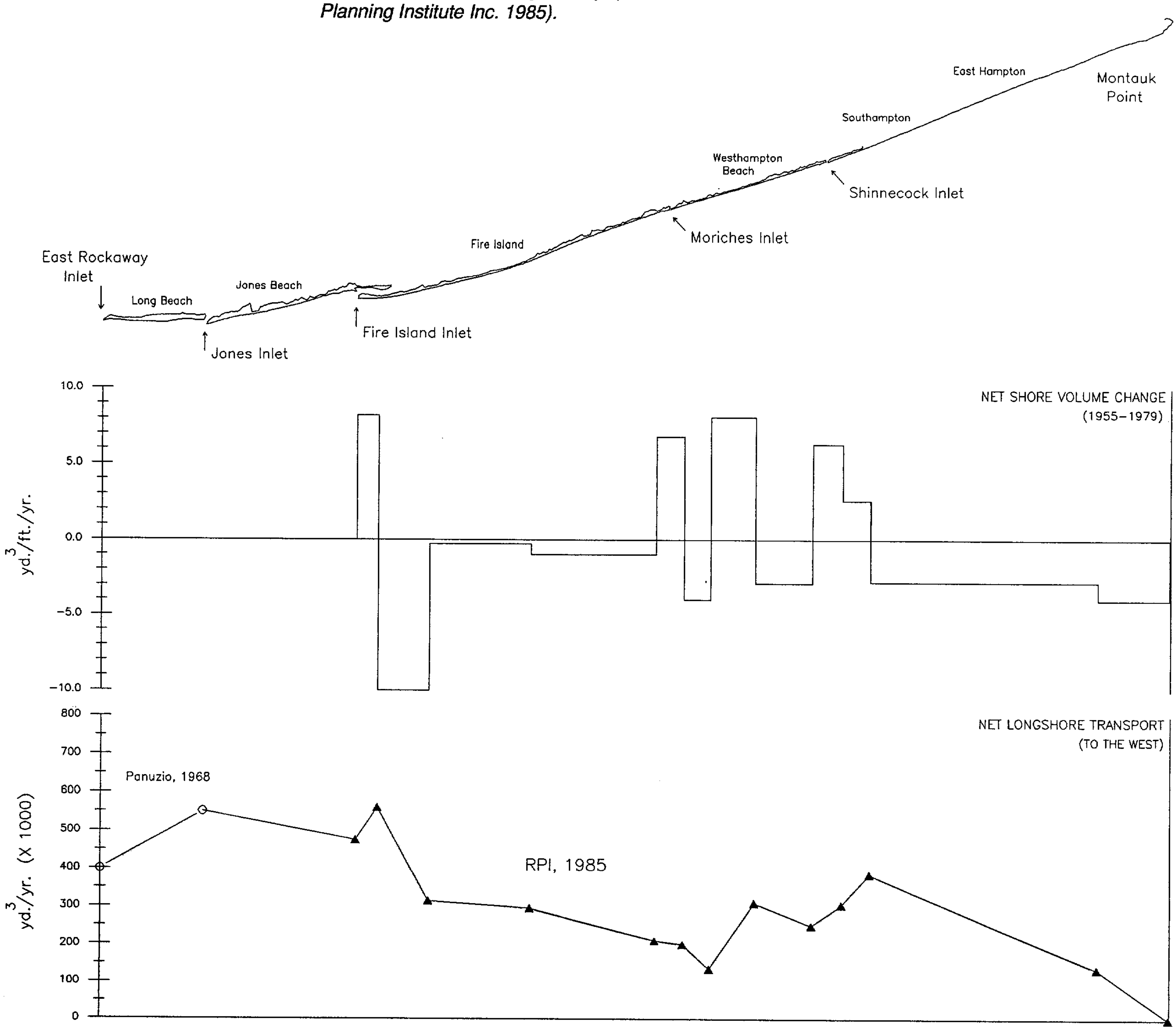


Figure 2-4 - *Annualized net shoreline volume changes by lens and total net change (Research Planning Institute Inc. 1985).*

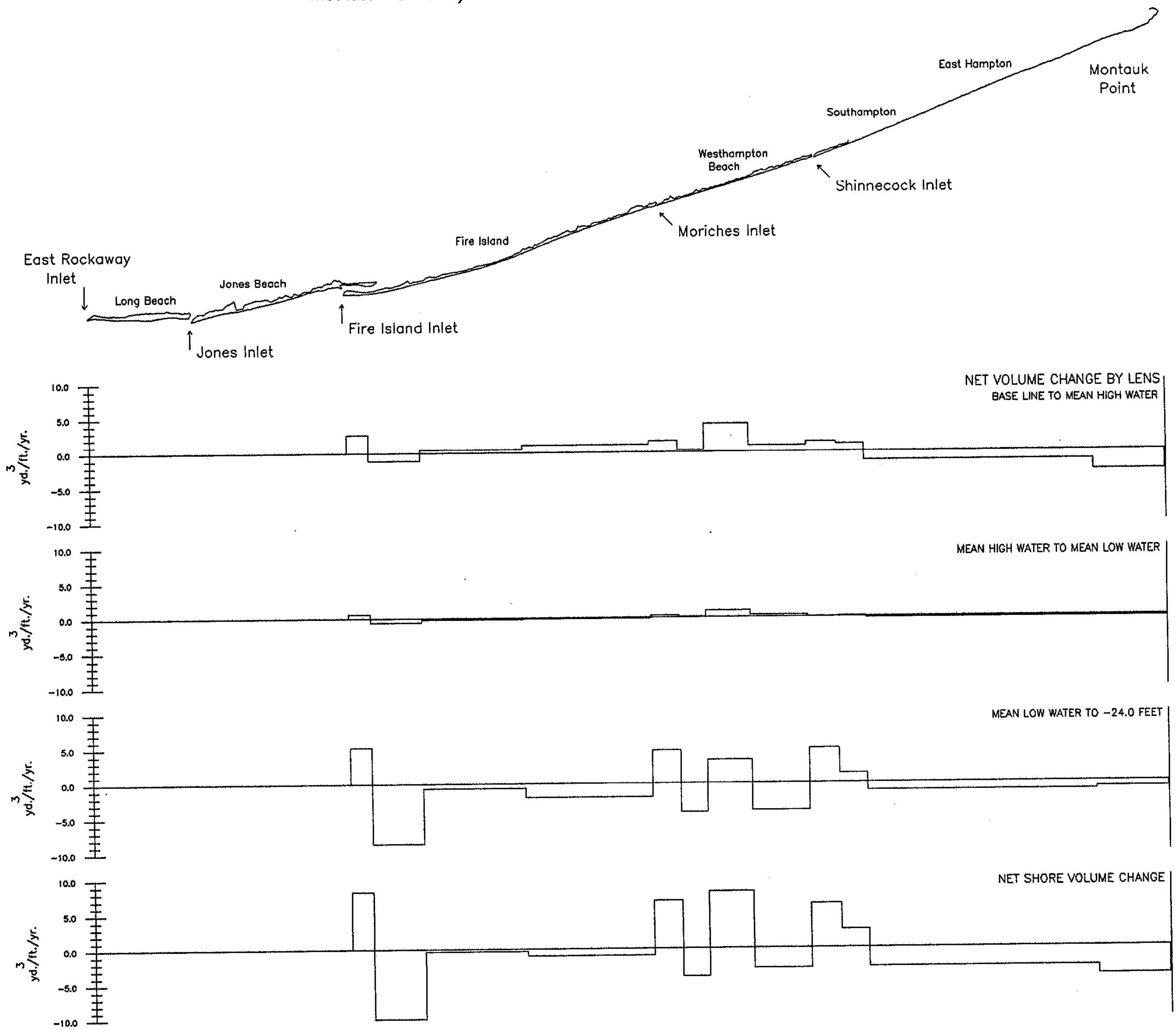
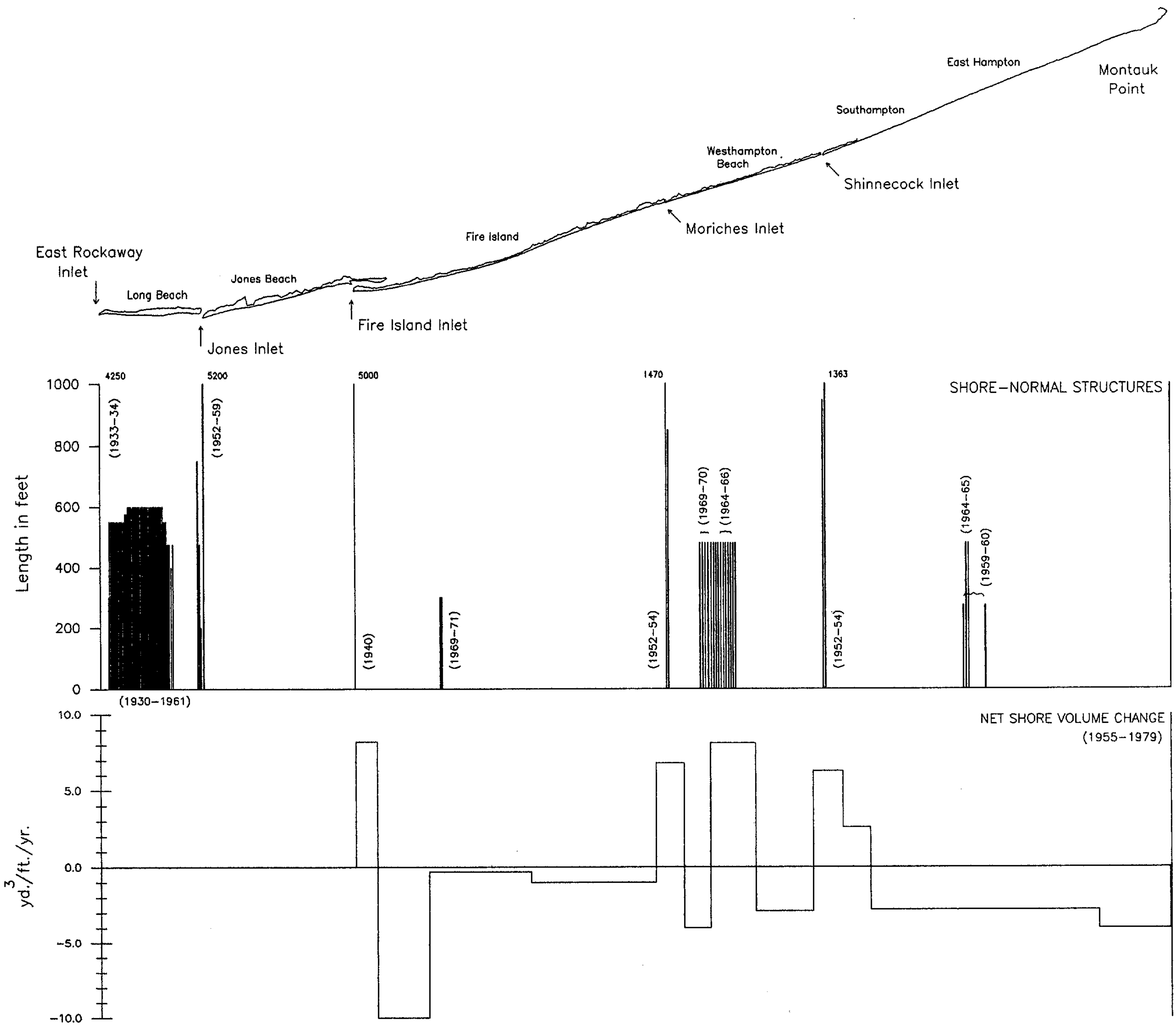


Figure 2-5 - *Locations , dates of construction and approximate lengths of groins and jetties in the study area.*



and from Corps records and surveys, such calculations may not reflect the current conditions, since the efficiency of sand trapping and the rate of bypassing would be expected to change as the structures age.

The locations of all of the inlets in the study area have been fixed as a result of jetty construction. Shinnecock and Moriches Inlets are both stabilized with pairs of jetties that were constructed between 1952 and 1954. Fire Island, Jones and East Rockaway Inlets are each stabilized with single jetties on the east (updrift) side of the respective inlets. These jetties were constructed in 1939-1944 at Fire Island; 1953-1959 at Jones Inlet; and 1933-1934 at East Rockaway Inlet (Panuzio 1968). Evidence of the impacts of the stabilization of the inlets on the down drift shoreline can also be seen in Figures 2-1,2-3, and 2-4.

Little data on the impacts of shore parallel structures built on Long Island's south shore, e.g., revetments, seawalls, are available. In fact, the location and extent of these structures along the shoreline have not been documented. However, the effects of structures on the overall sediment budget are probably small in that portion of the study area east of Jones Inlet, given that structures cover only a small stretch of the total coast (estimated to be 3 to 5 miles).

In the East Hampton area, revetments are usually almost entirely buried with sand and do not influence short-term beach changes. They have been effective in preventing inland erosion during severe storms (Bokuniewicz et al. 1980). Here and in other places on the eastern part of the shoreline, old bulkheads have occasionally been exposed by unusually severe erosion. These structures were apparently built several decades ago (presumably in response to local erosion), subsequently buried with sand and forgotten until uncovered by recent storm events.

As part of the sediment budget study, Research Planning Institute examined Federal, state and local records in an effort to identify dredge and fill projects undertaken along the shoreline east of Fire Island Inlet between 1955 and 1979. Although substantial amounts of fill were added to the beach (an estimated 12 million cubic yards over the 24 year period), it appears most of the material was dredged from the back barrier bays and placed on the beach. In many cases, the primary objective of these activities was probably dredged material disposal rather than beach nourishment. Precise information on the boundaries of the disposal areas was often lacking. Figure 2-6 indicates the volume added to the different compartments by these projects in terms of cubic yards per foot of a beach per year for the period 1955 to 1979.

As part of a combined inlet navigation and beach erosion control project, approximately 7 million cubic yards of sand dredged from Fire Island Inlet were placed on feeder beaches located approximately 1 mile west of the inlet on Jones Beach in 5 separate projects between 1959 and 1977 (Galvin 1985). However, dredging activities were suspended until the potential effects of this activity on erosion on the north side of the inlet could be studied. During this hiatus the downdrift beaches experienced severe erosion. Two emergency dredging projects in 1985 and 1987 resulted in a total of about 1.2 million cubic yards of sand being placed offshore of Jones Beach in waters 16 feet deep. In 1988/89 approximately 1 million cubic yards of sand was dredged from the vicinity of the inlet and placed at Gilgo Beach. The data for this area plotted in Figure 2-6 represent approximate volumes and locations of the fill projects.

Corps records (U.S. Army Corps of Engineers 1966) show that approximately 550,000 cubic yards of material dredged from the bay were placed on Long Beach between 1959 and 1962. However, recent information on the history of fill projects along this segment has not been compiled or summarized. These data may be contained in a Corps report scheduled for future release.

Detailed monitoring information on dredge and fill operations in the study area is not readily available. Additional effort would be needed to prepare a meaningful analysis of the performance of the various fill projects.

2.1.6 Wave Climate

Data on direct measurements of the wave climate are extremely sparse. In situ wave gauge data are either short in duration, not available or non-existent (Morton et al. 1986). One non-directional gauge that operated intermittently between 1950 and 1954 at several locations in the area of Jones Beach, indicated waves higher than 6 to 10 feet occurred less than 1% of the time, and a maximum wave height of 13.4 feet (Panuzio 1968).

The only directional, long-term near shore wave measurements available for the study area are visual observations collected at several points along the shore including Jones Beach, Fire Island, Westhampton, and Southampton. Some of these observations were made as part of CERC's Beach Evaluation Program in the 1970's. Unfortunately these data have not been summarized for the entire study area. Twenty-year hindcasts of the shallow water wave climate done as part of CERC's Wave Information Study are also available for 10 mile segments along the entire south shore (Jensen 1983). The average and largest significant wave heights from this data set are plotted in Figure 2-7. It is emphasized that the hindcast data do not take into account waves associated with tropical storms. Hindcasts may be adequate for some design needs or 2-dimensional shore models, but their use in other applications may be limited. The only way to improve this information would be to install at least two directional wave gauges in the study area; one in the east and one in the west.

For project design, the Corps of Engineers uses deepwater wave statistics from a number of sources. Based on these data, a design wave for hurricane conditions with a deep water wave height of 17 feet (20 foot breaking wave) and a period of 13 seconds, which has an exceedance probability of 1 percent, was

Figure 2-6 - *Annualized fill placement and net volume change (1955-!979)*

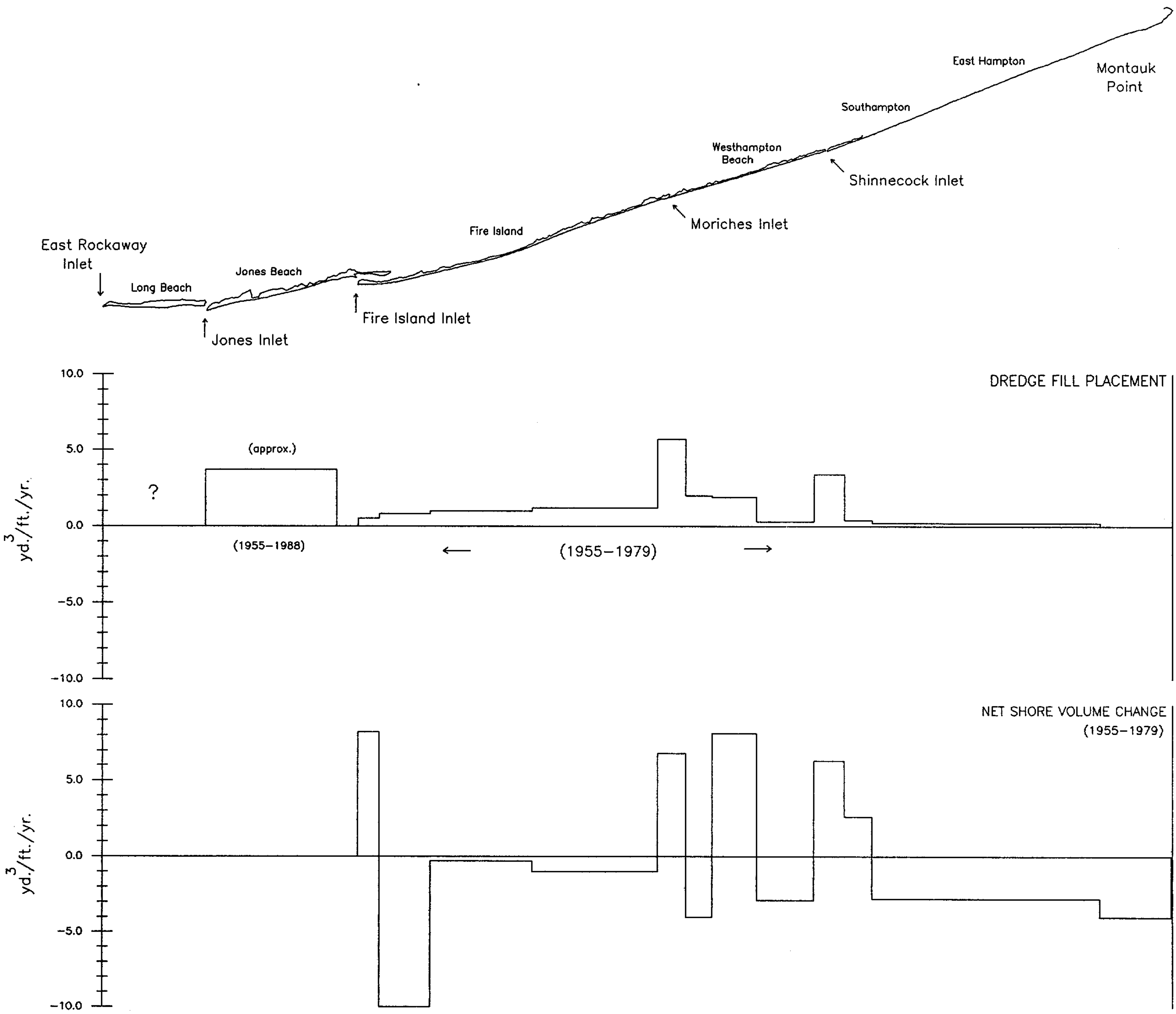
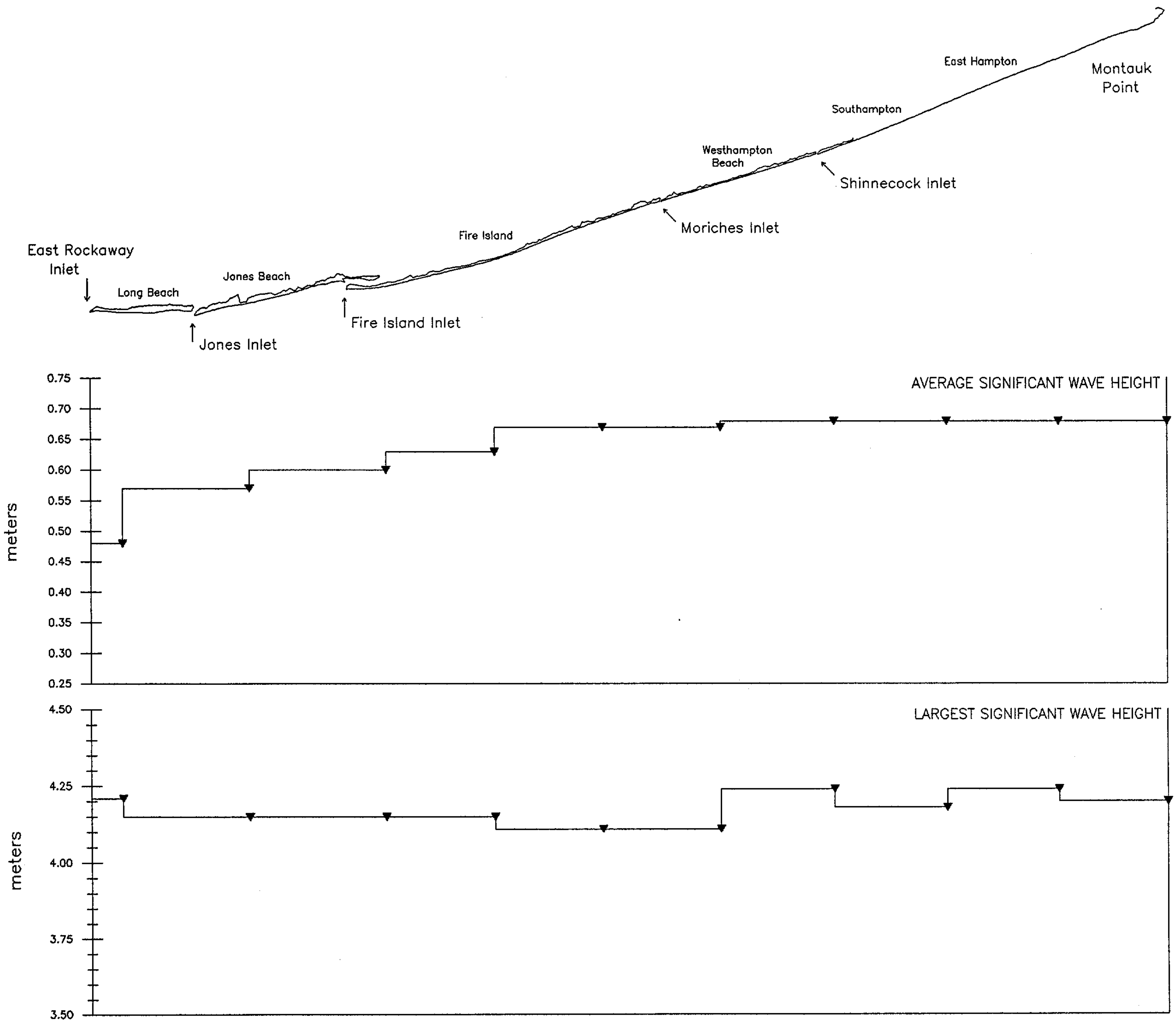


Figure 2-7 - *Significant wave heights based on Wave Information Study 20-year shollow-water wave hindcast data (Jensen 1983)*



selected for Westhampton Beach (U.S. Army Corps of Engineers 1980).

2.1.7 Sea Level Rise

Long-term tide gauge records in both New York Harbor and New London, CT, indicate an average rise in sea level on the order of 0.01 feet per year. Since these gauges are on bedrock, it is likely that the relative rise on Long Island may be somewhat higher due to compaction and subsidence. There are no accurate estimates of relative sea level rise available for the area.

According to McCormick (1973) sea level rise may not play a significant role in controlling erosion on the south shore. As part of the sediment budget study (Research Planning Institute, Inc. 1985), the Hands (1982) model was applied to estimate the possible sediment loss resulting from profile readjustments in response to a sea level rise of 0.01 feet per year. The results of this analysis in terms of annualized volume losses per foot of shoreline for the portion of the profile above and below MLW are plotted in Figure 2-8. These changes are for the most part much less than the total net volume changes reported in the study. In addition, there is evidence that offshore sources contribute sand to the near shore sediment budget (McCormick and Toscano 1980; Research Planning Institute 1985; Niedoroda et al. 1985; Williams and Meisburger 1987) indicating that the Bruun Rule (upon which the Hands model is based) may not be applicable in this area (Wolff 1982). If this is the case, even the relatively small volume losses caused by sea level rise shown in Figure 2-8 may be overestimates. In the absence of profile readjustment, Morton et al. (1986) estimated that in the Jones Beach area, the present observed rate of sea level rise over a period of 10 years would result in a landward displacement of the waterline of approximately one foot (0.1 feet per year). The degree to which sea level rise contributes to the total erosion occurring along the south shore is of secondary importance in comparison to other processes operating in the area, especially when considered in the context of this program's 35 year planning horizon.

A number of studies, such as Wolff, Radcliffe and Merguerian (1987), indicate that global warming caused by the *greenhouse effect* could result in an accelerated rate of sea level rise in the future. However, the timing and magnitude of future sea level rise are uncertain. While a detailed review of the causes of sea level rise is not in the scope of this study, it should be pointed out that global warming could also dramatically alter the frequency of severe storms in the North Atlantic region. Warmer ocean temperatures could shift the location of tropical cyclone genesis to higher latitudes. This could result in an increase of hurricane frequency and intensity in the Long Island area over the long-term.

A National Research Council (1987) study of the engineering implications of sea level rise examined three possible sea level rise scenarios to the year 2100; rises of 0.5 m, 1.0 m and 1.5 m. According to most projections, the increase in the rate of sea level rise, if it occurs, will not occur in a linear fashion. Rather, the change will start slowly and increase more rapidly in the distant future. Based on the National Research Council projections, accelerated sea level rise could increase present water level elevations along the south shore 4 to 5 cm (0.13 to 0.17 feet) by the year 2000 compared to an increase of 2.5 cm (0.08 feet) if the present rate of sea level rise continues. By the year 2025 the increase due to atmospheric warming could be 13 to 24 cm (0.42 to 0.75 feet), while the expected increase if present conditions persist would be about 8 cm (0.25 feet). For 2050, an accelerated sea level rise could result in water elevations 41 to 50 cm (1.3 to 1.8 feet) higher than present compared to an increase of 26 cm (0.5 feet) under current conditions. While the rate of sea level rise may increase more rapidly beyond 2050, these projections, already subject to a great deal of uncertainty, become less reliable with time. Because of these uncertainties, a rigorous assessment of the management implications of future sea level rise is required.

To account for potential increases in the rate of sea level rise, it was suggested the present rate could be doubled or tripled for erosion management purposes. However, even this increase would probably have a relatively small impact on the observed rate of erosion compared to the magnitude of shoreline changes caused by storms and disruptions in the nearshore sediment transport systems resulting from man's activities.

2.1.8 Storm Surges and Tides

Mean tide ranges and still water storm surge elevations for the 10, 50, and 100 year storms are plotted in Figure 2-9. Models that incorporate wave run up and beach and dune dynamics to determine storm surge penetration in coastal areas are of more value for planning purposes than models that only calculate still-water storm-surge elevations. The Corps of Engineer's Sea, Land, and Overland Surges from Hurricanes (SLOSH) model results are done for the New York Basin. These model results are accurate descriptions of the storm surge elevations which can be expected from hurricanes of various sizes and intensities.

2.1.9 Longshore Sediment Transport

Estimates of the net rate of longshore sediment transport based on the Research Planning Institute (1985) sediment budget study are shown in Figure 2-3. Estimates of the gross longshore transport and relative volumes moving east and west are also extremely important, especially for inlet areas where local deviations can be large and the direction of net drift can reverse due to changes in wave conditions. Although attempts to calculate these values based on available wave statistics have been made, the results have not agreed with the estimates obtained by using measurements of sand impoundment at structures and/or inlet migrations. More data and information on wave

Figure 2-8 - *Estimates of annualized net sediment loss by lens due to sea level rise and total observed net volume changes for the period 1955-1979 based on data from (Research Planning Institute ,Inc. 1985).*

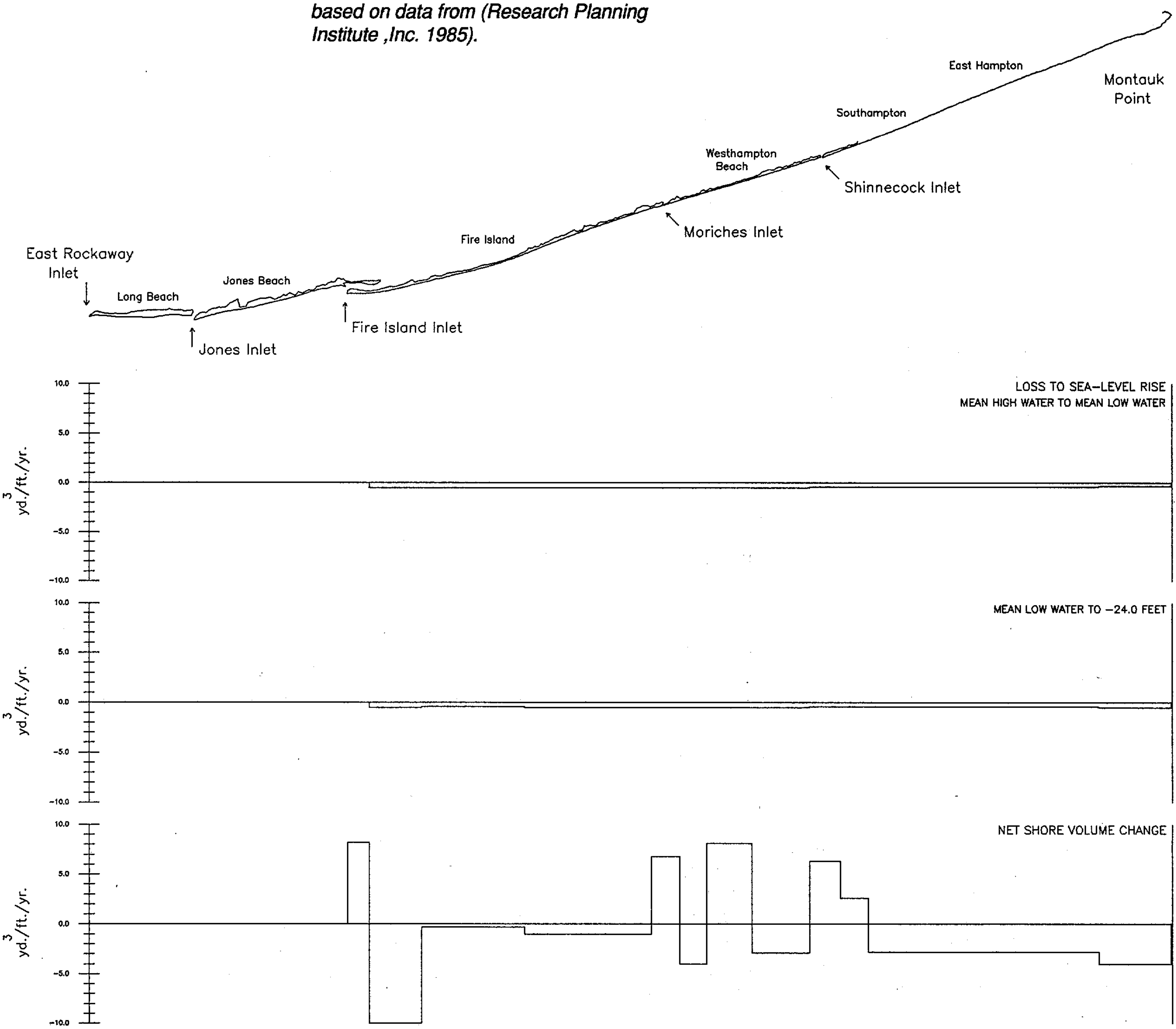
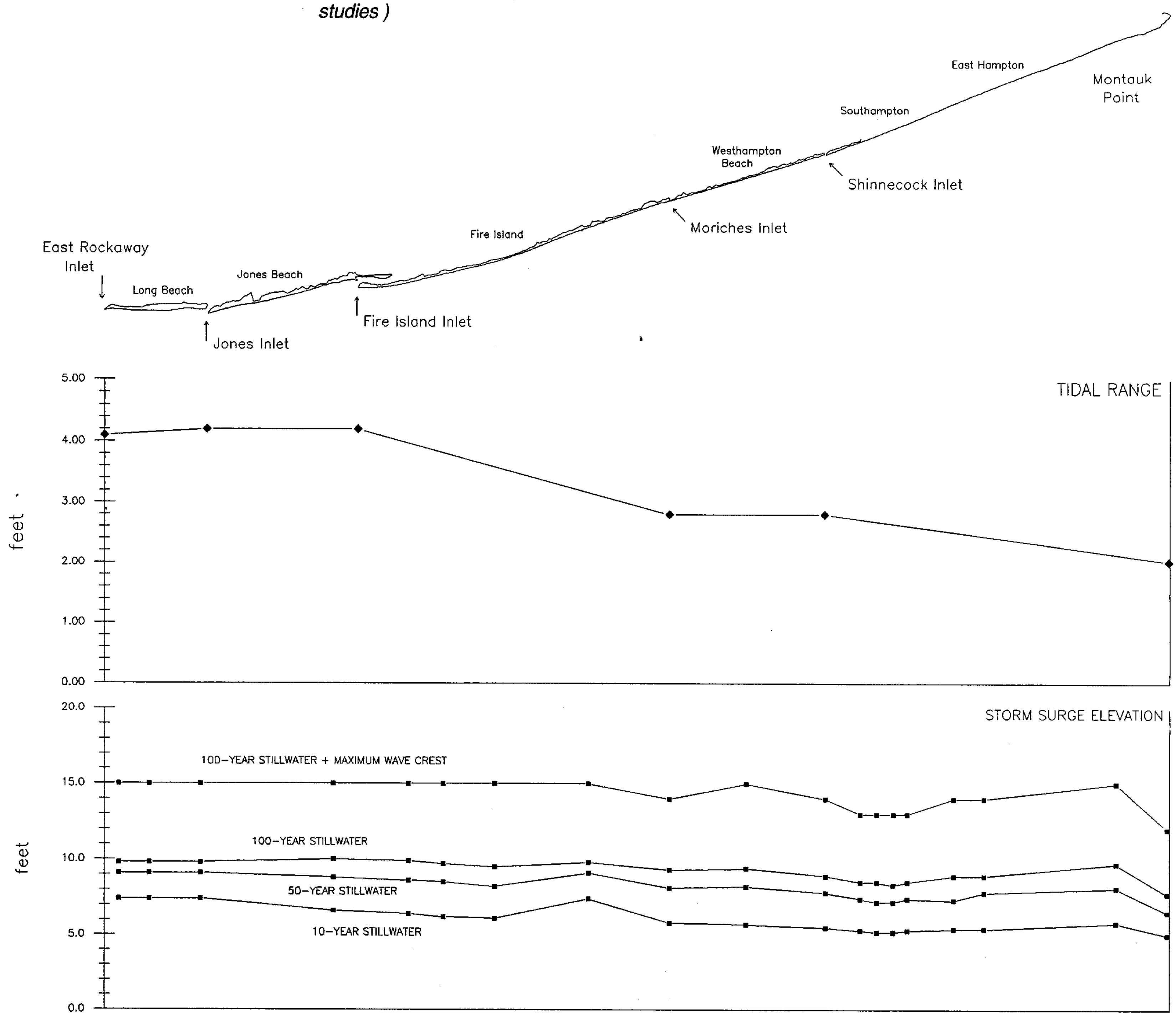


Figure 2-9 - *Mean tidal ranges and storm surge water level elevations for 10, 50, and 100-year storms (based on FEMA flood insurance studies)*



characteristics along the south shore are needed to develop reliable estimates.

2.1.10 Cross-shore Sediment Transport

Sediment exchange between the shore face and inner continental shelf does occur, but more data are needed to develop quantitative estimates of the onshore transport of sand. A single offshore bar located about 500-1500 feet offshore with a crest 10 to 15 feet below NGVD is present along much of the coast between Fire Island Inlet and Montauk Point. Although two short-term, site-specific studies of this feature have been undertaken at East Hampton (Shipp 1980) and at Fire Island (Allen and Psuty 1987), the scale and variation in bar morphology and the effects of bar geometry on the shoreline have not been documented. Pre-and post storm profiles along the coast may be especially useful in defining the behavior of the offshore bar and sediment transport patterns.

2.1.11 Inlet Processes

The five inlets in the study area exert a dominant influence on the coastal changes occurring along the shore. As can be seen in the plots of long-term shoreline recession/accretion rates (Figure 2-1) and, to a lesser extent, the plots of volume changes (Figures 2-3 and 2-4), the most dramatic variations are associated with inlets. With the exception of the Westhampton groin field, the most acute erosion problems are the result of the interruption of sand transport patterns and inadequate sand management practices at inlets.

The amount of sand bypassing occurring at the inlets is of critical importance in determining the effects of these features on shoreline erosion. While estimates of the bypassing taking place at the various inlets have been made (Table 2-1), the accuracy of these figures is somewhat questionable due to the paucity of data.

For the most part, south shore inlet dredging projects are done in response to navigation needs, rather than for erosion control purposes. There is no program of regular artificial sand bypassing. At Shinnecock and Moriches Inlets most of the dredging work has focused on maintaining channels through the flood tidal deltas bayward of the inlet channels, and much of the resultant dredged material has been placed on the emergent portion of the flood delta (Kassner and Black 1982). The only dredging in the channel or seaward of the channel at Shinnecock Inlet since its position was fixed by jetty construction was the emergency removal of 162,000 cubic yards of material in 1984 (U.S. Army Corps of Engineers 1987) and 83,000 cubic yards in 1988. This sand was placed offshore at a depth of 10 feet below MLW downdrift of the inlet. No dredging in the channel or seaward of the channel has been done at Moriches Inlet since it was stabilized in the 1950's. The inlet has been legally closed to navigation for a number of years due to severe shoaling conditions.

TABLE 2 -1

Estimates of Inlet Bypassing.

Inlet	*Net Longshore Transport (cu. yds./yr)*	*Amount Bypassing (cu. yds./yr.)*
E. Rockaway	400,000a	150,000[b]
Jones	550,000[a]	100,000[b]
Fire Island	600,000[c]	?d
Moriches	304,500[c]	250,000[c]
Shinnecock	300,000[e]	247,000[e]

Sources:

[a]Panuzio (1968);
[b]U.S. Army Corps of Engineers (1966);
[c]Research Planning Institute, Inc. (1985);
[d]Galvin (1985); and
[e]U.S. Army Corps of Engineers (1987).

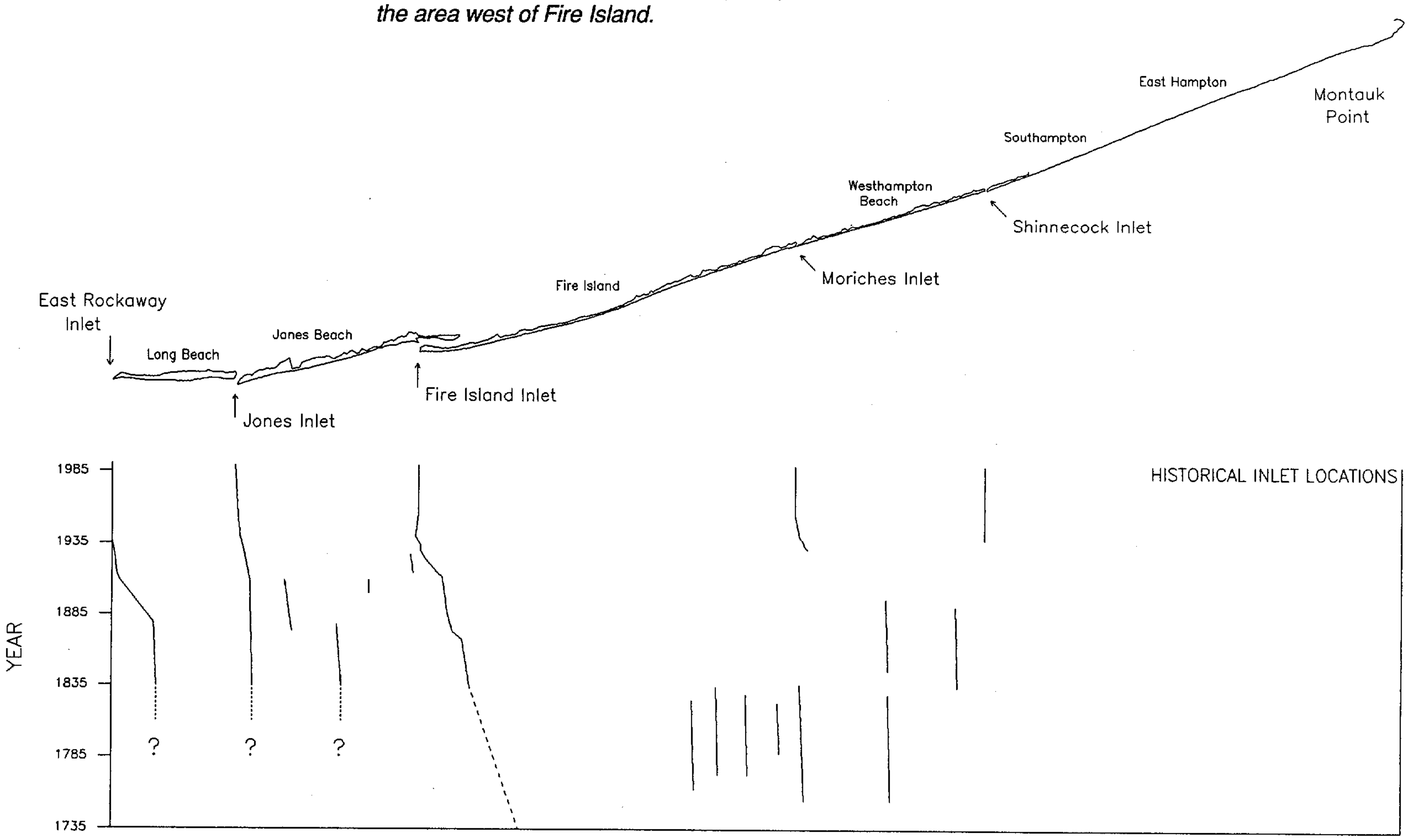
The recent dredging history of Fire Island Inlet was previously described in the section on the effects of structures. Some 8 million cubic yards of material have been dredged from the inlet and placed on the downdrift beaches or in the nearshore area in six separate projects undertaken between 1954 and 1989.

Inlets function as large sinks of sand in the near shore system. The ebb and flood tidal deltas associated with Moriches trapped 1 to 2 million cubic yards of sand with most of this material stored in the ebb tidal delta (Research Planning Institute, Inc. 1985). Although not quantified, similarly large ebb tidal deltas are also associated with the other inlets in the area (Leatherman and Allen 1985).

The impacts and processes associated with the inlets are variable with time. Because of their complexity and importance in the coastal sediment system, detailed sand budgets are needed for each of the inlets. The amount of sand naturally bypassing the inlets and the volume of the flood and ebb deltas and their rates of change should be documented. This information should be used to construct models of local inlet behavior which can be used to guide management decisions.

The locations of historical inlets along the eastern section as suggested by Leatherman and Allen (1985) are shown in Figure 2-10. According to their geomorphic analysis, sediment transport associated with inlet creation is an important process in the migration of the eastern section of the barrier system (between Southampton and a point about 10 miles west of Moriches Inlet). The inlet formation and sediment transport processes that drive barrier migration in this section operate intermittently at 50-75 year intervals. The central and western sections of the Fire Island have been axially stable for hundreds of years (Leatherman and Allen 1985). From a management standpoint, the relative stability of the barrier island over long time periods indicates that concerns regarding disruption of barrier island migration by inlet processes may be of secondary importance compared to the other more immediate impacts

Figure 2-10 - *Location of historical inlets based on data from Leatherman and Allen (1985) for area east of Fire Island Inlet and Taney (1961) for the area west of Fire Island.*



importance compared to the other more immediate impacts associated with the formation of new inlets.

Site-specific information on the potential impacts of new inlets along the south shore is largely limited to one modeling study (Pritchard and DiLorenzo 1985) which was done in response to a breach that occurred in 1980 just east of Moriches Inlet. This breach grew to a width of 2900 feet before it was artificially closed one year after it opened (Schmeltz et al. 1982). The results of the modeling suggested that a large breach would increase normal tidal ranges in Moriches Bay by about 60 percent and short-period (hurricane) storm water level elevations by 35 to 40 percent. The modeling study also indicated that the tidal exchange between Moriches Bay and the ocean is not great enough to maintain two inlets indefinitely. The shoaling problems presently occurring at Moriches and Shinnecock Inlets tend to support this finding. Although reliable estimates of the potential lifetimes and possible closure rates of new inlets are not available, the formation of new inlets could adversely affect shoaling rates at the existing inlets due to limited tidal flow.

No known studies have focused on the possible effects of new inlets on shoreline erosion. It is reasonable to infer that these features could have significant impacts in terms of accelerated downdrift erosion. About 750,000 cubic yards of material from the longshore sediment system were trapped on the flood tidal delta of the Moriches breach during the 11 months it was open (Research Planning Institute, Inc. 1985). The loss of such large volumes of material from the near shore sediment budget can result in significant downdrift shoreline changes.

2.1.12 Overwash Processes

Based on the sediment budget study, only about 35,000 cubic yards of sediment per year are moved by overwash processes east of Fire Island Inlet, indicating this mechanism is a minor agent in terms of overall sediment transport. Annual overwash volumes (cubic yards per foot) for different sections of the coast are shown in Figure 2-11 for the period 1955-1979. The importance of overwash depends on the migration rate of the barrier island. Since Long Island's barriers are relatively stable as compared to those along the south Atlantic coast, overwash processes are probably not that important especially in terms of management time scales of 30 to 50 years.

2.1.13 Bluff Erosion

The volume of material contributed to the longshore sediment system by bluff erosion in the eastern headlands section of the south shore is small. Based on historic shoreline recession rates, bluff elevations and subtidal volume changes, the sediment budget study indicated that 133,000 cubic yards of sediment per year are derived from erosion along the bluff section of the coast (Research Planning Institute, Inc. 1985). However, not all of this material is moved to the west in the longshore transport system. Because of the varied composition of the bluffs, only a portion of the material released by erosion of these features is transported by littoral processes. The larger fraction of the material remains in place, while the finer sediments are dispersed offshore. In addition, the inhomogeneities in the composition of the bluff also result in an irregular shoreline, further complicating estimates of longshore transport. The geomorphic configuration of the headland and orientation of numerous pocket beaches in this area indicate the longshore transport of material to the west is probably significantly less than the volume derived from erosion processes. Although more information on bluff composition and actual bluff recession rates (rather than shoreline recession rates) is needed, it is estimated that the actual total contribution from the bluff section of coast to the longshore transport system is on the order to 20,000 to 40,000 cubic yards per year, or less than 10 percent of the transport estimated to occur at Fire Island Inlet.

2.2 Natural Resources Inventory

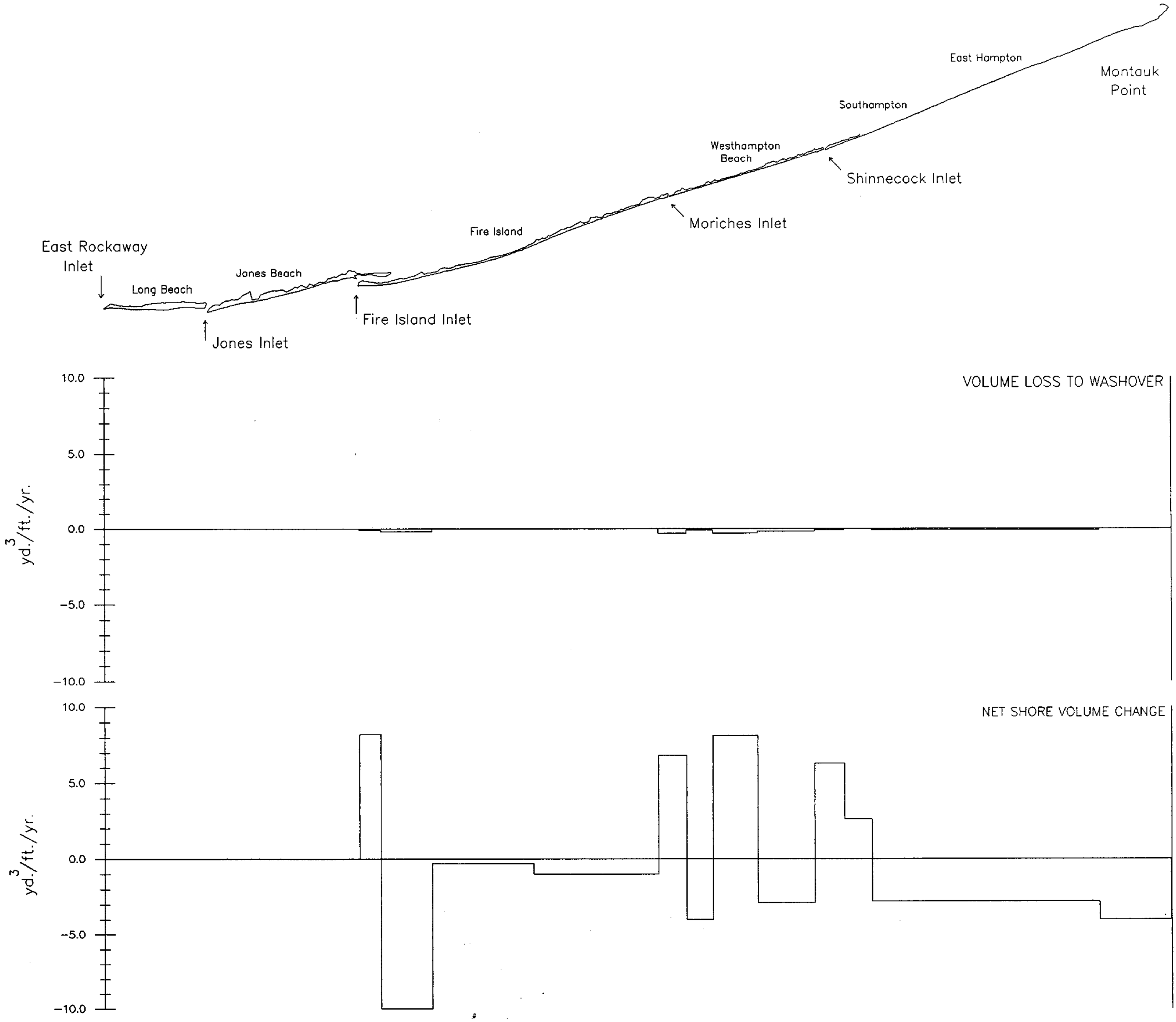
Long Island south shore natural resources are shown on a series of 18 Natural Resources maps at a scale of 1" = 2000' included in this chapter. The development of this map series constitutes an update of the Natural Resources Inventory Map series completed as part of the *Long Island Regional Element New York State Coastal Management Program* (Long Island Regional Planning Board 1979)

Mapping units were divided into the following categories: freshwater wetland, tidal wetland, forest, maritime flora, dunes, beach, old field, farmland, bluff and developed areas. Sources of information for the 1979 map series for areas other than the South Fork were April 1976 aerial photographs (scale 1" = 1000') flown by the Aerographics Corp. of Bohemia, N.Y. and staff field checks. Vegetation information for the South Fork was obtained from the Group for America's South Fork Map Series. Sources of information for freshwater wetlands included the NYS Dept. of Environmental Conservation (NYS Freshwater Wetland Maps); Bureau of Water Pollution Control,Nassau County Health Dept.; and Town of Hempstead Dept. of Conservation and Waterways. Tidal wetland information was obtained from the Town of Hempstead Dept. of Conservation and Waterways and NYS Dept. of Environmental Conservation (NYS Tidal Wetland Maps).

Tidal wetlands were mapped as one unit that included low marsh, intertidal marsh, high marsh, and coastal fresh marsh. Freshwater streams, tidal streams, ponds, lakes, estuaries, bays, and other surface waters were also delineated on the maps. In addition, New York State Designated Significant Fish and Wildlife Habitats (New York State Dept. of State 1987) were identified in this updated map series.

Whenever there was an overlap between two mapping units, the predominant feature/characteristic was represented; for example, the presence of bluffs took precedence over vegetation, dunes took precedence over maritime vegetation, etc. Transitional areas, such as formerly connected tidal wetlands and

Figure 2-11 - *Annualized volume losses due to washovers for the period 1955-1979 from (Research Planning Institute, Inc. 1985)*



drained freshwater wetlands, are represented as they appear on the aerial photos unless more specific site information was available.

Certain dredge spoil sites, particularly those located on islands within the coastal embayments, were initially mapped as developed areas in 1976. However, there are no structures, etc., on these sites and a clarification of these maps was necessary. Therefore, if the site had maritime shrubland, or tidal wetland (whether sparsely or fully vegetated), etc., it was designated as such.

An update of the 1976 map series was conducted through interpretation of the aerial photographs listed below:

Town	Year	Scale
Hempstead	1980	1" = 2000'
Oyster Bay	1980	1" = 2000'
Babylon	1980	1" = 2000'
Islip	1984	1" = 1000'
Brookhaven	1987	1" = 1000'
Southampton	1988	1" = 1000
East Hampton	1988	1" = 1000'

The area updated on the 1989 maps only includes that portion of the coast south of Montauk Highway (Route 27A) in Suffolk County. In Nassau County, Merrick Road was the northern map boundary until it meets Sunrise Highway (Route 27) in Rockville Centre. Sunrise Highway was then used as the northerly boundary west to the New York City boundary. (It should be noted that the Natural Resources map series does not show a portion of the area updated near the northern map boundary in Nassau County, as well as a part of the Suffolk County mainland south of Montauk Highway.)

Overall, sections of western Suffolk County and Nassau County were almost entirely developed as of 1976 and further development was minimal during the last 13 years. The areas of greatest loss of vegetation occurred within the Towns of Brookhaven, Southampton and East Hampton.

The following discussion of natural resources is presented by embayment or area (East End) along the south shore. Table 2-2 lists the embayments/areas and their respective Natural Resources Map number(s), as well as the appropriate shoreline segment name(s) for ease of identification.

2.2.1 West, Middle and East Hempstead Bays and Oyster Bay Natural Resources

Minimal natural dune formations exist on the eastern end of Long Beach Barrier Island; virtually no dunes are evident on the western end. Although the 1980 aerial photos and natural resource maps do not indicate the presence of natural dunes, the Town of Hempstead and the City of Long Beach are involved in the creation of man-made dunes (see photos in chapter 3). Long Beach is almost entirely developed, however, a tidal wetland area exists along the back bay area of the eastern portion of this barrier island. Numerous tidal wetland islands are located within Oyster Bay, and virtually the entire area of West, Middle and East Hempstead Bays is interspersed with tidal wetland islands. The mainland area north of West, Middle and East Hempstead Bays and Oyster Bay is densely developed, although a few tidal wetlands remain intact.

The barrier beach and dune formations are predominant natural features along the Jones Island oceanfront with extensive tidal wetlands in the back bay area. This island is entirely publicly owned and has been developed primarily for recreational use.

New York State Designated Significant Fish and Wildlife Habitats within the area south of Montauk Highway include: East Hempstead Bay; Middle Hempstead Bay; West Hempstead Bay; South Oyster Bay; Silver Point Beach; Nassau Beach; Short Beach, Jones Beach State Park; West End, Jones Beach State Park; Storehouse, Jones Beach State Park; Cedar Creek County Park; and Tobay Sanctuary.

There has been no evident loss in vegetation in this area during the period from 1976 to 1980.

2.2.2 Great South Bay Natural Resources

The barrier beach/dune system is the most prominent natural feature along the oceanfront in this area. The eastern portion is undeveloped and exhibits extensive beach, dune, tidal wetlands along the back bay area, as well as tidal wetland islands scattered in Great South Bay. Large tidal wetland islands are located in the back bay areas along Jones Island to the west. Development on Fire Island is concentrated in a number of summer communities. Loss of dune formations along the oceanfront of certain communities is evident. Public recreation uses on western Fire Island and Jones Island have precluded extensive development along the oceanfront in these areas. Recent beach nourishment along certain areas of Jones Island has aided in dune building and widening of the beach. The mainland on the north side of Great South Bay contains two large river systems with extensive tidal and freshwater wetlands: Carmans River and Connetquot River. Other public holdings adjacent to Great South Bay have forested areas and tidal wetlands, but the area is primarily developed with a few parcels of maritime shrubland, old field and farmland in the eastern portion of the area.

New York State Designated Significant Fish and Wildlife Habitats within the area south of Montauk Highway include Great South Bay East, Great South Bay West, Beaverdam Creek, Swan River, Carmans River, Connetquot River, Champlin Creek, Orowoc Creek, Cedar Beach, Gilgo Beach and Sore Thumb.

TABLE 2-2.

Natural Resources Map Series - Embayment/Area, Natural Resources Map Numbers(s) and Shoreline Segment Name(s).

Embayment/Area	*Natural Resources Map Number(s)*	*Shoreline Segment Name(s)*
West, Middle and East Hempstead Bay, Oyster Bay	1, 2, 3	Atlantic Breach/Long Beach; Jones Inlet, Gilgo Beach
Great South Bay	3, 4, 5, 6, 7 16, 17, 18	Gilgo Beach; Fire Island Inlet; Ocean Beach; Central Fire Island; FINS Wilderness
Moriches Bay	7, 8, 9	Moriches Inlet; Westhampton Beach
Shinnecock Bay	9, 10, 11	Shinnecock Inlet
Coastal Ponds	11, 12, 13	Coastal Ponds
Napeague	13, 14	Napeague
Montauk	14, 15	Montauk

Continued development infilling occurred on the mainland in this area from 1976 to 1980, 1984 and 1987 (Towns of Babylon, Islip and Brookhaven, respectively). However, larger areas of natural vegetation were lost in the eastern portion of the mainland as compared to the western portion, which was almost completely developed as of 1976. Minimal losses of vegetation occurred on Jones Island and Fire Island barrier beaches during this time period.

2.2.3 Moriches Bay Natural Resources

The barrier beach/dune system is the most dominant natural feature along the oceanfront in this area. The Dune Road area in Westhampton Beach is highly developed; west of Moriches Inlet the barrier beach is undeveloped with extensive dune, beach and back bay wetlands. Significant losses of beach and dune formations are evident in the oceanfront area west of the last groin in Westhampton Beach. A few tidal wetland islands are situated within Moriches Bay. The mainland along the northern boundary of Moriches Bay provides numerous stream corridors with associated tidal and freshwater wetlands. Overall, this area is approximately two-thirds developed. The remaining undeveloped land is a mixture of farmland, old field, forest, and maritime shrubland.

New York State Designated Significant Fish and Wildlife Habitats within the area south of Montauk Highway include Moriches Bay, Smith Point County Park, Cupsogue County Park and a portion of the Quantuck Creek and Quogue Refuge Significant Fish and Wildlife Habitat.

There have been extensive losses from 1976 to 1987/88 (Towns of Brookhaven and Southampton, respectively) of vegetation on the mainland (approximately one-third of the area). Some loss of tidal wetlands has also occurred along the barrier beach, which has experienced minimal changes overall during this time period. The extensive land area in County ownership retains natural vegetation in the vicinity of Moriches Inlet and west along the Fire Island barrier beach.

2.2.4 Shinnecock Bay Natural Resources

The barrier beach with its continuous dune system is the predominant natural feature in this area. Beach width is generally consistent along the oceanfront. There are significant tidal wetlands in the back bay area of both the Quogue/Tiana and Southampton barrier beaches and several tidal wetland islands are situated in Shinnecock Bay. The Tiana Beach section of the barrier beach is in County ownership and is primarily undeveloped. The mainland area along the northerly boundary of Shinnecock Bay is predominantly developed. Some farmland and old fields exist in the Southampton area. The Shinnecock Hills area exhibits mostly maritime shrubland vegetation, and there is a scattering of forested parcels in the Hampton Bays and Quogue areas.

New York State Designated Significant Fish and Wildlife Habitats within the area south of Montauk Highway include Southampton Beach, Tiana Beach, Shinnecock Bay, Dune Road Marsh, Far Pond and Middle Pond Inlets and a portion of the Quantuck Creek and Quogue Refuge.

The greatest loss of vegetation from 1976 to 1988 occurred in the maritime shrubland category in the Shinnecock Hills area; approximately three quarters of this area is now developed. More losses in farmland occurred to the east. Major losses of forest were evident in the Quogue area. New development occurred along the dune system of the barrier beach particularly in the Quogue area south of Dune Road.

2.2.5 Coastal Ponds Natural Resources

Coastal ponds and their associated freshwater wetlands are dispersed throughout this area. It is important to note, however, that a few of these ponds are tidally influenced, and subsequently contain tidal wetland habitats as well as freshwater wetland habitats. The upland area is dominated by farmlands and the dunes along the oceanfront are narrower than in the Napeague area to the east. Small areas of forest, old field and maritime shrubland are interspersed throughout. Developed areas include portions of the incorporated Villages of East Hampton and Southampton.

New York State Designated Significant Fish and Wildlife Habitats within the area south of Montauk Highway include the Atlantic Double Dunes, Long Pond Greenbelt, Mecox Bay and Beach, and a small portion of Shinnecock Bay Significant Fish and Wildlife Habitat.

Significant losses in farmland were evident in this area from 1976 to 1988. Roughly one-third of the area was subject to new residential development in this period.

2.2.6 Napeague Natural Resources

The predominant features include the extensive dune formations adjacent to the ocean shoreline in Hither Hills and Napeague and the Atlantic double dune area of Amagansett. Maritime shrubland and freshwater wetlands are also interspersed within these areas. Immediately east of the Village of East Hampton are farmlands along with developed areas north of Bluff Road. Further east, developed areas exist along the oceanfront to Napeague State Park and then, again, south of Napeague Harbor.

New York State Designated Significant Fish and Wildlife Habitats within the area south of Montauk Highway include Napeague Beach and Atlantic Double Dunes. Another significant habitat nearby includes Napeague Harbor.

Scattered parcels throughout the area were developed during the period from 1976 to 1988 and involved losses in farmland, maritime shrubland and dunes. Public holdings along the oceanfront at Hither Hills, Napeague and Amagansett minimized losses of vegetation in this area.

2.2.7 Montauk Natural Resources

The predominant feature adjacent to the ocean in this area is a bluff coastline. The upland is primarily a mature forest, along with areas of maritime shrubland vegetation and significant freshwater wetlands. Dunes are not predominant here, and the beach is narrow from Montauk Point west to the area south of Fort Pond Bay. From Fort Pond Bay west to Napeague, the beach widens and dune formations are apparent; bluffs are no longer evident. Developed areas include Ditch Plains, Montauk and Montauk Beach.

New York State Designated Significant Fish and Wildlife Habitats within the area south of Montauk Highway include a portion of the Oyster Ponds Significant Fish and Wildlife Habitat. Other significant habitats nearby include: Montauk Harbor, Fort Pond and Hither Hills Uplands.

From 1976 to 1988, loss of forest and maritime shrubland vegetation occurred primarily adjacent to the existing developed areas. Scattered large lot residential development in the Montauk Point area was also evident. The loss of freshwater wetlands was minimal.

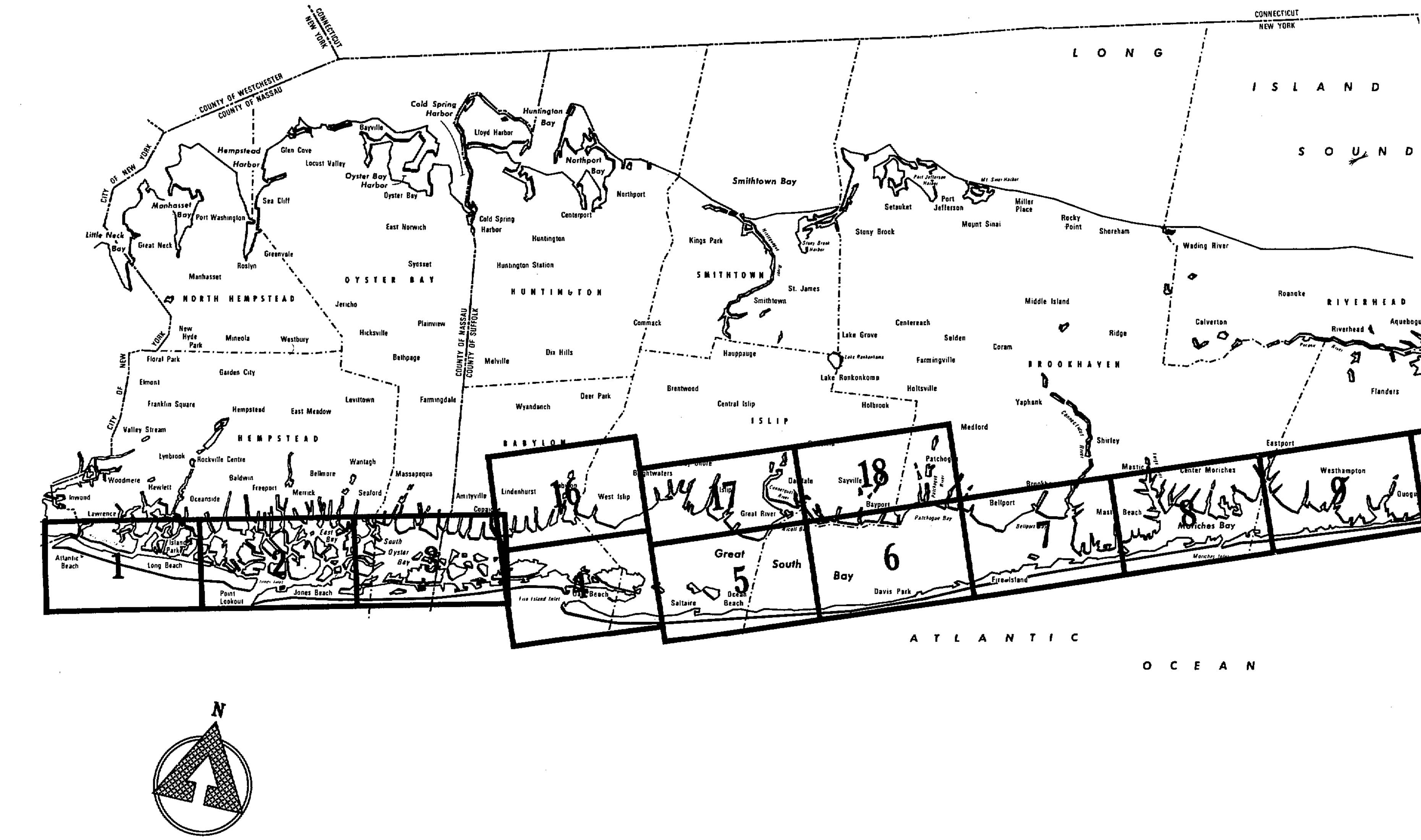
2.2.8 Colonial Waterbird and Piping Plover Populations

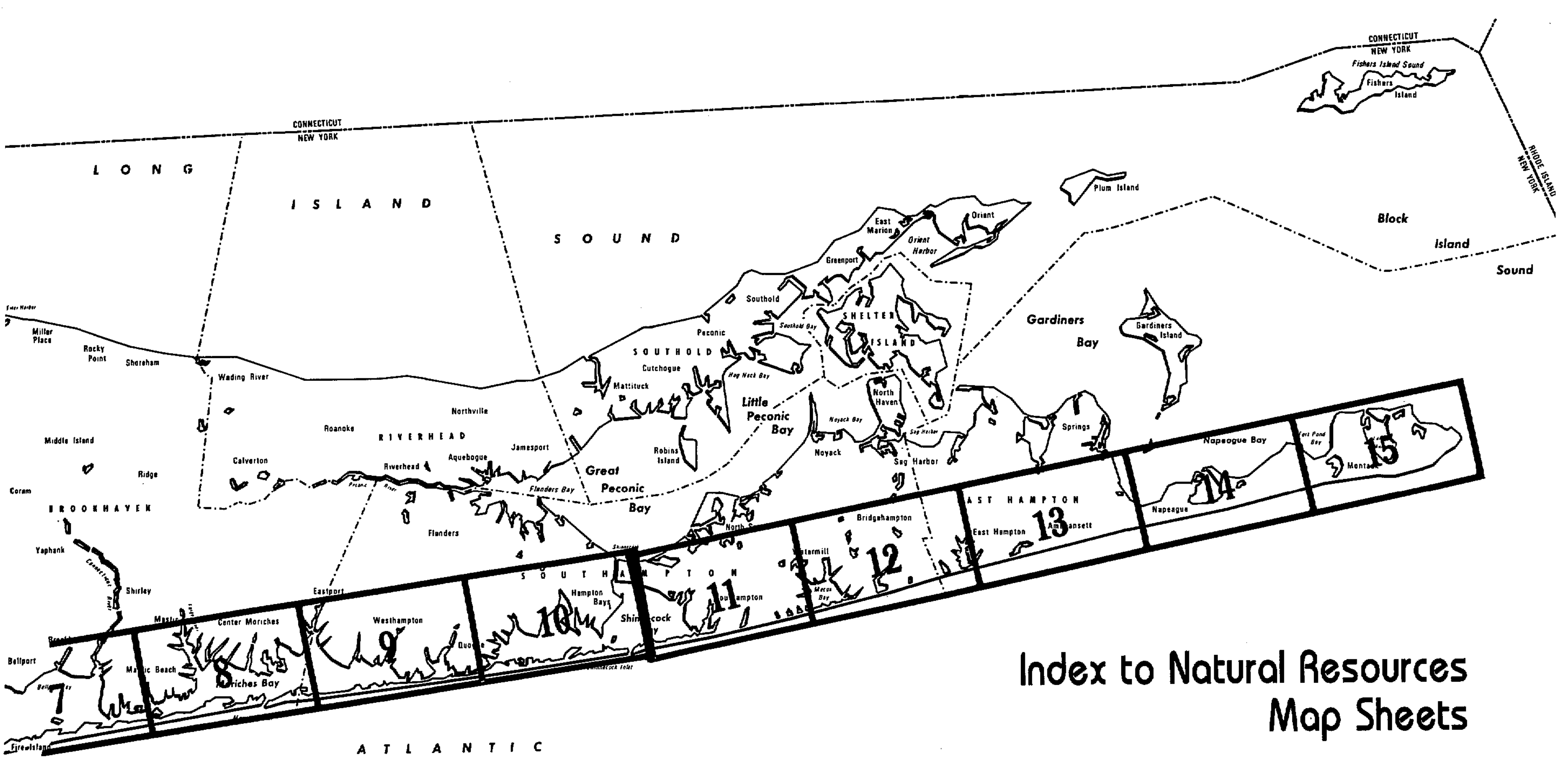
A large number of colonial waterbirds including herons, egrets, gulls, skimmers, terns, wading birds, cormorants, oystercatchers, and piping plovers breed in Long Island's coastal areas. Due to increasing pressure from human activity, the health of colonially nesting waterbird populations has been a focus of concern throughout the northeastern United States. In 1983, the NYS Dept. of Environmental Conservation listed the **least tern** (*Sterna antillarum*) and **roseate tern** (*Sterna dougallii*) as Endangered Species in New York State. In addition, the **common tern** (*Sterna hirundo*) and **piping plover** (*Charadrius melodus*) were listed as Threatened Species. The roseate tern is a federally endangered species for the southeastern coastal portion of New York State. Effective in 1986, the United States Fish and Wildlife Service granted federal threatened status to the Atlantic coast population of the piping plover. Additional concern has been voiced concerning population trends in other coastal colonial waterbird species.

In response to the need for current colonial waterbird population data, the Long Island Least Tern and Piping Plover Survey was initiated in 1983 by the Seatuck Research Program in cooperation with the NYS Dept. of Environmental Conservation. The goal of the survey was to provide a systematic method for monitoring the population status of Long Island's colonial waterbirds. This has been accomplished by expanding the survey each year since 1983 to the present. The location of waterbird colonies and piping plover nesting sites along the south shore of Nassau and Suffolk Counties as of 1986 was mapped on the Waterbird Colonies Map included in this chapter. This information was obtained from MacLean and Litwin (1987). Other information collected at each colony includes: ownership, site characteristics, nesting substrate, vegetation coverage, causes of disturbance and protection measures being undertaken at the site. It is important to note that these data are continuing to be collected on an annual basis. New sites are added to subsequent surveys as additional information is obtained.

According to the U.S. Fish and Wildlife Service (Day 1988), certain mitigation measures to protect colonial waterbirds have been developed for coastal construction projects. The U.S. Fish and Wildlife Service's Mitigation Policy requires that, for beach nourishment projects, no placement of material should occur during the period April 1 to September 1 in locations where shorebirds/waterbirds nest.

NATURAL RESOURCES

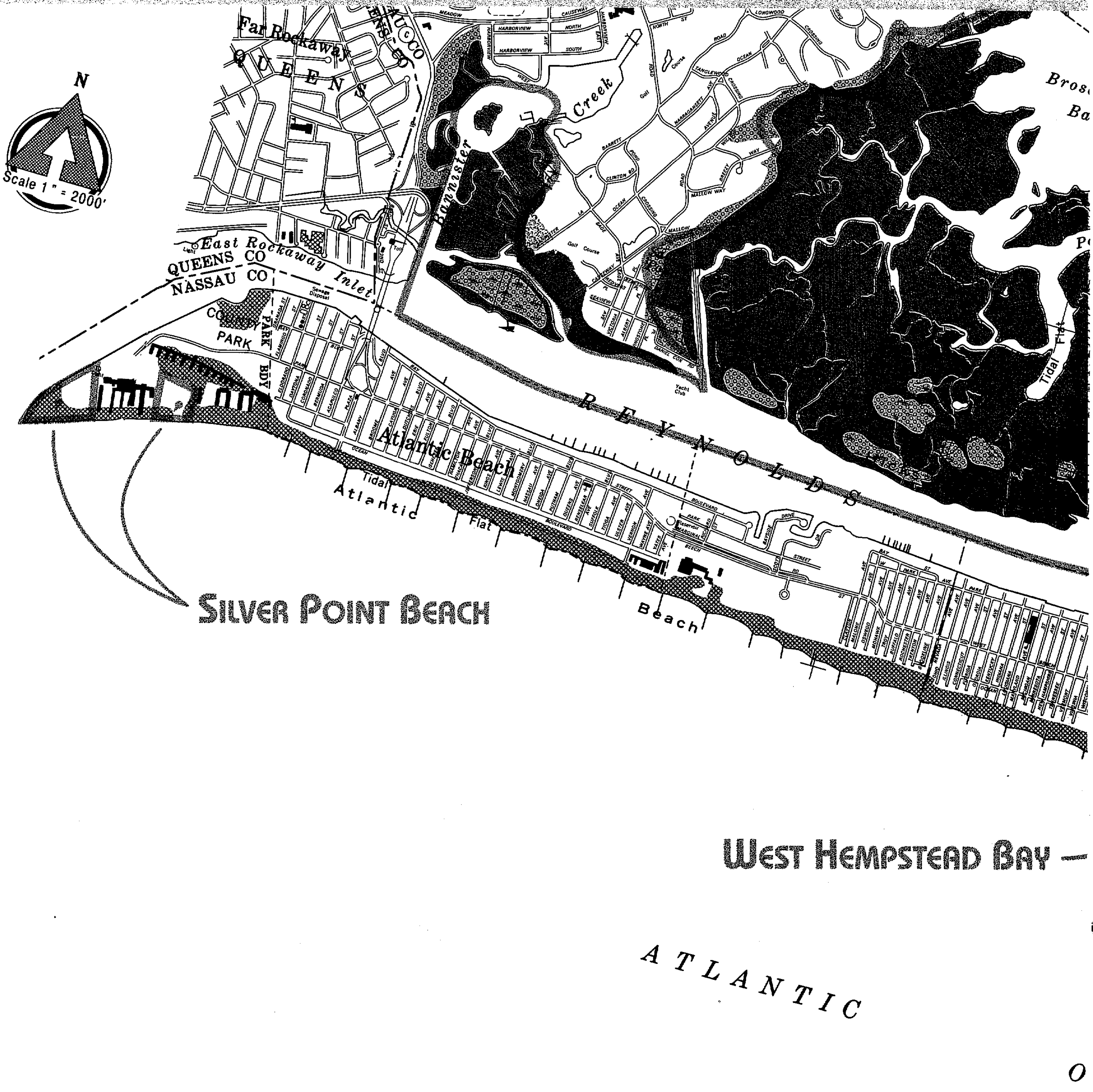


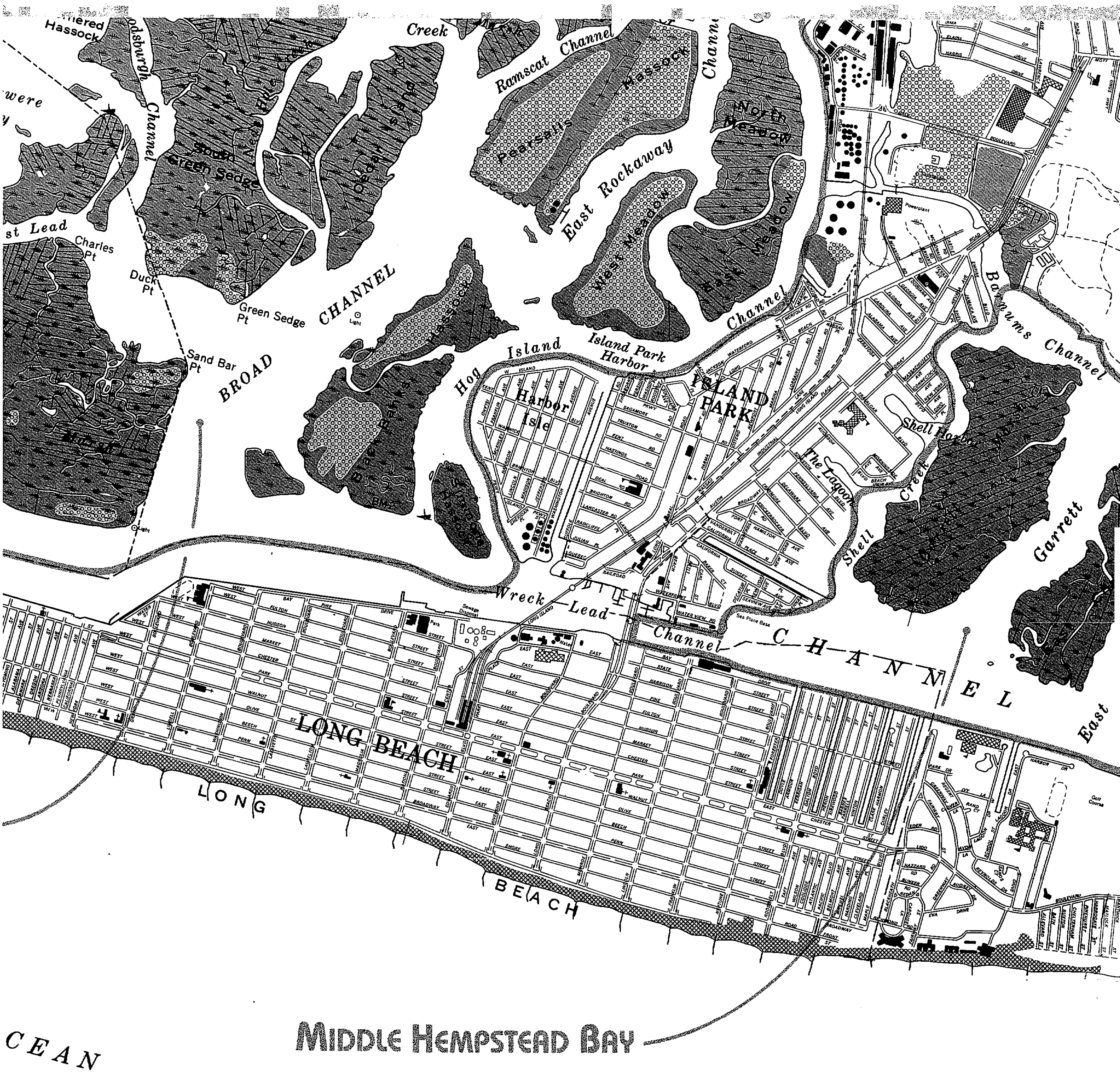


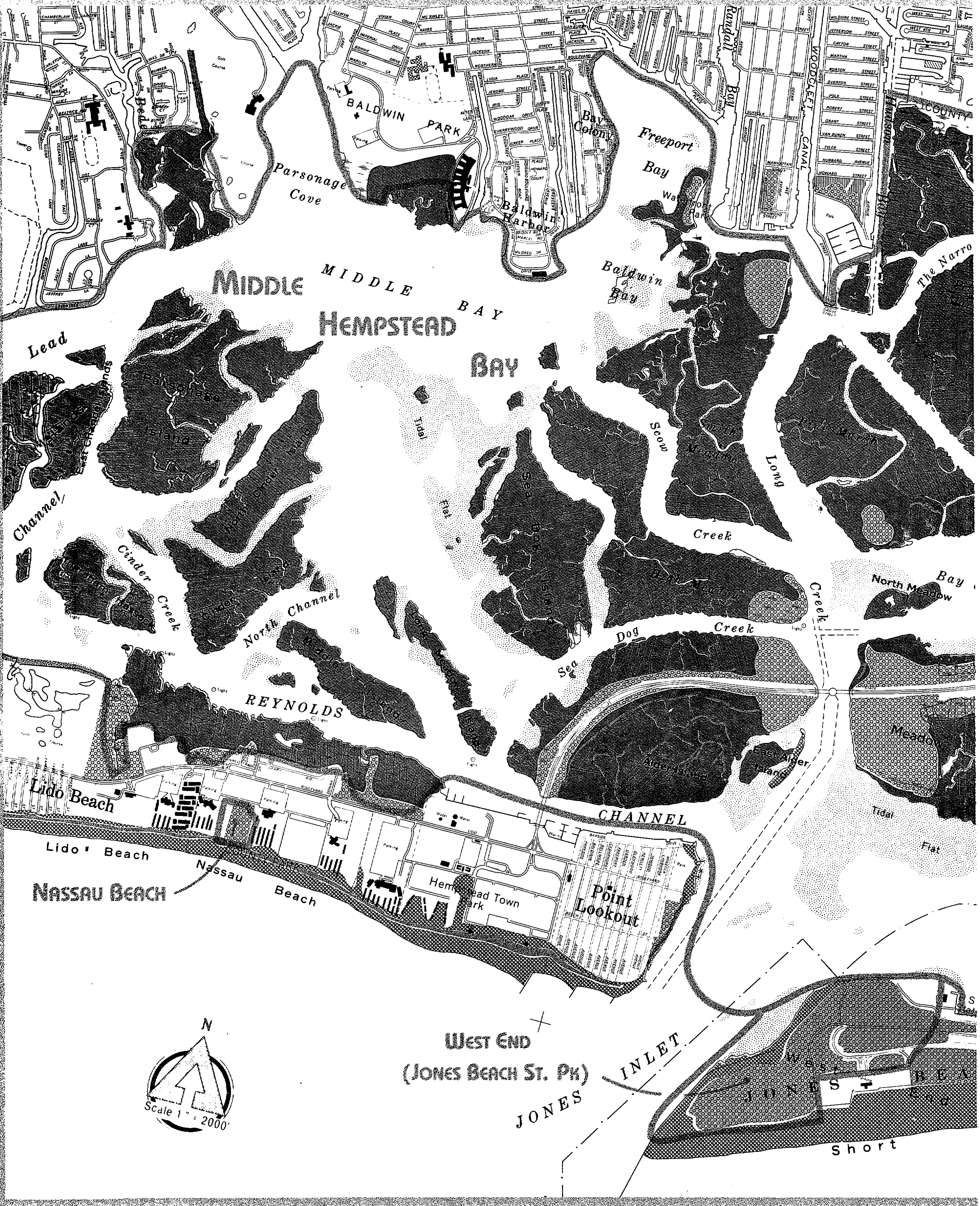
Index to Natural Resources Map Sheets

-LEGEND-

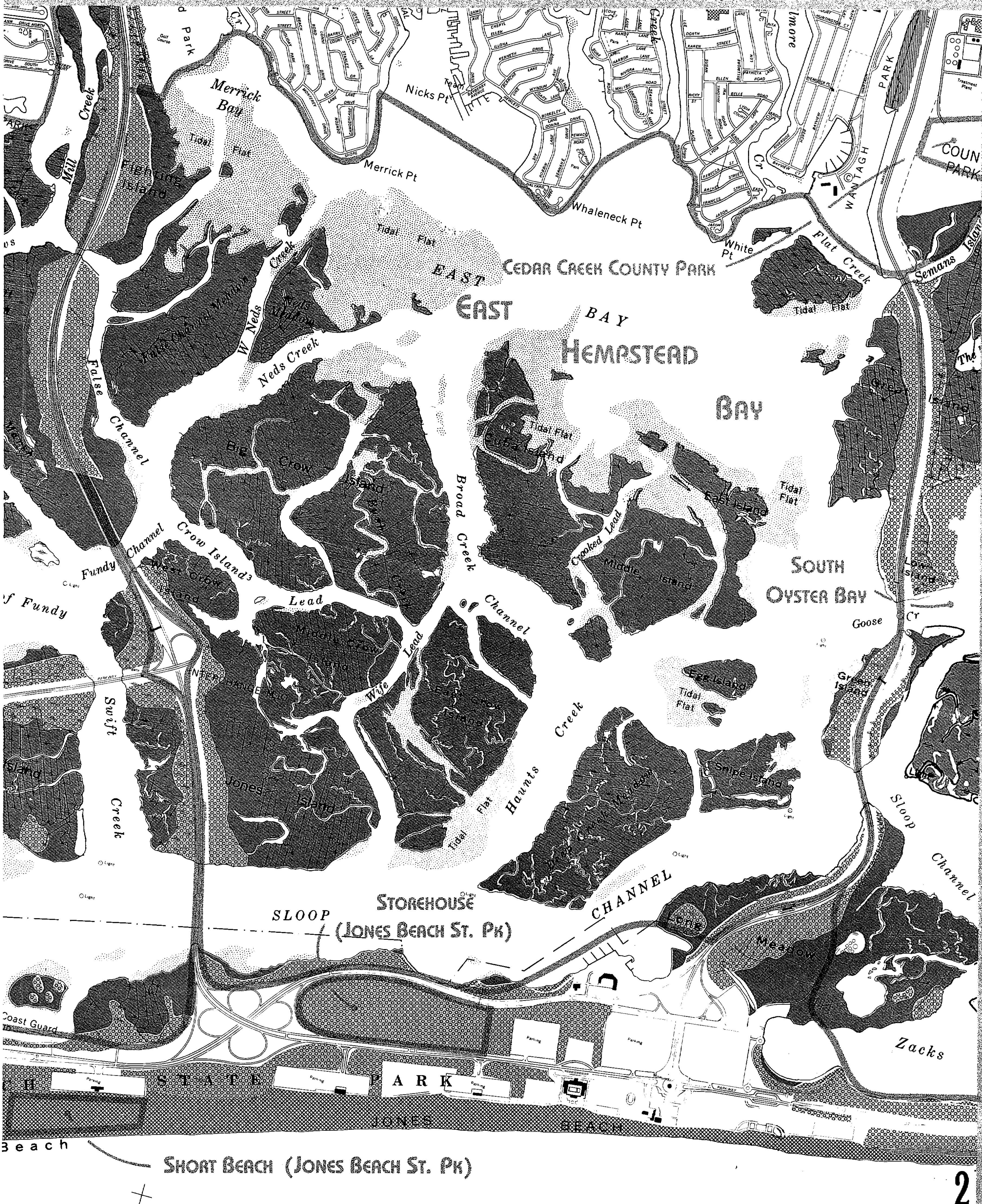
- Freshwater Wetland
- Tidal Wetland
- Forest
- Maritime Flora
- Dunes
- Beach
- Old Field
- Farmland
- Bluff
- Significant Fish & Wildlife Habitats Boundary

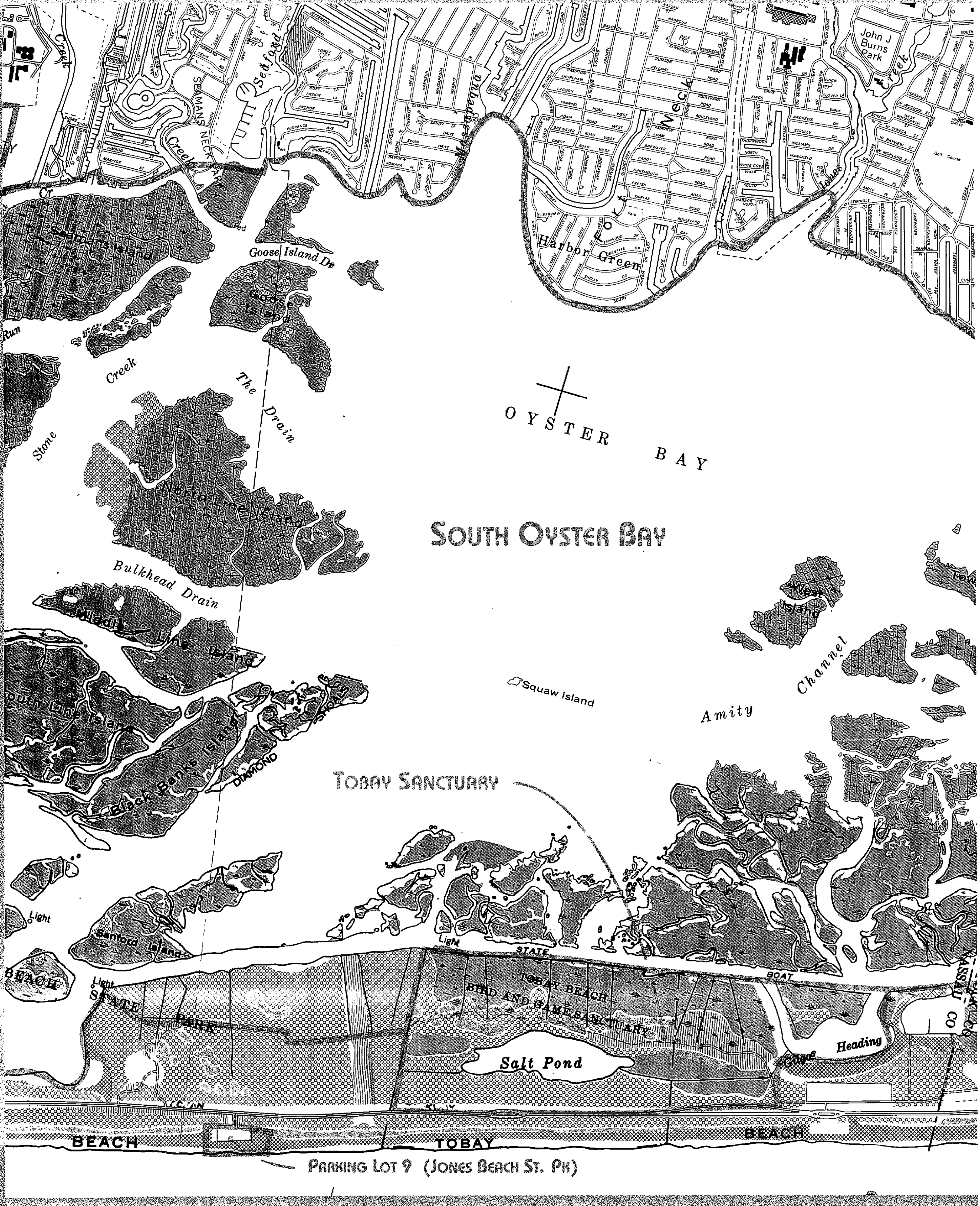

N
Scale 1" = 2000'
Far Rockaway
QUEENS
East Rockaway Inlet
QUEENS CO
NASSAU CO
COUNTY PARK
PARK BDY
Bannister
Creek
Golf Course
Broad Ba
Tidal Flat
REYNOLDS
Atlantic Beach
Tidal Atlantic Flat
Beach
Yacht Club
SILVER POINT BEACH
WEST HEMPSTEAD BAY
ATLANTIC
O

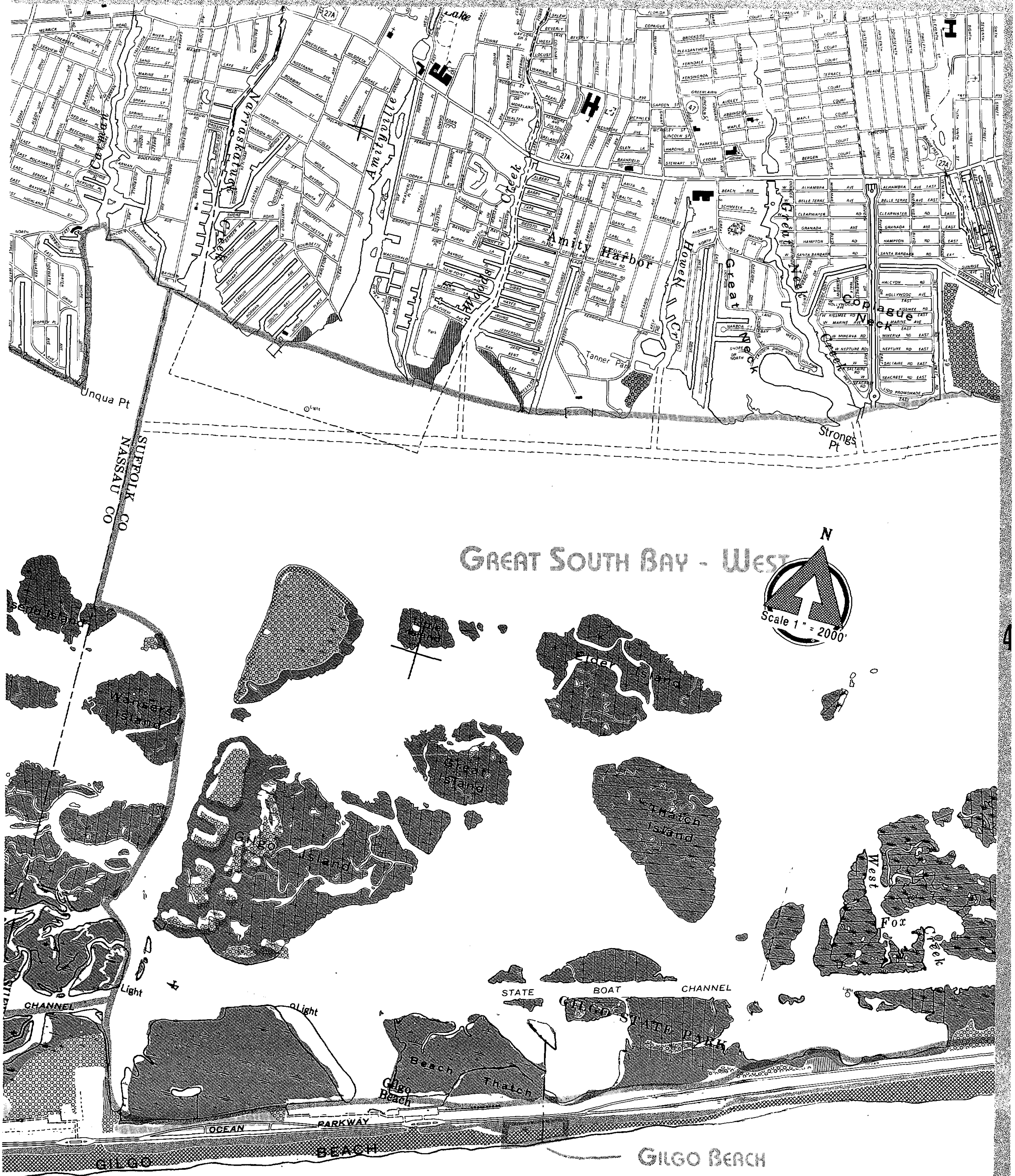

Hassock
Creek
Ramscat Channel
Channel
Hassock
North Meadow
Pearsalls
East Rockaway
South Green Sedge
Cedar Island
st Lead
Charles Pt
Duck Pt
Green Sedge Pt
West Meadow
East Meadow
BROAD CHANNEL
Light
Sand Bar Pt
Hog Island
Island Park Harbor
Channel
Barnums Channel
Harbor Isle
ISLAND PARK
Shell Harbor
The Lagoon
Shell Creek
Garrett
Wreck Lead Channel
CHANNEL
East
Sewage Disposal
Sea Plane Base
Powerplant
LONG BEACH
LONG BEACH
Golf Course
CEAN
MIDDLE HEMPSTEAD BAY

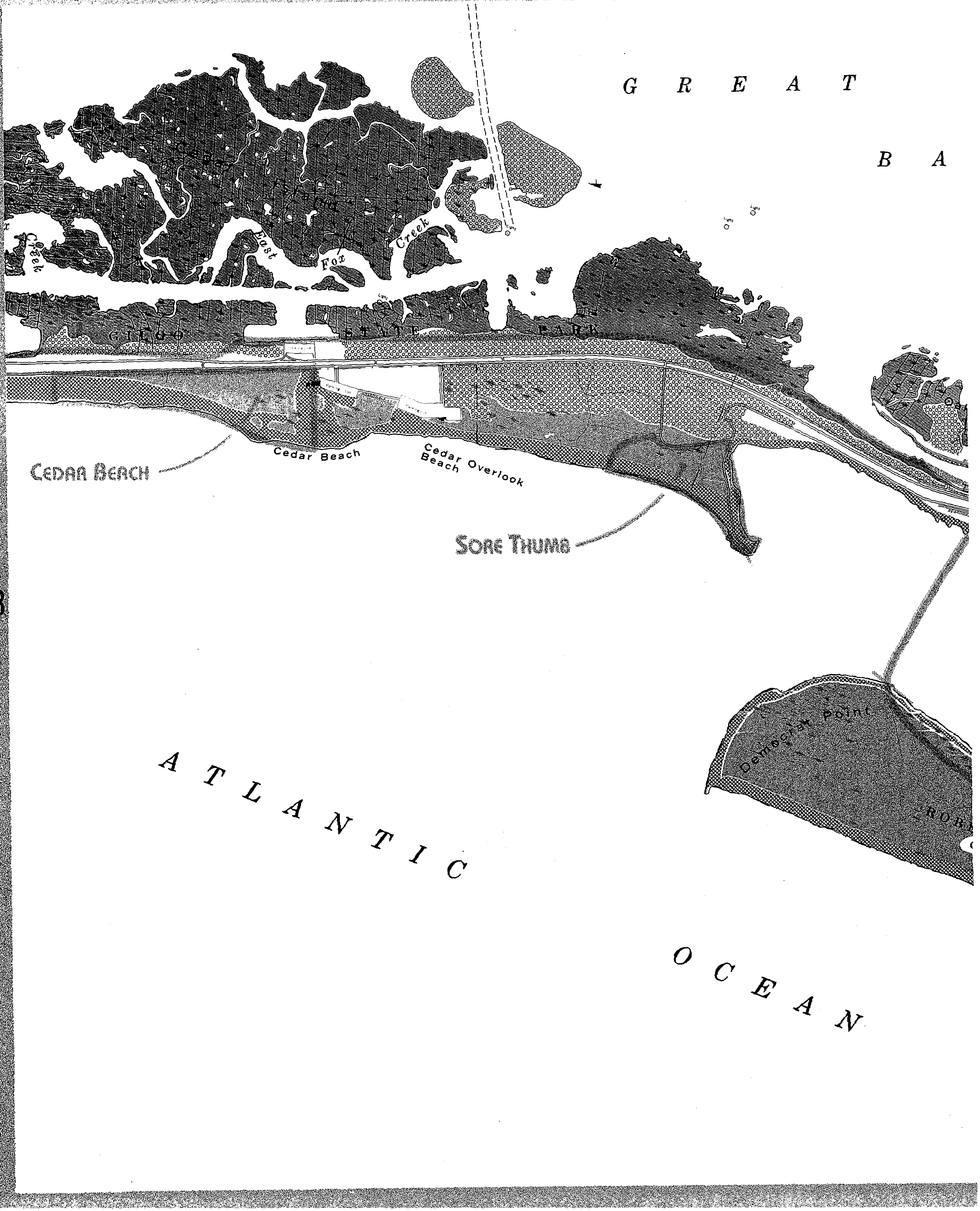


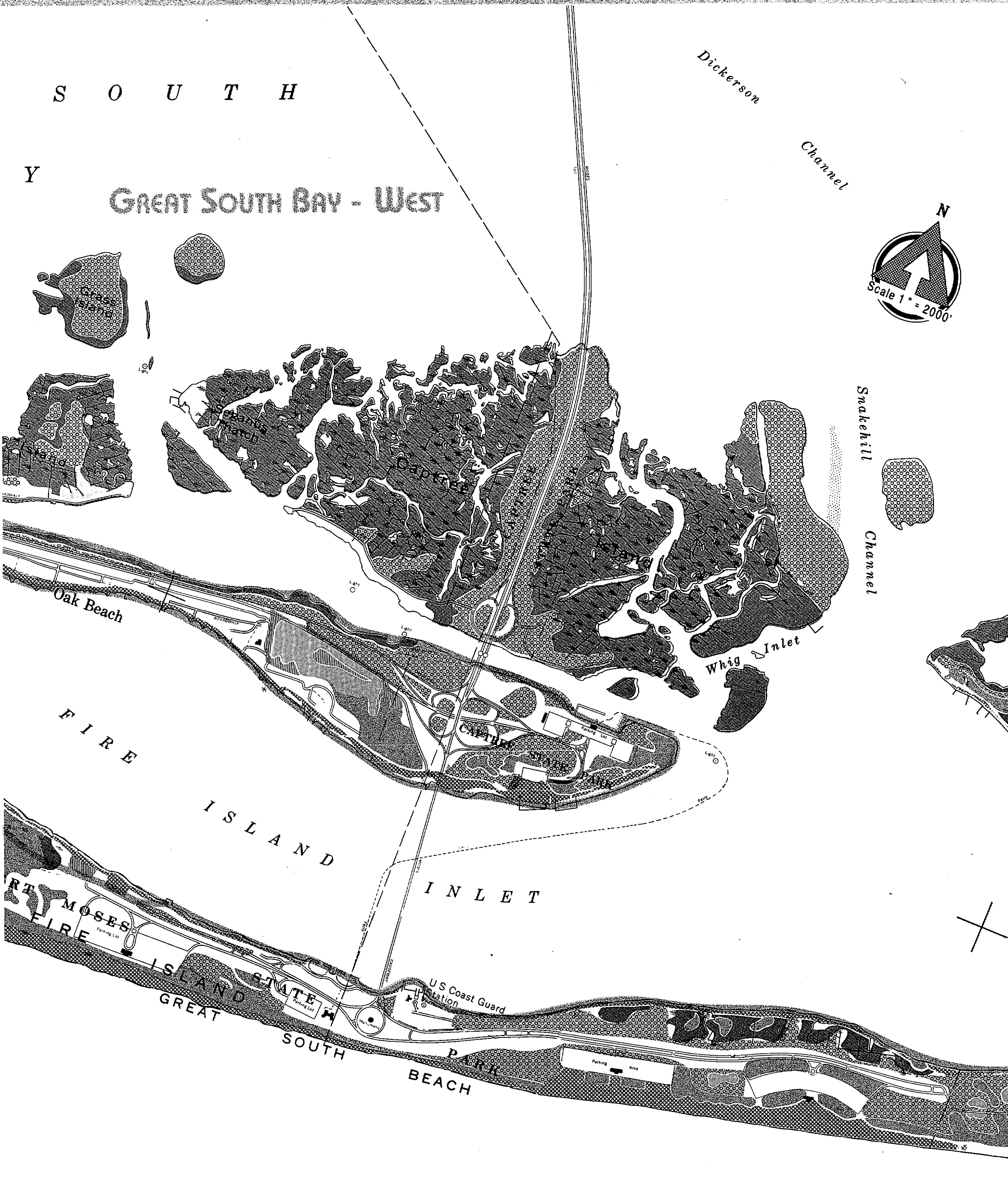
MIDDLE HEMPSTEAD BAY
MIDDLE BAY
Parsonage Cove
BALDWIN PARK
Baldwin Harbor
Bay Colony
Freeport Bay
Baldwin Bay
Randall Bay
WOODCLEFT CANAL
Lead
Channel
Cinder Creek
North Channel
REYNOLDS
CHANNEL
Tidal
Flat
Scow
Long
Creek
Sea Dog Creek
North Meadow
Lido Beach
Nassau Beach
NASSAU BEACH
Hempstead Town Park
Point Lookout
WEST END
(JONES BEACH ST. PK)
JONES INLET
West
JONES BEA
Short
N
Scale 1" = 2000'

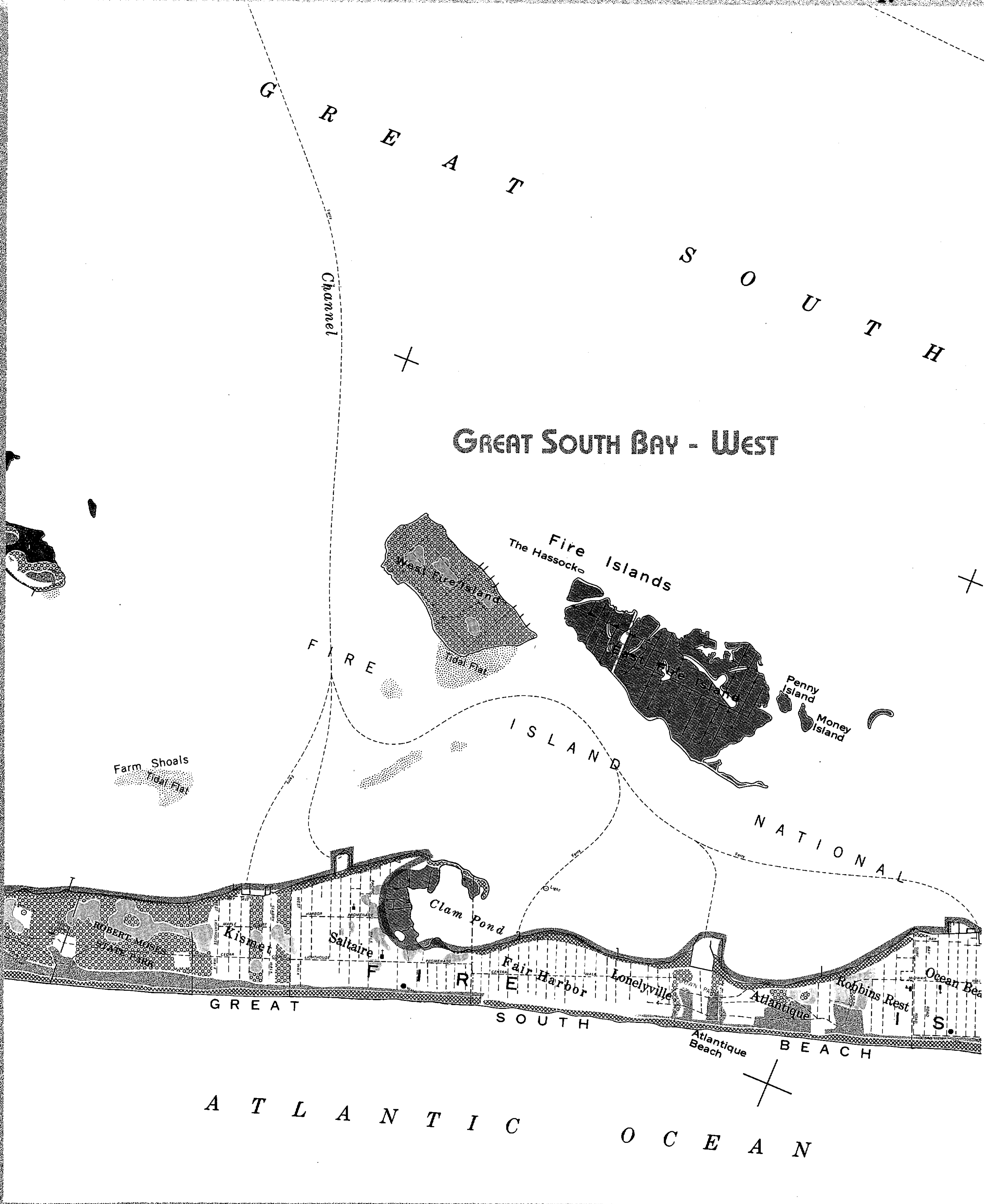

Merrick Bay
Tidal Flat
Merrick Pt
Nicks Pt
Whaleneck Pt
White Pt
Flat Creek
Semans Island
CEDAR CREEK COUNTY PARK
EAST BAY
EAST HEMPSTEAD BAY
Mill Creek
Fighting Island
False Channel
W Neds Creek
Neds Creek
Neds Meadow
False Channel Meadow
Big Crow Island
Broad Creek
Broad Creek Channel
Cuba Island
East Island
Crooked Lead
Middle Island
Great Island
SOUTH OYSTER BAY
Goose Cr
Green Island
Egg Island
Snipe Island
Haunts Creek
Crow Island Lead
West Crow Island
Middle Crow Island
East Crow Island
Wife Lead
Fundy Channel
Swift Creek
Jones Island
Sloop Channel
Storehouse Meadow
SLOOP CHANNEL
STOREHOUSE (JONES BEACH ST. PK)
Long Meadow
Zacks
Coast Guard
Parking
STATE PARK
JONES BEACH
SHORT BEACH (JONES BEACH ST. PK)
COUNTY PARK
WANTAGH
Treatment Plant
Light

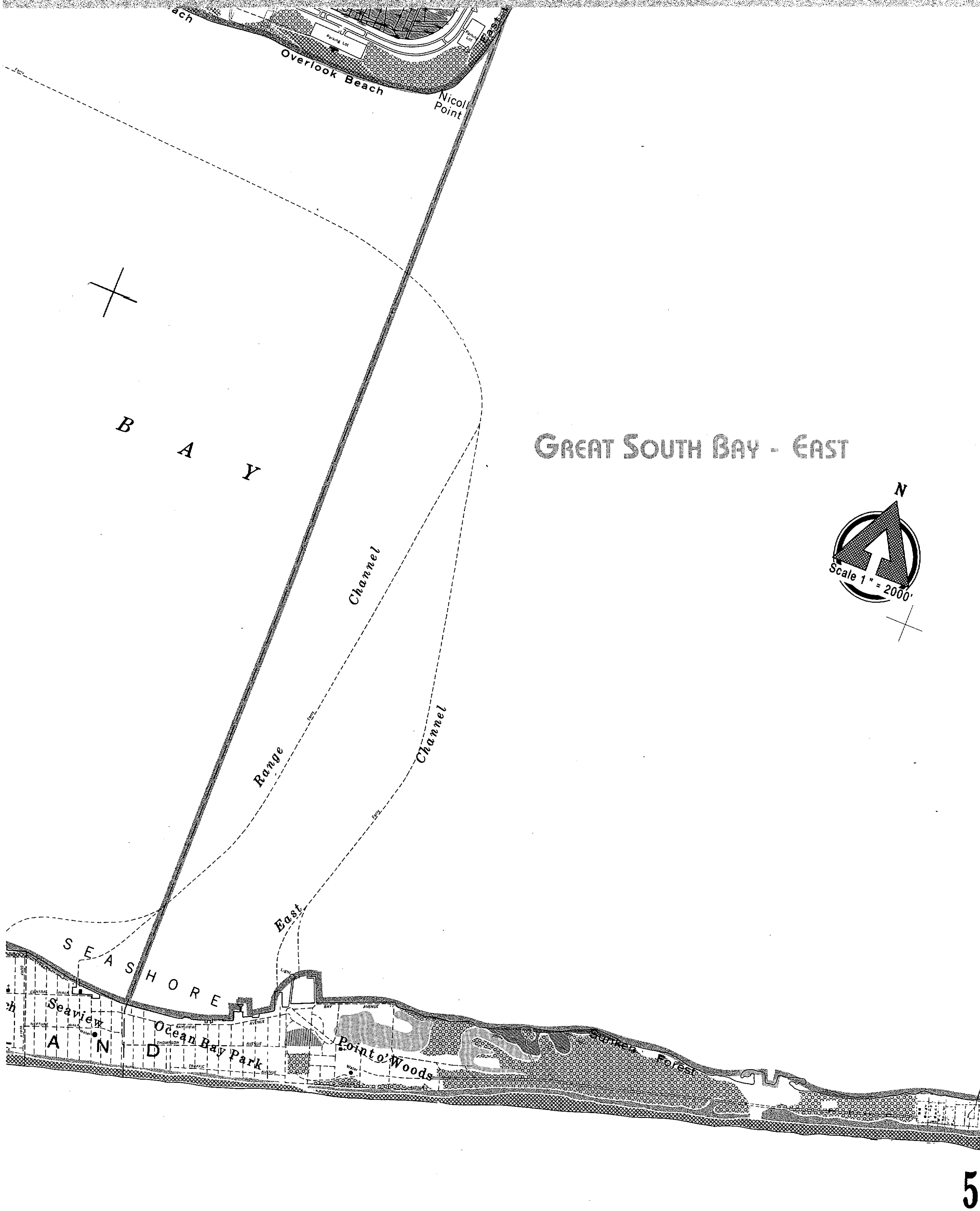

SOUTH OYSTER BAY
OYSTER BAY
TOBAY SANCTUARY
PARKING LOT 9 (JONES BEACH ST. PK)
Seaford
Massapequa
Harbor Green
John J Burns Park
Seamans Island
Goose Island
Goose Island Dr
The Drain
Stone Creek
North Line Island
Bulkhead Drain
Middle Line Island
South Line Island
Black Banks Island
Diamond Shoals
Squaw Island
West Island
Amity Channel
Sanford Island
Light
STATE BOAT
TOBAY BEACH BIRD AND GAME SANCTUARY
Salt Pond
Heading
BEACH STATE PARK
BEACH TOBAY BEACH
NASSAU CO


GREAT SOUTH BAY - WEST
N
Scale 1" = 2000'
Amityville Creek
Narrasketuck Creek
Woods Creek
Amity Harbor
Howell Cr
Great Neck
Great Neck Creek
Copiague Neck Canal
Tanner Park
Unqua Pt
Strongs Pt
SUFFOLK CO
NASSAU CO
Elder Island
Grass Island
Thatch Island
Gilgo Island
West Fox Creek
STATE BOAT CHANNEL
GILGO STATE PARK
Beach Thatch
Gilgo Beach
OCEAN PARKWAY
GILGO BEACH
Light
CHANNEL
4

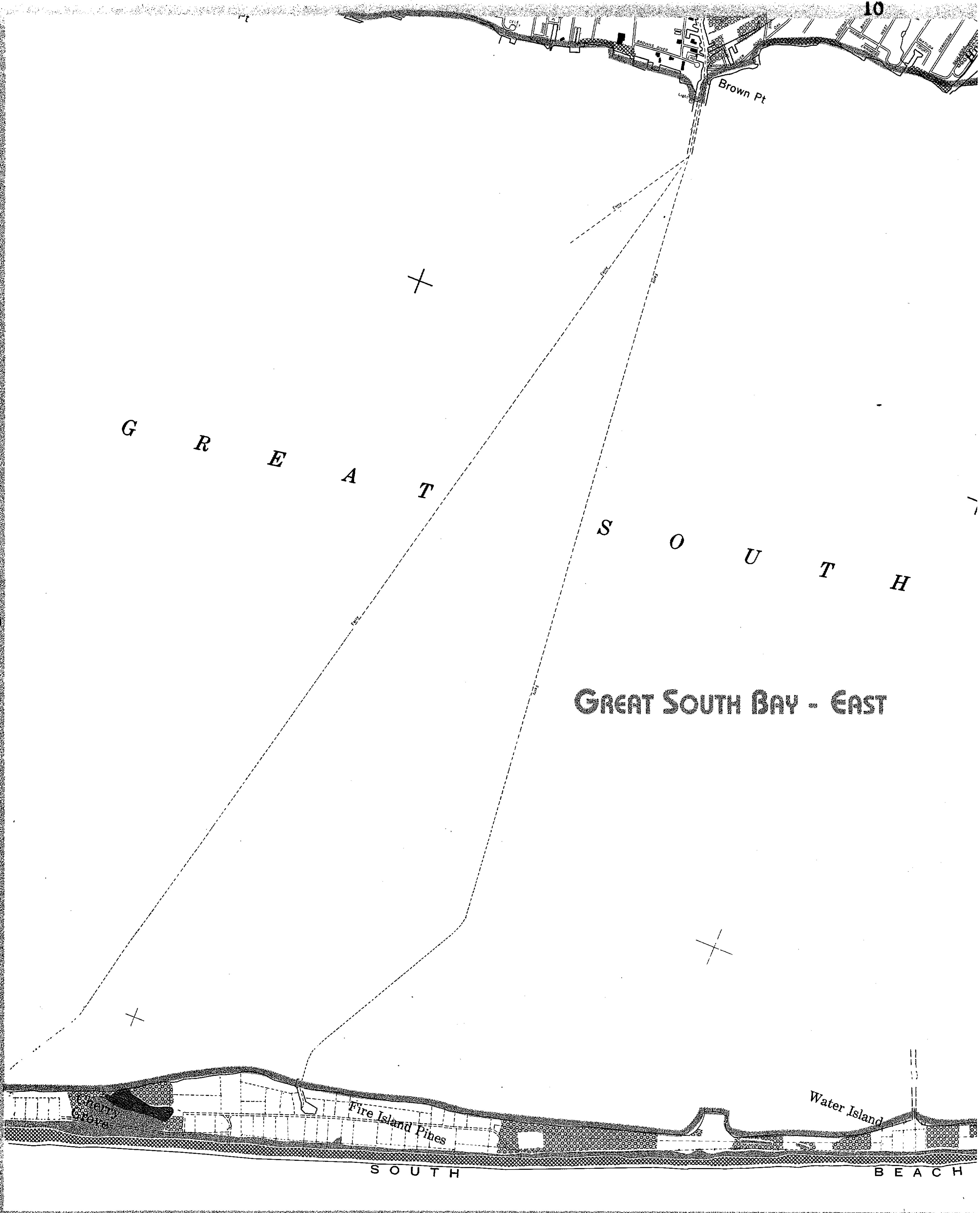

G R E A T
B A
Creek
East
Fox Creek
GILGO
STATE
PARK
Cedar Beach
Cedar Overlook Beach
CEDAR BEACH
SORE THUMB
Democrat Point
A T L A N T I C
O C E A N

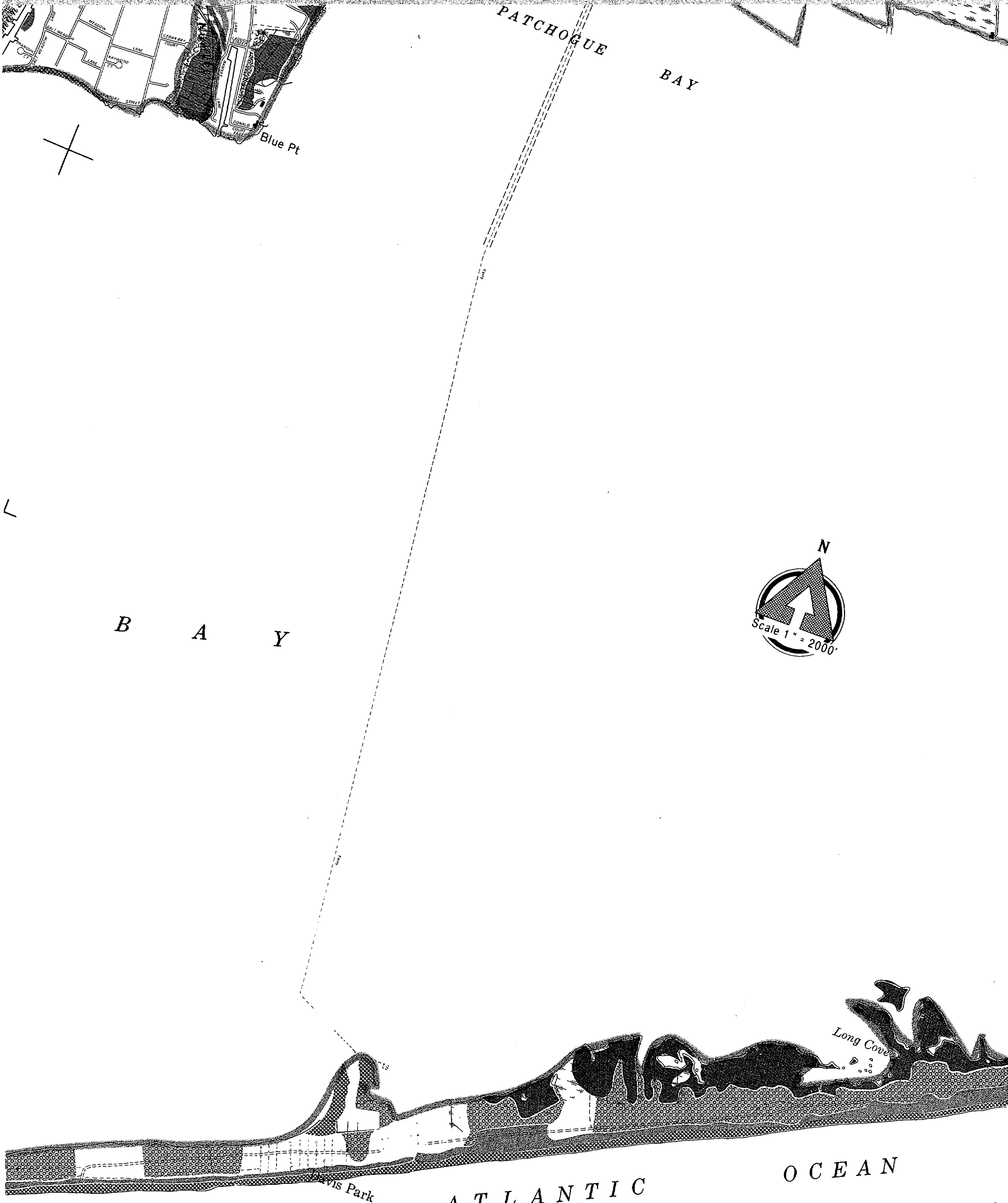

GREAT SOUTH BAY - WEST
S O U T H
Y
Dickerson Channel
N
Scale 1" = 2000'
Grass Island
Island
Captree Island
Snakehill Channel
Oak Beach
Light
Whig Inlet
CAPTREE STATE PARK
Parking Lot
FIRE ISLAND INLET
ROBERT MOSES
FIRE ISLAND STATE PARK
U S Coast Guard Station
Monument
Parking Area
GREAT SOUTH BEACH

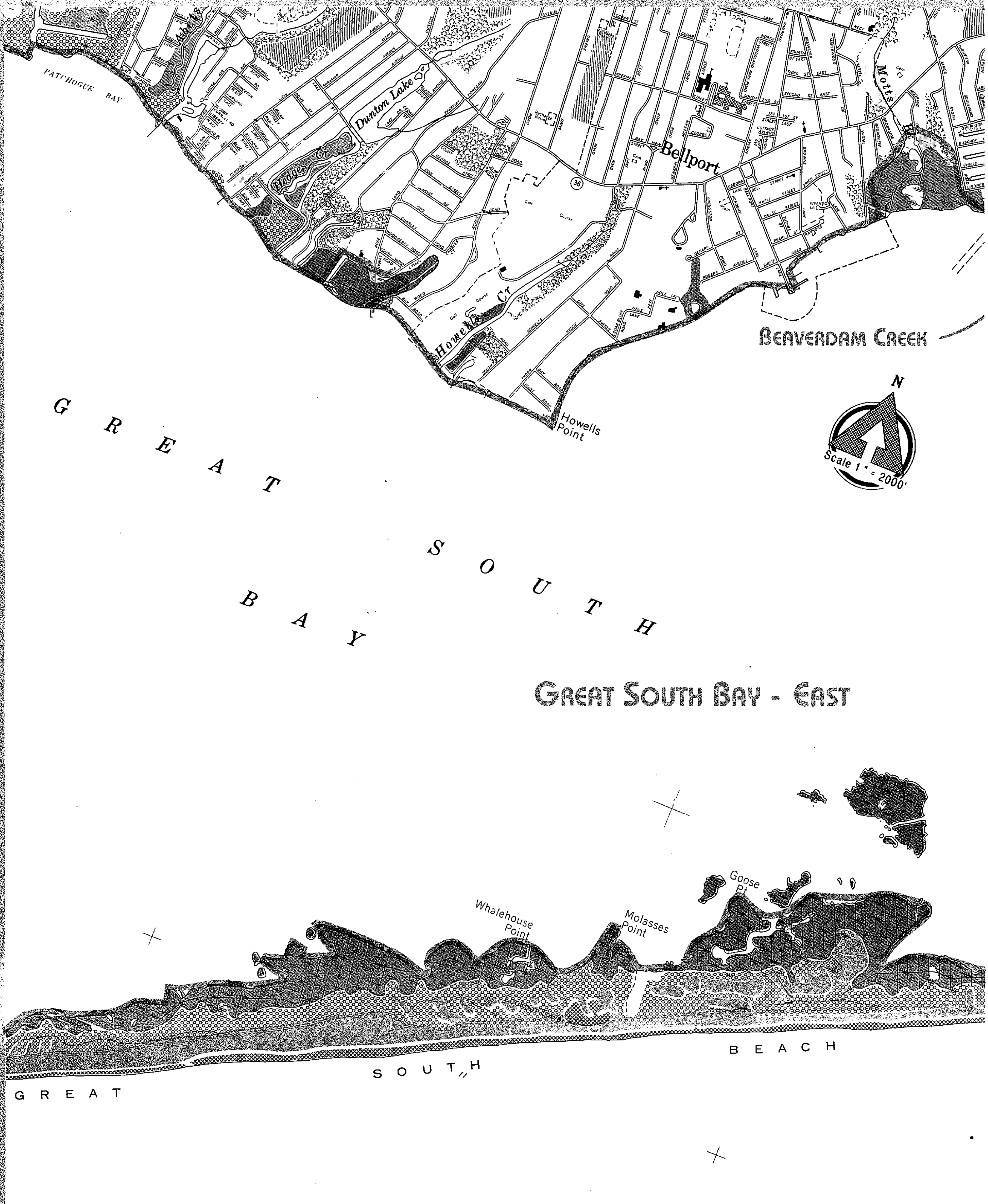

GREAT SOUTH BAY - WEST
G R E A T S O U T H
Channel
Fire Islands
The Hassock
West Fire Island
Tidal Flat
Penny Island
Money Island
F I R E I S L A N D N A T I O N A L
Farm Shoals
Tidal Flat
ROBERT MOSES STATE PARK
Kismet
Saltaire
Clam Pond
Fair Harbor
Lonelyville
Atlantique
Robbins Rest
Ocean Bea
F I R E I S.
GREAT SOUTH BEACH
Atlantique Beach
A T L A N T I C O C E A N
4



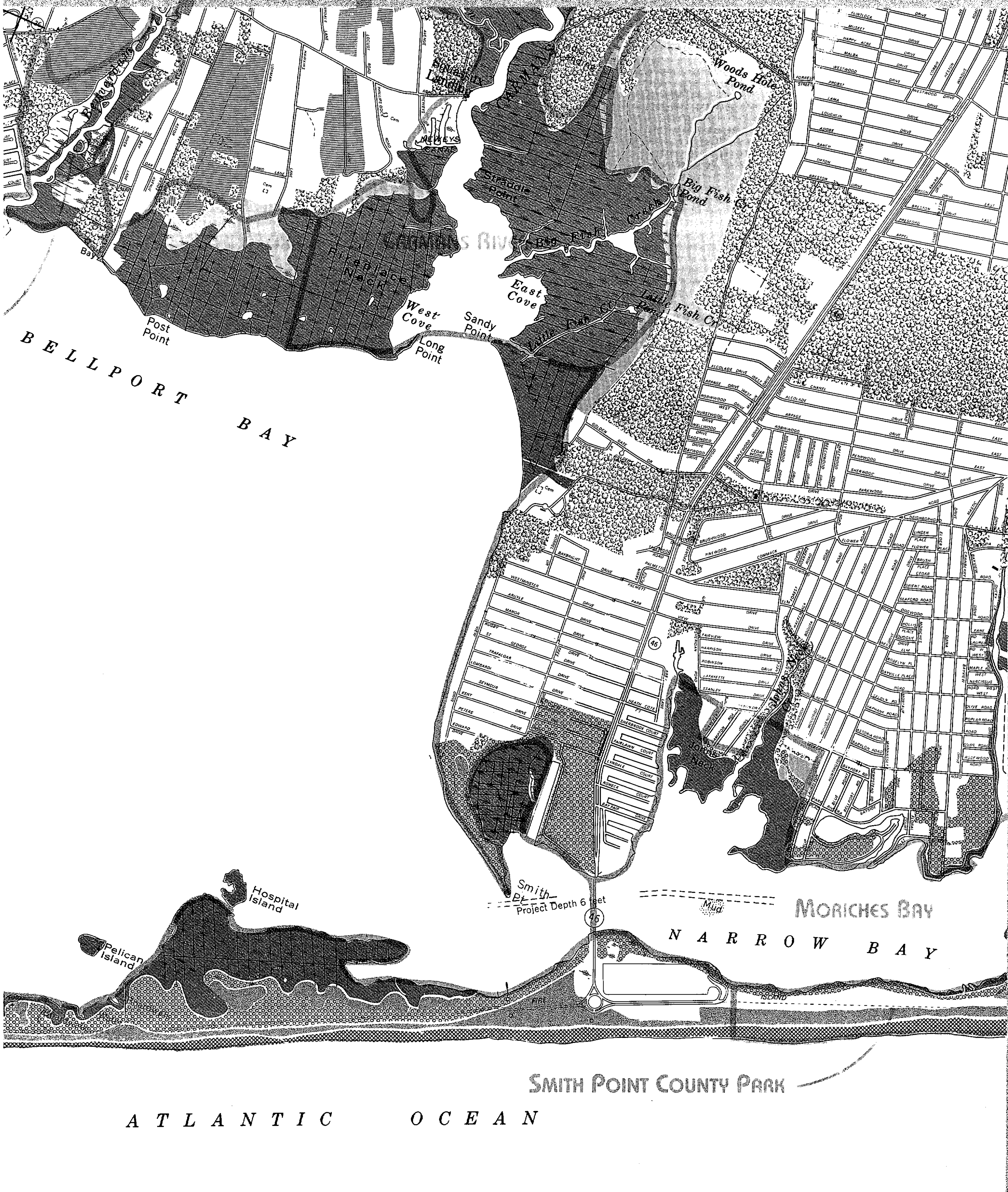
Overlook Beach
Parking Lot
Nicoll Point
East
B A Y
Channel
Range
Channel
East
Light
S E A S H O R E
Seaview
Ocean Bay Park
Point o'Woods
Sunken Forest
A N D
Water
GREAT SOUTH BAY - EAST
N
Scale 1" = 2000'


10
5
Brown Pt
G R E A T
S O U T H
Ferry
GREAT SOUTH BAY - EAST
Cherry Grove
Fire Island Pines
Water Island
S O U T H
B E A C H

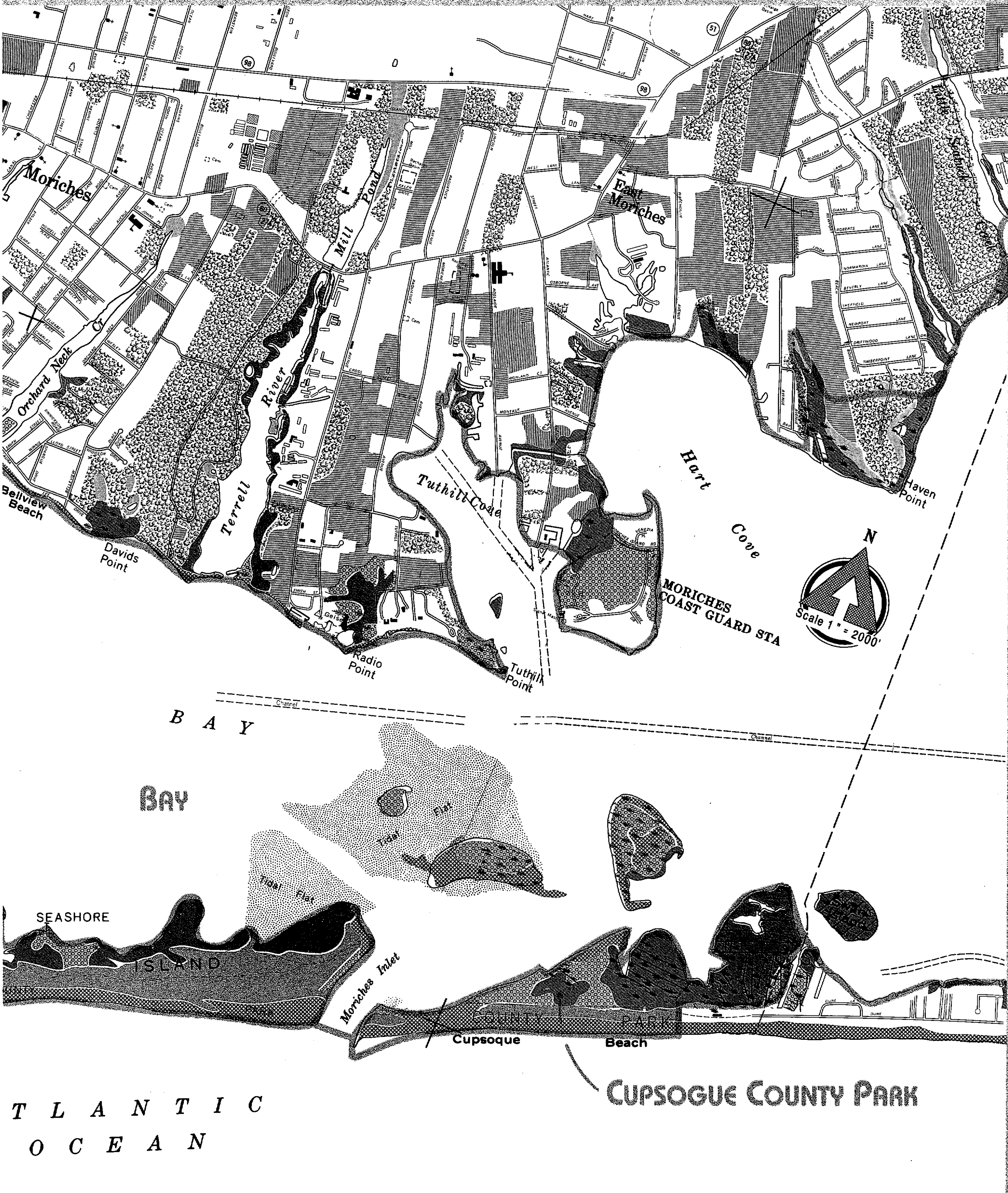

PATCHOGUE BAY
Blue Pt
B A Y
N
Scale 1" = 2000'
Long Cove
Davis Park
ATLANTIC OCEAN


GREAT SOUTH BAY - EAST
PATCHOGUE BAY
GREAT SOUTH BAY
Bellport
Dunton Lake
Hedges Cr
Howells Cr
Howells Point
BEAVERDAM CREEK
Motts
Golf Course
N
Scale 1" = 2000'
Goose Pt
Whalehouse Point
Molasses Point
GREAT SOUTH BEACH

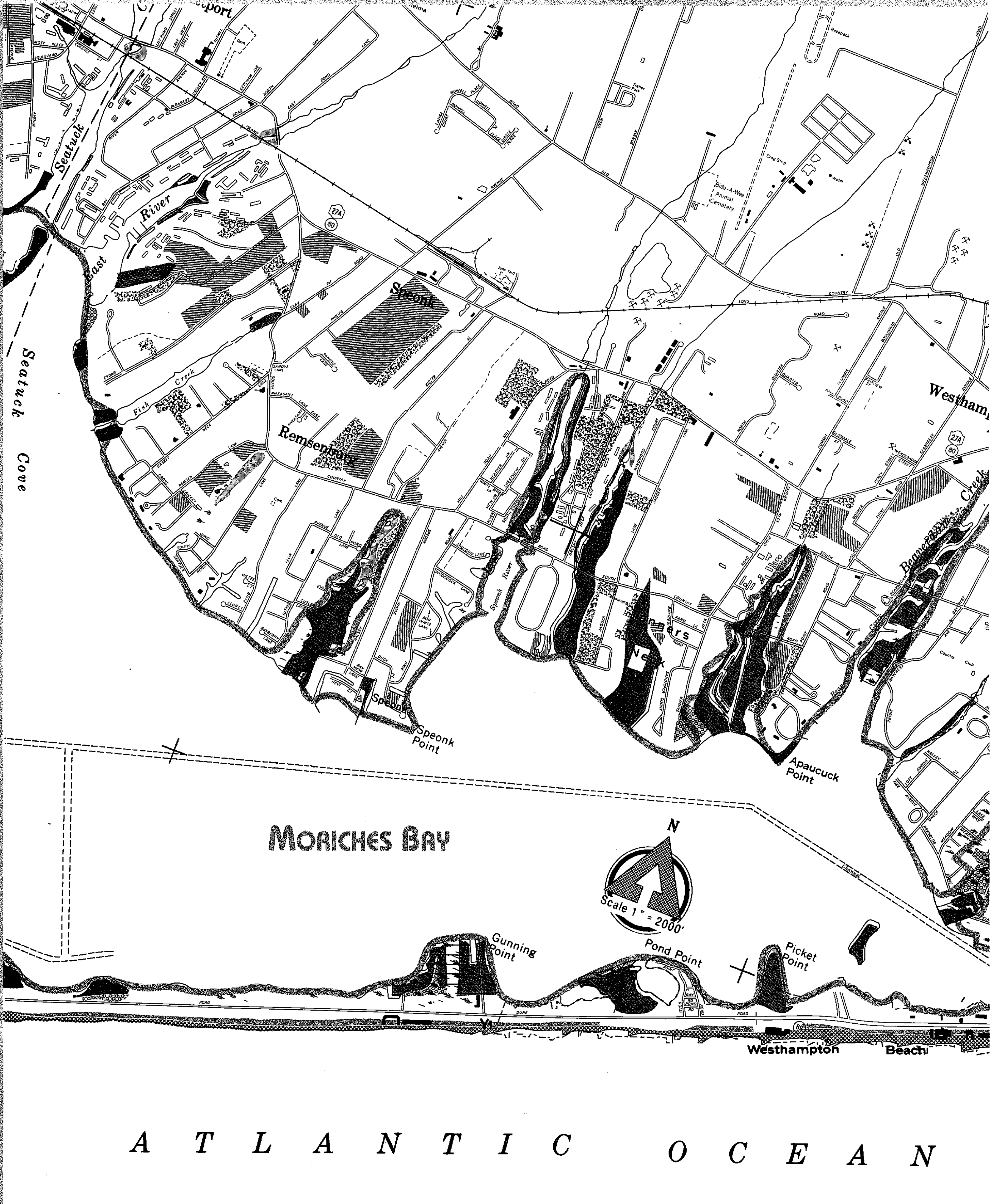
6


Woods Hole Pond
Big Fish Pond
Big Fish Cr
Sprague Point
Fireplace Neck
East Cove
West Cove
Sandy Point
Long Point
Post Point
Little Fish Cr
B E L L P O R T   B A Y
Hospital Island
Pelican Island
Smith Pt
Project Depth 6 feet
Mud
MORICHES BAY
N A R R O W   B A Y
SMITH POINT COUNTY PARK
A T L A N T I C   O C E A N
8

Neck Cr
FORGE
RIVER
Channel
POOSPATUCK INDIAN RESERVATION
Poospatuck Creek
Libby Point
Old Neck Creek
Mud Creek
Senix Creek
Areskonk Cr
Smiths Point
Sands Point
Masury Point
Mastic Beach
Laurence
Home Creek
Forge Point
The Lagoon
Floyd Point
MORICHES
M O R I C H E S
New Made Island
SMITH POINT COUNTY PARK
7
A


Moriches
Orchard Neck Cr
Terrell River
Mill Pond
East Moriches
Bellview Beach
Davids Point
Radio Point
Tuthill Cove
Tuthill Point
Hart Cove
Haven Point
MORICHES COAST GUARD STA
N
Scale 1" = 2000'
Channel
B A Y
Bay
Tidal Flat
Tidal Flat
SEASHORE
ISLAND
Moriches Inlet
COUNTY PARK
Cupsoque Beach
Cupsogue County Park
T L A N T I C
O C E A N

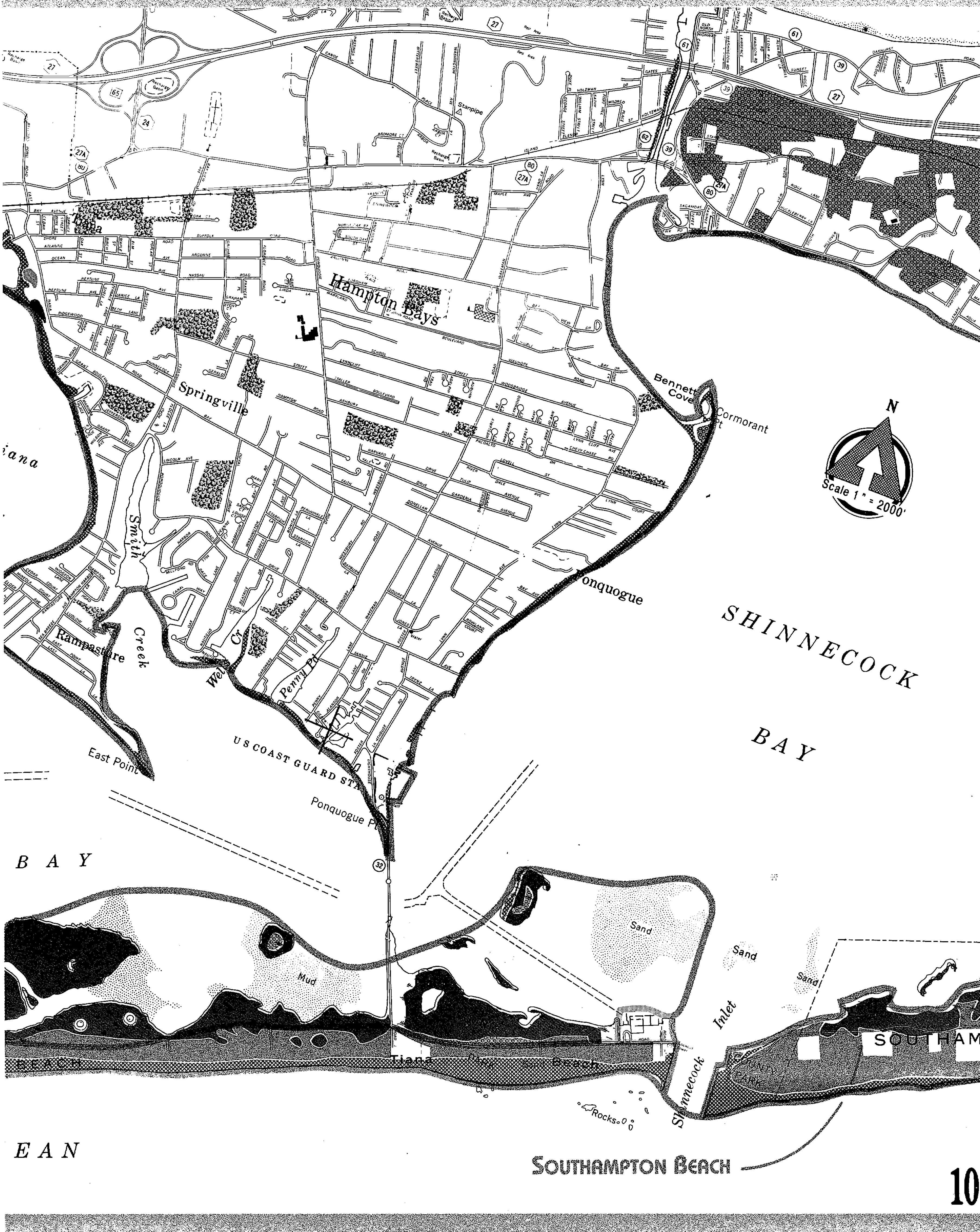
8

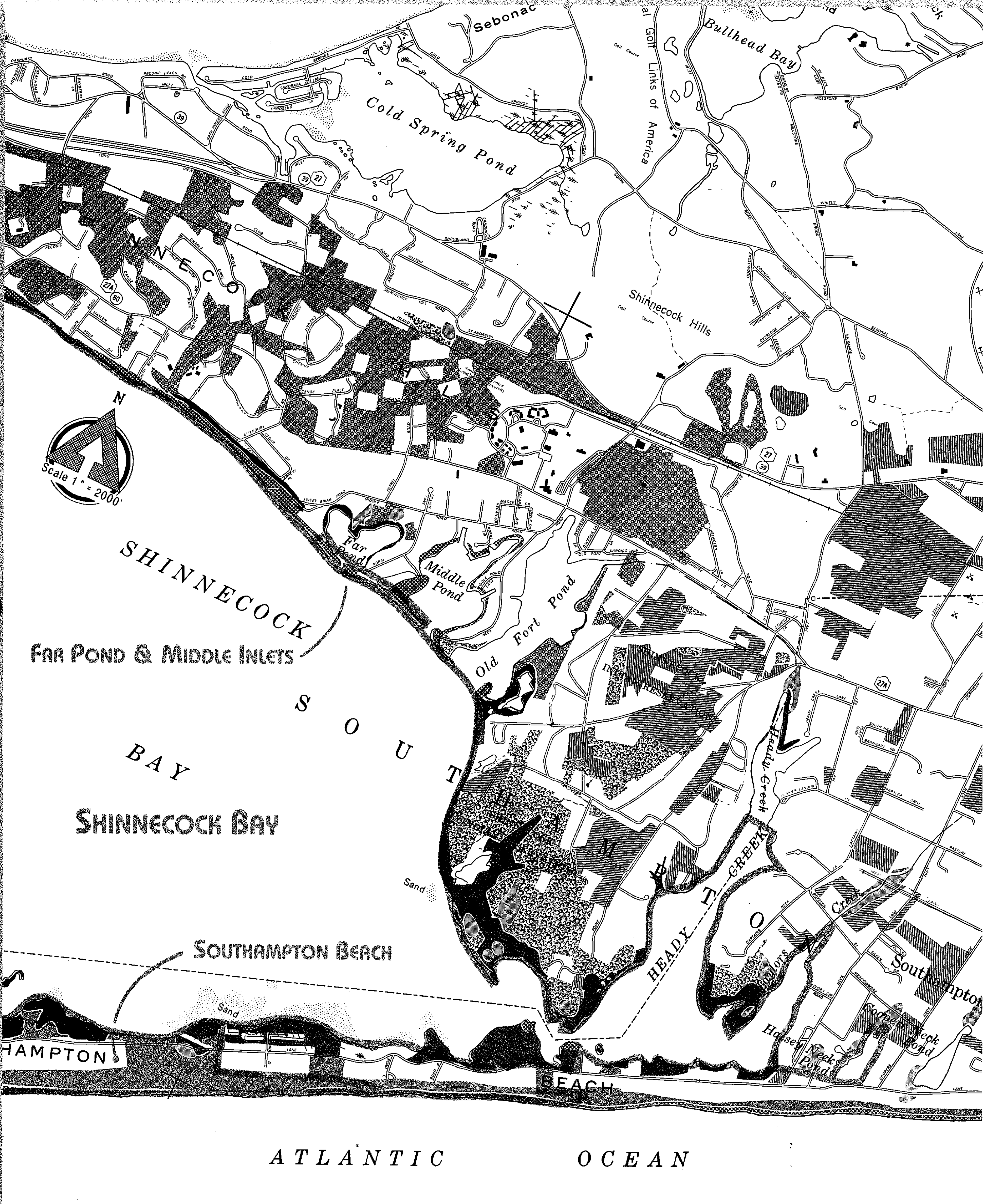


Seatuck
East River
Seatuck Cove
Fish Creek
Speonk
Remsenburg
Speonk River
Speonk Point
Apaucuck Point
Westhampton
Moriches Bay
N
Scale 1" = 2000'
Gunning Point
Pond Point
Picket Point
Westhampton Beach
Bide-A-Wee Animal Cemetery
Racetrack
Drag Strip
Trailer Park
Country Club
ATLANTIC OCEAN


SUFFOLK COUNTY AIRPORT
QUOGUE WATERFOWL REFUGE
North Pond
Beaverdam Pond
Aspatuck Creek
Quogue
Quantuck Creek
Westhampton Beach
Moneyboque Bay
Reedy Island
Potunk Pt
QUANTUCK BAY
Ogden Pond
CANAL
Quantuck
Canal
QUOGUE
SHINNECOCK BAY
TIANA BEACH


Henrys Hollow
Tiana
Weesuck
Trailer Park
West Tiana
East Quogue
Alcotts Pond
Dodges
Phillips
Stone Cr
Hampton Point
Phillips Point
Pine Neck P
West Point
Bay
Penniman Cove
Penniman Cr
Yacht Club
SHINNECOCK BAY
S H I N N E C O C K
DUNE ROAD MARSH
Mud
TIANA BEACH
A T L A N T I C
O C


Hampton Bays
Springville
Rampasture
Smith Creek
Weil Cr
Penny Pd
Bennett Cove
Cormorant Pt
Ponquogue
SHINNECOCK BAY
US COAST GUARD STA
East Point
Ponquogue Pt
BAY
EAN
BEACH
Mud
Sand
Sand
Sand
Tiana Beach
Shinnecock Inlet
Rocks
SOUTHAMPTON BEACH
N
Scale 1" = 2000'
Stanpipe

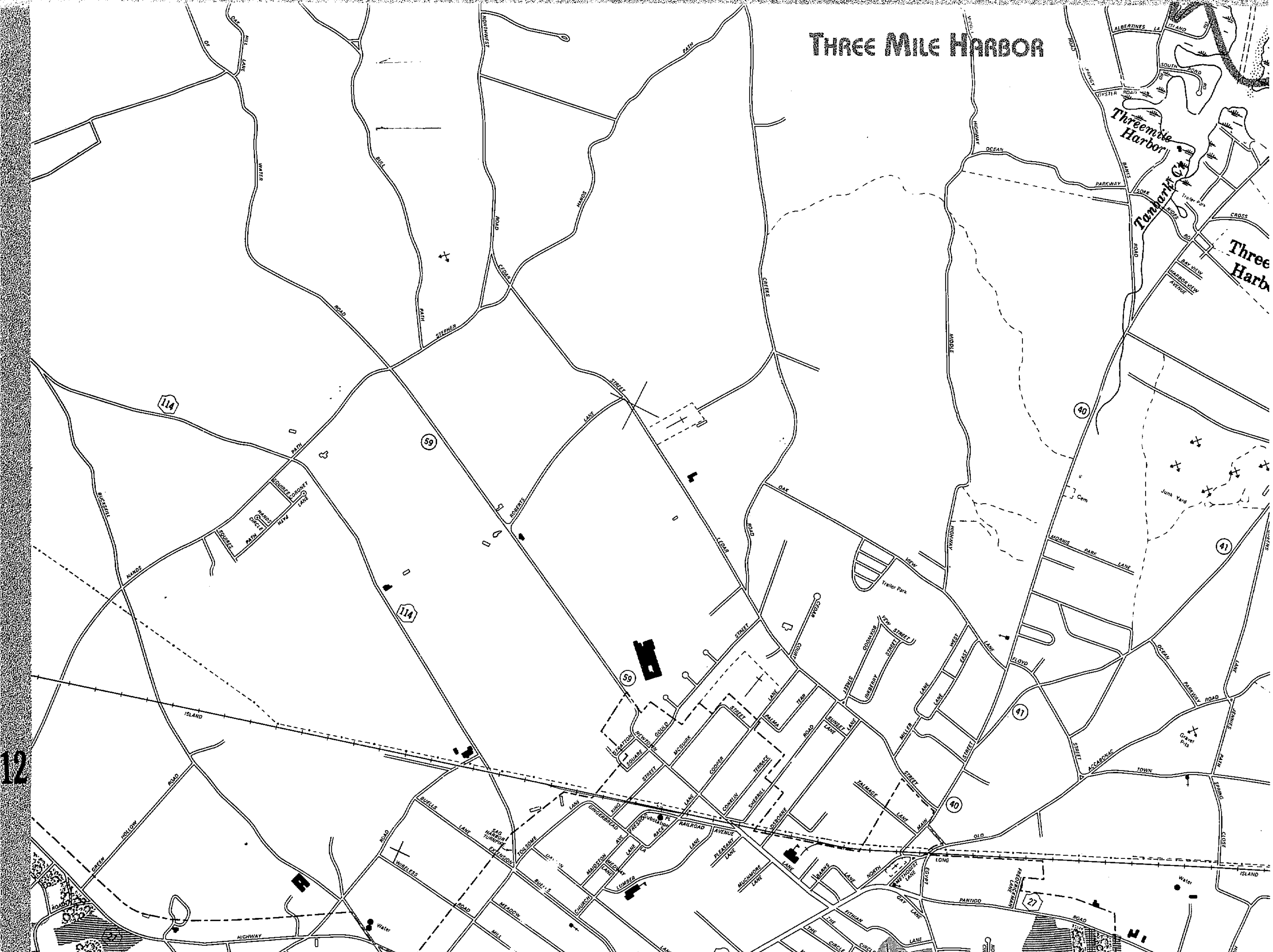

Sebonac
Bullhead Bay
al Golf Links of America
Cold Spring Pond
Shinnecock Hills
N
Scale 1" = 2000'
SHINNECOCK
BAY
Far Pond
Middle Pond
Old Fort Pond
FAR POND & MIDDLE INLETS
SHINNECOCK BAY
S O U T H A M P T O N
Heady Creek
HEADY CREEK
Taylors Creek
Southampton
Coopers Neck Pond
Halsey Neck Pond
Sand
SOUTHAMPTON BEACH
HAMPTON
BEACH
ATLANTIC OCEAN

Big Fresh Pond
Little Fresh Pond
Tuckahoe
Cemetery
Seven Ponds
Mill Pond
Water Mill
Mill Creek
Southampton
Burnett Creek
Flying Point
Channel Pond
Jule Pond
Sayre Pond
Phillips Pond
Wickapogue Pond
Old Town Pond
Agawam Lake
Mecox Bay & Beach

11

SOUTHAMPTON
Shorts Pond
Haines Pond
Goldfish Pond
Long Pond
Little Long Pond
Kellis Pond
Bridgehampton
Hayground Cove
West Mecox Village
Calf Creek
Kellis Creek
Swan Creek
Mecox
Mecox Creek
Sams Creek
Sagaponack Pond
MECOX BAY
Mecox Bay & Beach
Sagaponack Inlet
ATLANTIC OC

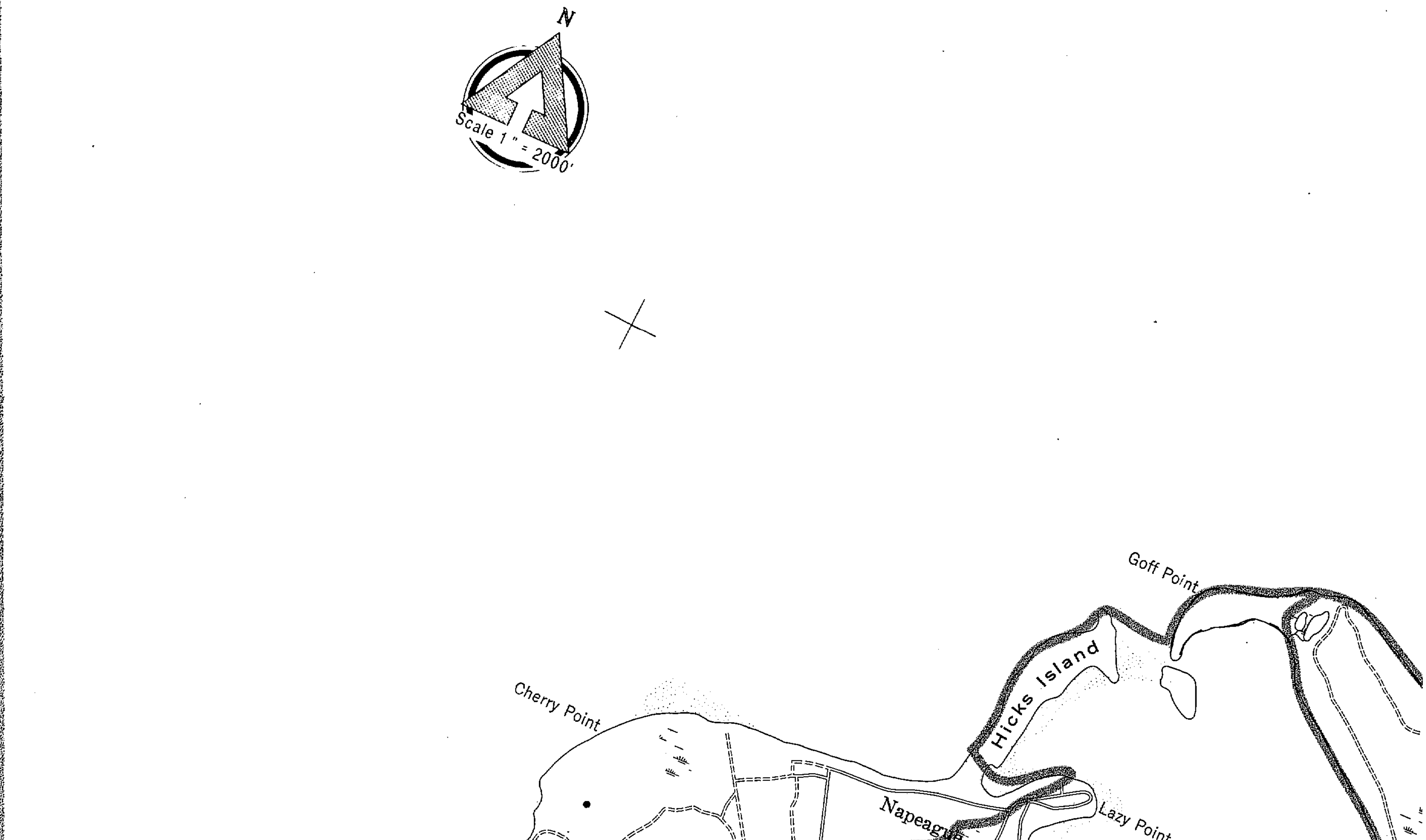

Crooked Pond
Black Pond
Slate Pond
Little Poxabogue Pond
Poxabogue Pond
EAST HAMPTON AIRPORT
Sagaponack
Wainscott
Georgica Pond
Wainscott Pond
Peters Pond
Fairfield Pond
Wainscott Beach
LONG POND GREENBELT
E A N
N
Scale 1" = 2000'



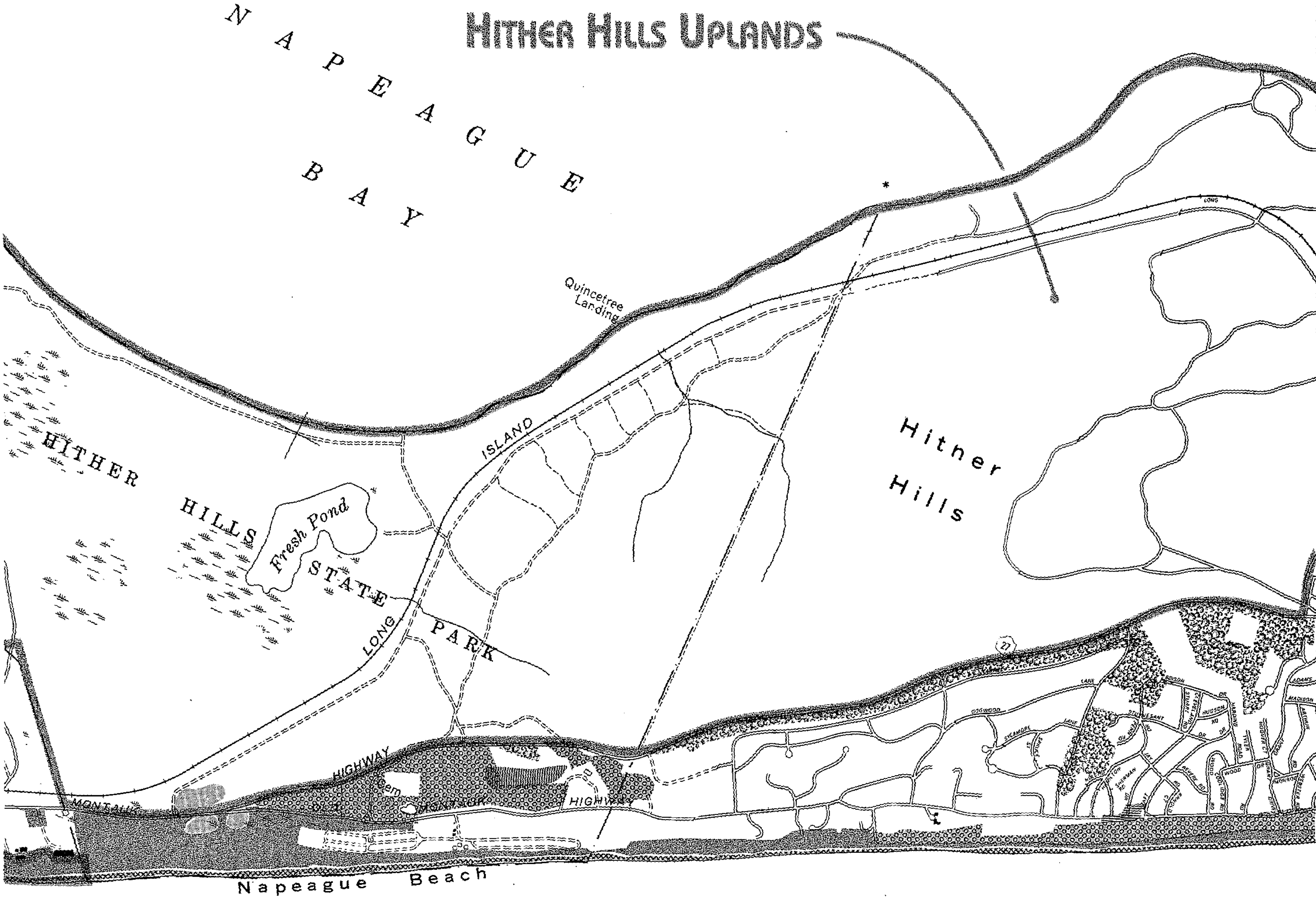
Three Mile Harbor
Threemile Harbor
East Hampton
Hook Pond
Lily Pond
Golf Course
Golf Club
East Hampton Beach
Atlantic Double Dunes
A T L A N T I C
12


Acabonack Harbor
Gardiners Bay
Louse Pt
Accabonac Cliff
Barnes Landing
Water
Alberts Landing
N
Scale 1" = 2000'
Fresh Pond
Cross Rd
Amagansett
Abrams Landing
Ocean View
Cross Road
Cranberry
Naval Res (Radio Sta)
Napeague Beach
Ocean

13

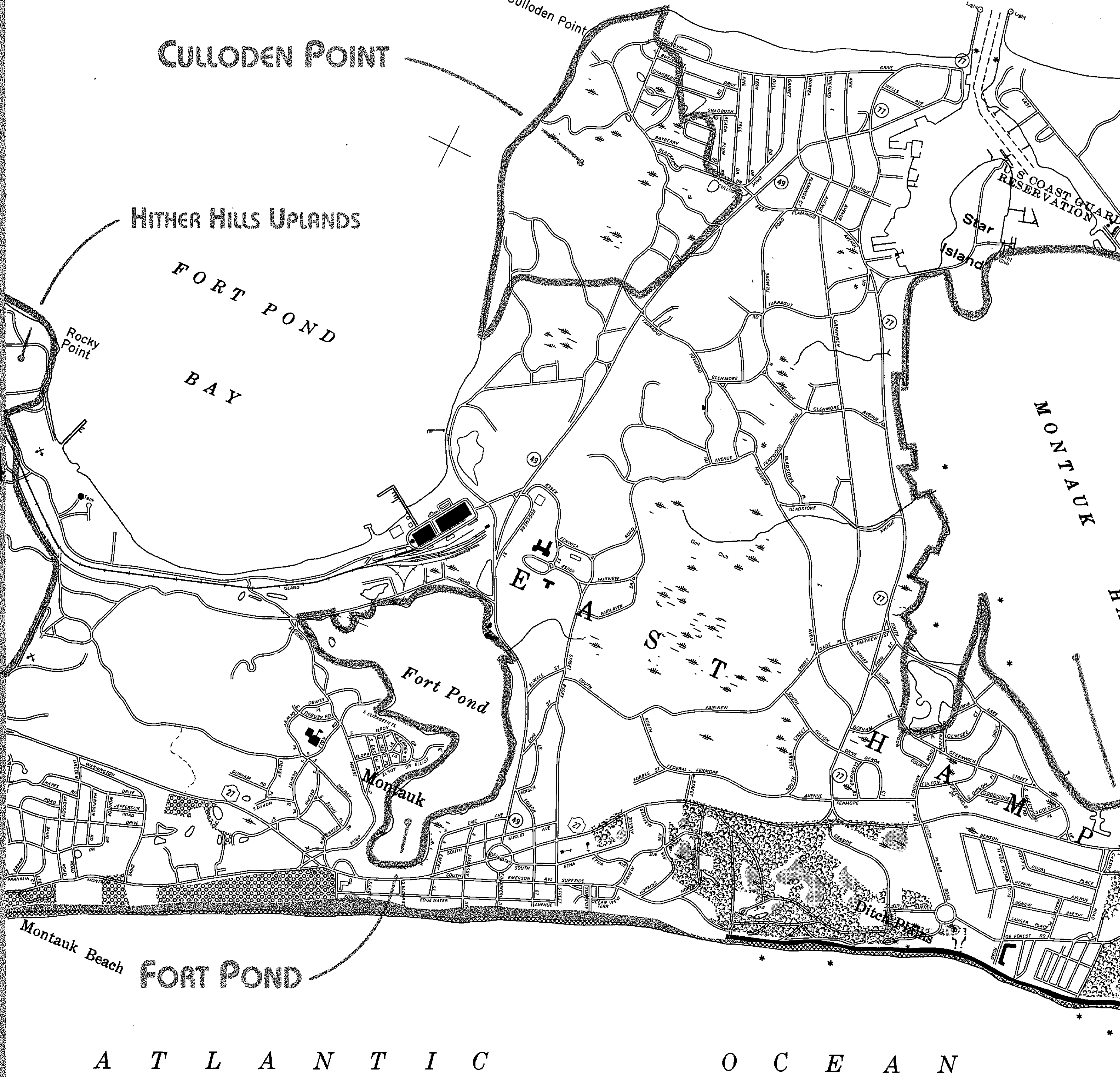


NAPEAGUE BEACH

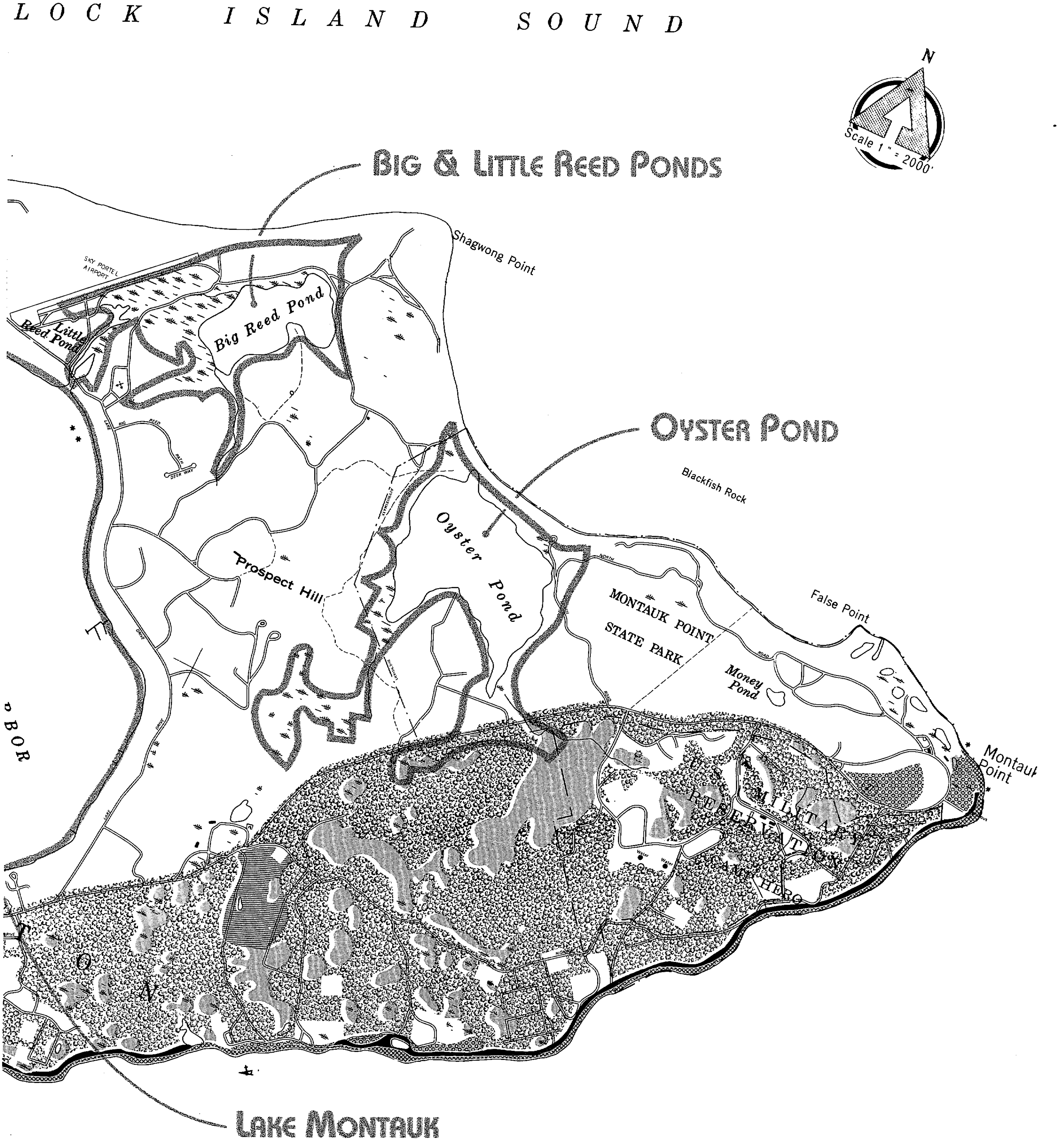


Hither Hills Uplands
NAPEAGUE BAY
Quincetree Landing
LONG ISLAND
Hither Hills
HITHER HILLS STATE PARK
Fresh Pond
MONTAUK HIGHWAY
Napeague Beach

B


Culloden Point
CULLODEN POINT
HITHER HILLS UPLANDS
FORT POND BAY
Rocky Point
U.S. COAST GUARD RESERVATION
Star Island
MONTAUK
Golf Club
EAST HAMP
Fort Pond
Montauk
Ditch Plains
Montauk Beach
FORT POND
ATLANTIC OCEAN

14

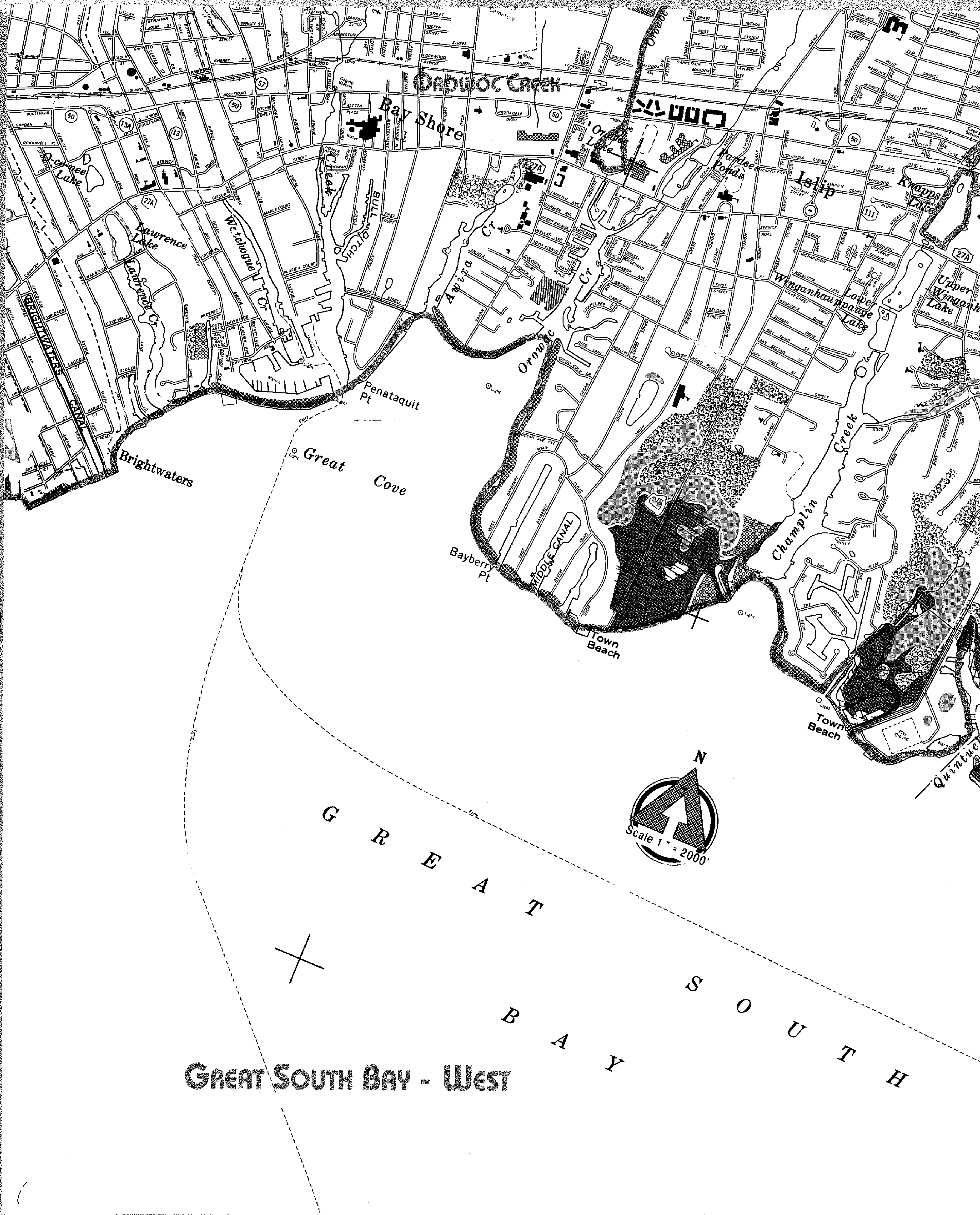


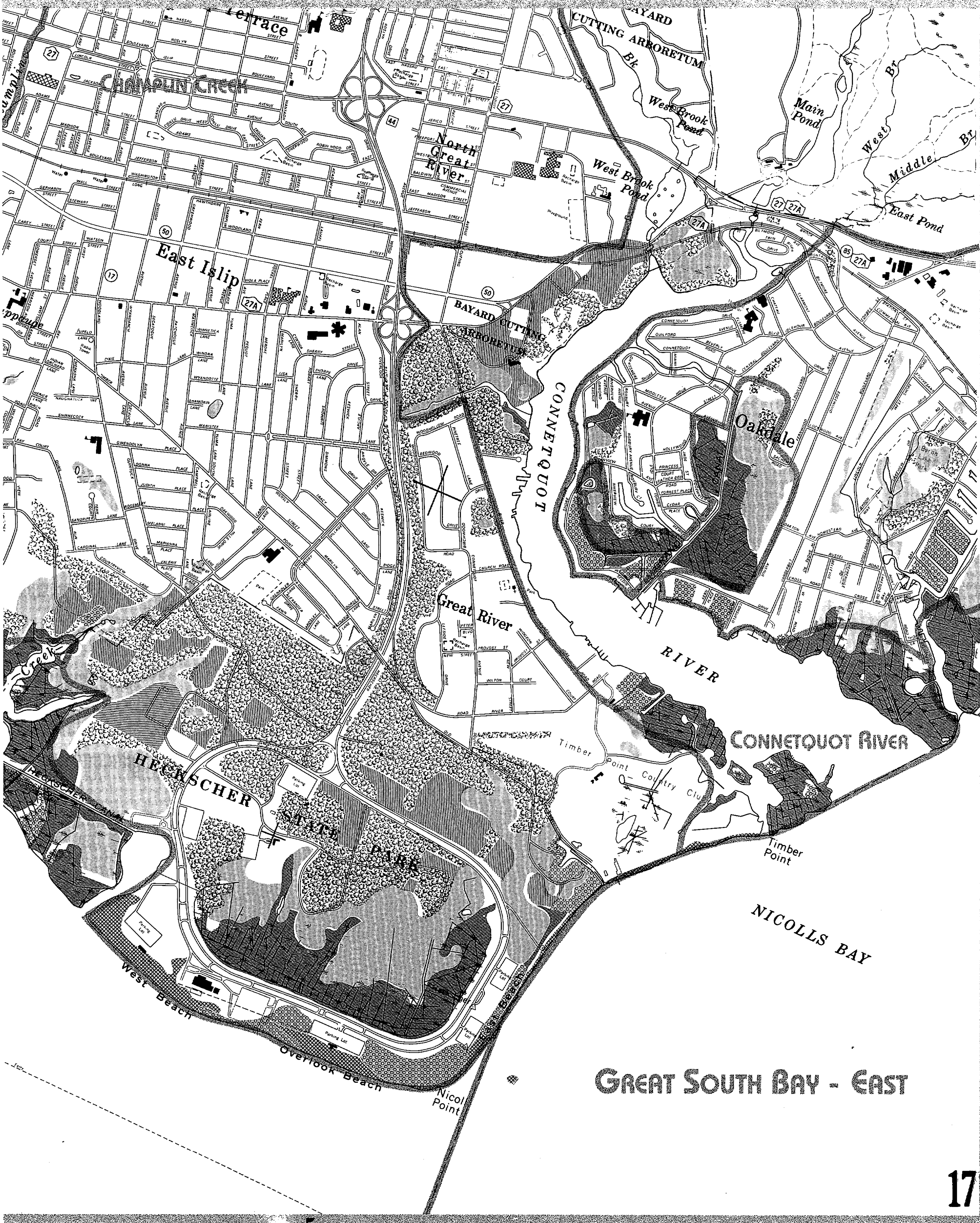
LOCK ISLAND SOUND
N
Scale 1" = 2000'
BIG & LITTLE REED PONDS
SKY PORTEL AIRPORT
Shagwong Point
Little Reed Pond
Big Reed Pond
OYSTER POND
Blackfish Rock
Oyster Pond
Prospect Hill
MONTAUK POINT STATE PARK
False Point
Money Pond
Montauk Point
MILITARY RESERVATION
LAKE MONTAUK

3

GREAT SOUTH BAY - WEST


North Babylon
West Islip
West Bay Shore
Southards Pond
Sampawams
Sampawams Cr
Skookwams Cr
Willetts
Lake Capri
Creek
Thompsons
Trues
Nosreka Lake
Appletree Neck
COUNTY PARK
Okenok Neck
Babylon Cove
Sampawams Pt
Willetts Point
Conklin Point
OAK ISLAND CHANNEL
A Y
N
Scale 1" = 2000'
16
17
5


Orowoc Creek
Bay Shore
Islip
O-co-nee Lake
Lawrence Lake
Lawrence Cr
Watchogue Cr
Bull Ditch
Brightwaters Canal
Brightwaters
Penataquit Pt
Great Cove
Awixa Cr
Orowoc Cr
Orowoc Lake
Pardee's Ponds
Knapps Lake
Winganhauppauge Lake
Lower
Upper Winganhauppauge Lake
Champlin Creek
Bayberry Pt
Middle Canal
Town Beach
Town Beach
Quintuck
N
Scale 1" = 2000'
Great South Bay
Great South Bay - West

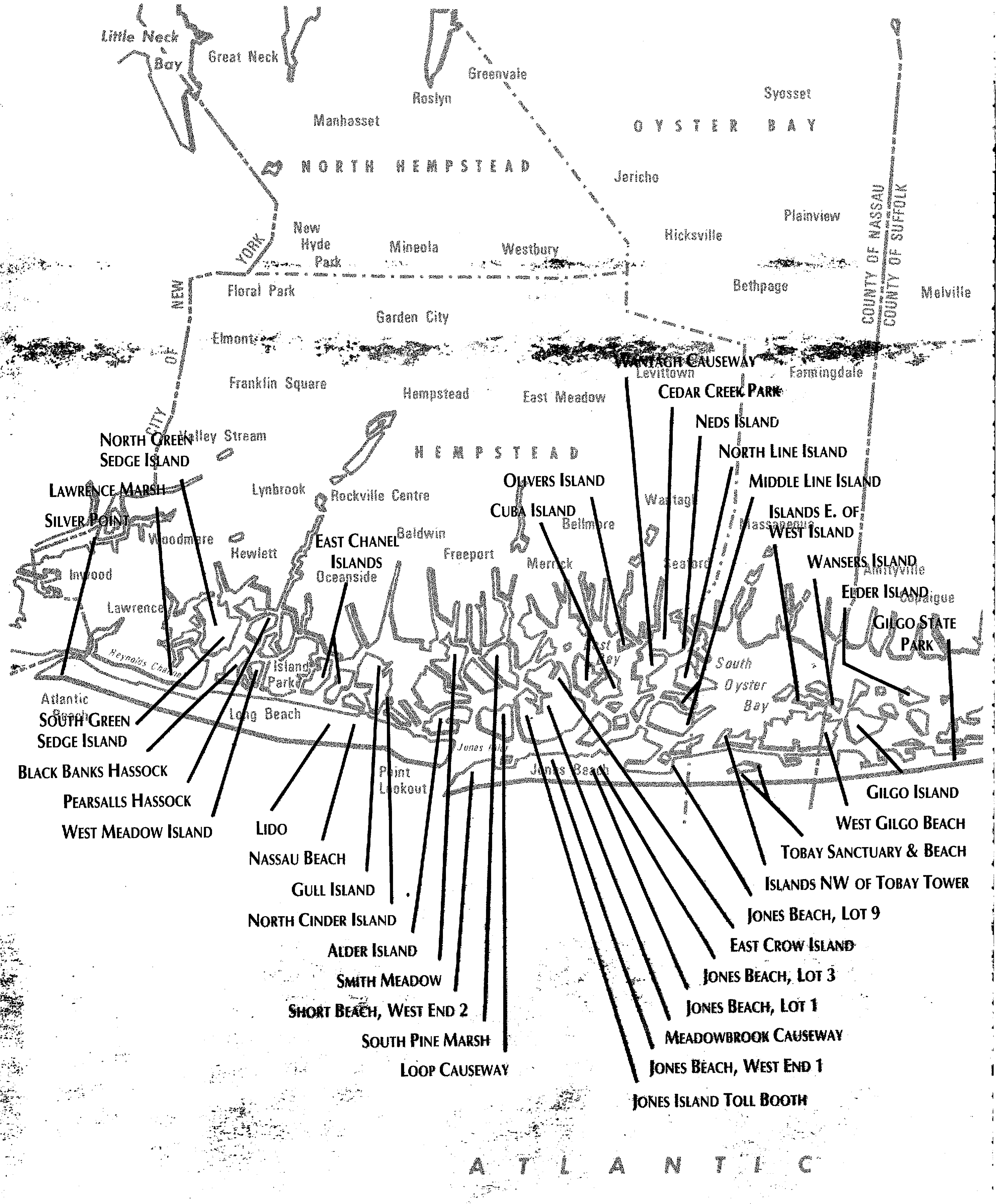


Terrace
Champlin Creek
Bayard
Cutting Arboretum
Main Pond
West Br
Middle Br
East Pond
North Great River
West Brook Pond
East Islip
Bayard Cutting Arboretum
Connetquot
Oakdale
Great River
River
Connetquot River
Timber Point Country Club
Timber Point
Heckscher State Park
Heckscher Canal
West Beach
Overlook Beach
Nicoll Point
Nicolls Bay
Great South Bay - East

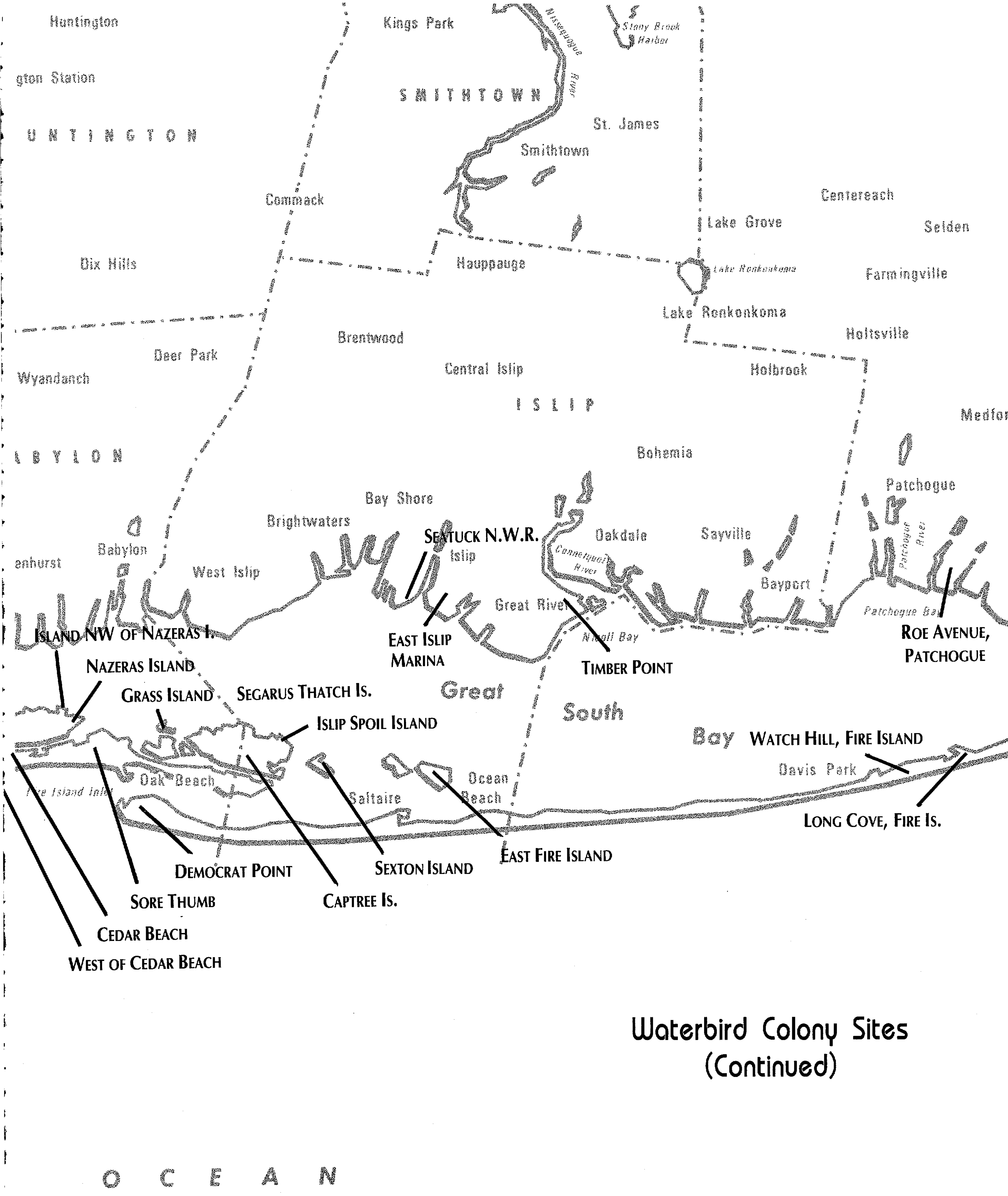
GREAT SOUTH BAY - EAST


Patchogue Highlands
North Patchogue
Canaan Lake
Great Patchogue Lake
West Lake
PATCHOGUE
East Patchogue
Sans Souci Lakes
Edwards Airport
Purgatory
Blue Point
Bayport
Patchogue
PATCHOGUE
BAY
SWAN RIVER
Blue Pt
N
Scale 1" = 2000'
18
6

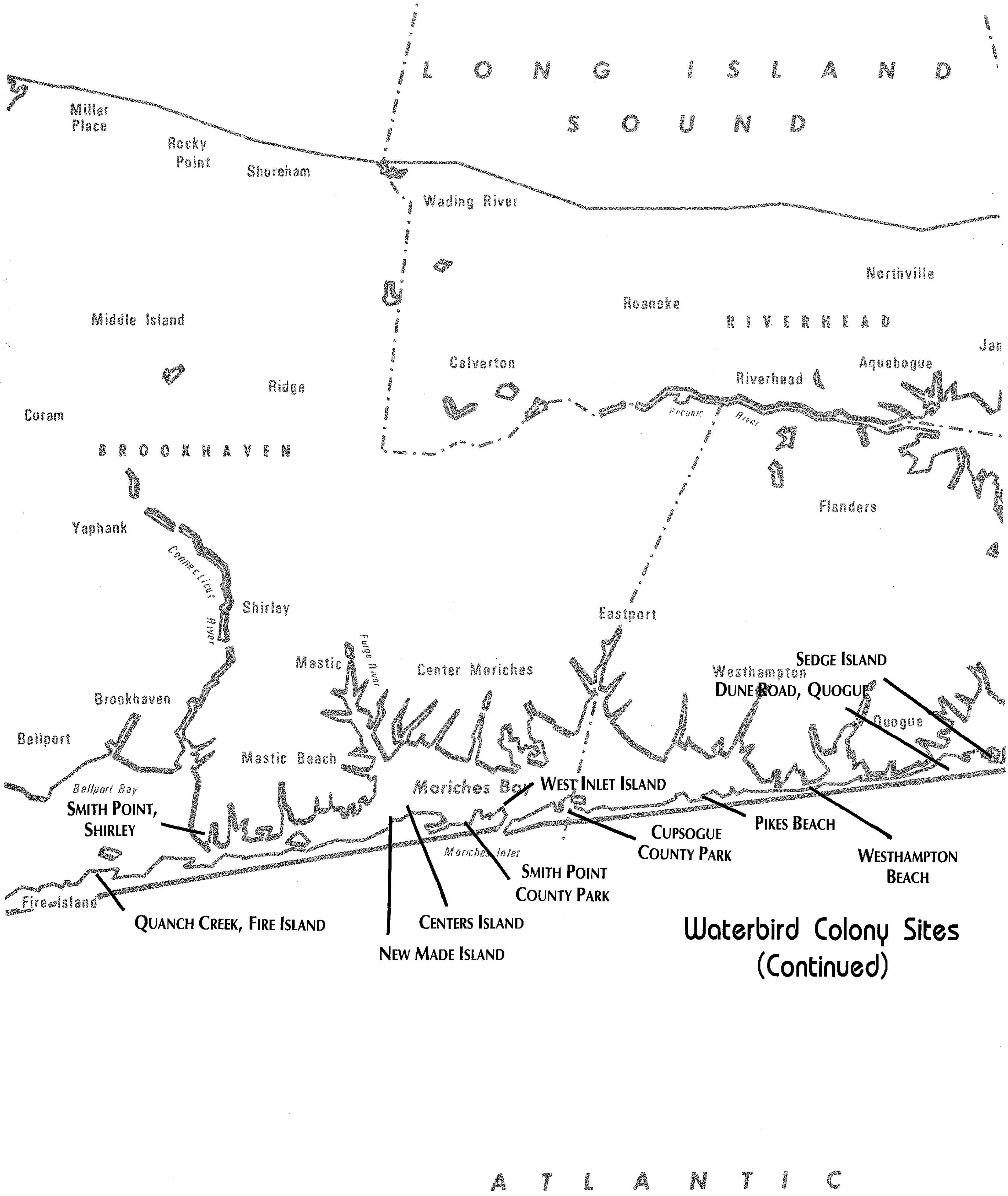
Waterbird Colony Sites



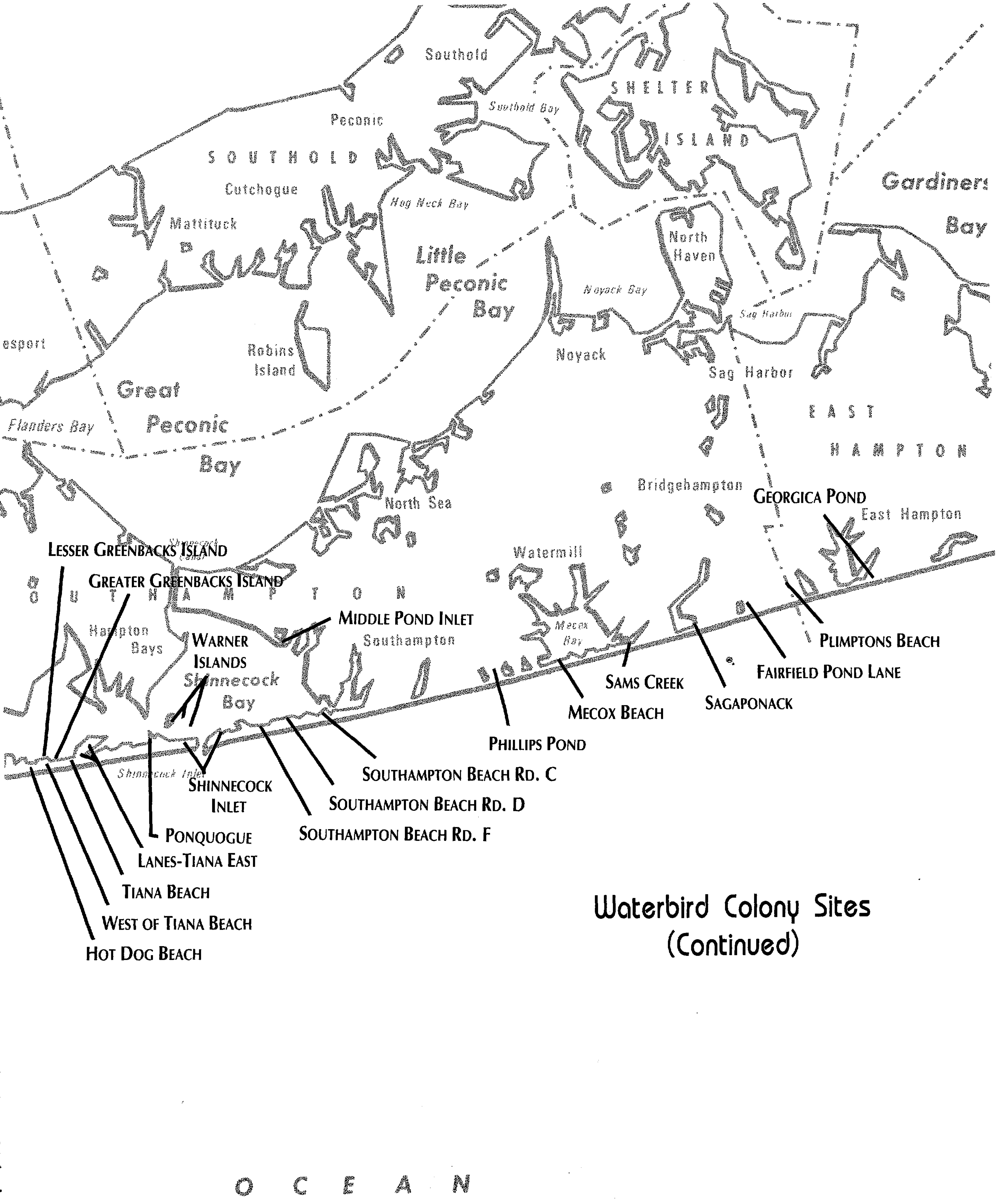
Little Neck Bay
Great Neck
Roslyn
Greenvale
Syosset
Manhasset
OYSTER BAY
NORTH HEMPSTEAD
Jericho
Plainview
Hicksville
New Hyde Park
Mineola
Westbury
NEW YORK CITY
COUNTY OF NASSAU
COUNTY OF SUFFOLK
Floral Park
Bethpage
Melville
Garden City
Elmont
WANTAGH CAUSEWAY
Levittown
Farmingdale
Franklin Square
Hempstead
East Meadow
CEDAR CREEK PARK
NEDS ISLAND
NORTH GREEN SEDGE ISLAND
Valley Stream
HEMPSTEAD
NORTH LINE ISLAND
OLIVERS ISLAND
MIDDLE LINE ISLAND
LAWRENCE MARSH
Lynbrook
Rockville Centre
Wantagh
SILVER POINT
CUBA ISLAND
Bellmore
ISLANDS E. OF WEST ISLAND
Woodmere
Hewlett
EAST CHANEL ISLANDS
Baldwin
Massapequa
Freeport
Merrick
Seaford
WANSERS ISLAND
Amityville
Inwood
Oceanside
ELDER ISLAND
Copiague
Lawrence
GILGO STATE PARK
Reynolds Channel
Island Park
South Oyster Bay
Atlantic Beach
SOUTH GREEN SEDGE ISLAND
Long Beach
Jones Inlet
Jones Beach
Point Lookout
BLACK BANKS HASSOCK
GILGO ISLAND
PEARSALLS HASSOCK
WEST GILGO BEACH
WEST MEADOW ISLAND
LIDO
TOBAY SANCTUARY & BEACH
NASSAU BEACH
ISLANDS NW OF TOBAY TOWER
GULL ISLAND
JONES BEACH, LOT 9
NORTH CINDER ISLAND
EAST CROW ISLAND
ALDER ISLAND
JONES BEACH, LOT 3
SMITH MEADOW
JONES BEACH, LOT 1
SHORT BEACH, WEST END 2
MEADOWBROOK CAUSEWAY
SOUTH PINE MARSH
JONES BEACH, WEST END 1
LOOP CAUSEWAY
JONES ISLAND TOLL BOOTH
ATLANTIC



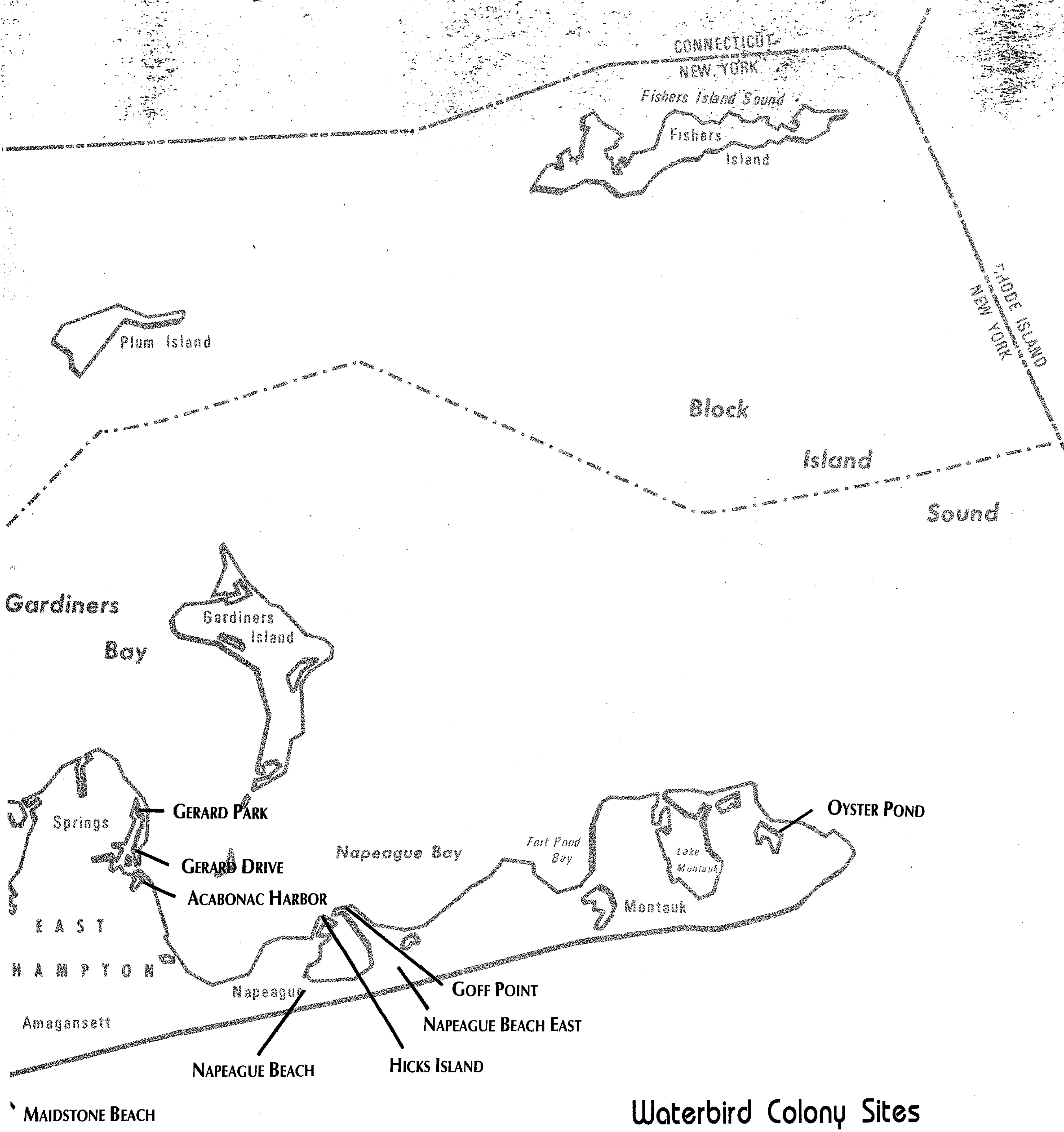
Waterbird Colony Sites
(Continued)



Waterbird Colony Sites (Continued)



Waterbird Colony Sites
(Continued)



Waterbird Colony Sites
(Continued)

Chapter Three

HAZARD MANAGEMENT PROGRAM

3.0 Introduction

This chapter includes land use and coastal management recommendations that address erosion and flooding problems on the south shore of Long Island Both generic and location-specific recommendations are discussed The generic recommendations refer to situations that could develop at any or most locations along the south shore study area. Site specific recommendations have been made for the 13 shoreline segments that comprise the study area with reference made to the Land Use Plan Map Series in this chapter. Policy justifications and preferred erosion management options for each segment are also included.

3.1 South Shore Land Use Plan Maps

This chapter contains the Land Use Plan Map Series at a scale of 1" 2000', which depicts the following categories of land use·

Residential

- 1 dwelling unit or less/acre (low density)
- 2-4 dwelling units/acre
- 5-10 dwelling units/acre
- 11 dwelling units or more/acre (high density)

Commercial

Industrial

Institutional

Open Space and Recreational

Transportation and Utilities

This map series is based on an analysis of existing land uses, development trends, natural resource considerations and other study components. Detailed descriptions of the map series and land use plan goals are contained in section 3.8

3.2 Coastal Hazard Planning Policies

To facilitate the identification of preferred hazard management options, the study area was divided into 13 shoreline segments, averaging about 8 miles in length, on the basis of land use patterns and geomorphic and physical criteria, such as shoreline type, inlet location, etc The names and general location of the shoreline segments are shown in Figure 3-1; boundary descriptions and a key referencing segment location on the Land Use Plan Map Series are located in Table 3-1.

Coastal hazard planning policies that reflect long range land use goals were developed and assigned to the 13 shoreline segments by the Board staff. (The specific assignments are discussed later in section 3 8) These policies are summarized as follows

- *Maintain Shoreline Position*· The policy of maintaining the location of the present shoreline was assigned to those locations where the desire is to protect high density development and/or substantial public infrastructure
- *Maintain the Beach*· Adequate beaches for recreational activities should be maintained in those areas subject to high intensity recreational use. This policy does not imply that the beach must also provide hurricane protection
- *Maintain Barrier Islands:* The existence and continuity of barrier islands, spits, bars, etc should be maintained to protect bay environments and mainland shoreline areas. This policy does not necessarily imply maintaining the actual position of the shoreline
- *Regulate Private Development and Erosion Control Projects:* This policy emphasizes regulation of private construction and erosion control activities as the primary means of protecting coastal features and development In those areas where this policy is applicable, there is not a sufficient public interest in maintaining shoreline position, beaches or coastal landforms to warrant public expenditures.

The intent of the South Shore Hazard Management Program is to protect coastal resources and public amenities from impacts associated with shoreline erosion and flooding Management recommendations made for each of the 13 shoreline segments must be compatible with the hazard planning policy(ies) above and the overall intent of the program

3.3 Assessment of Erosion Management Options

Based on the hazard planning policy(ies) assigned to each shoreline segment, and the available data and information on coastal features/changes and the physical forces that cause such changes, the teams of coastal engineers and geologists were asked to identify those erosion management options that they felt were most reasonable, promising or preferable, given the conditions extant in each segment. Eight erosion management options were considered

Figure 3-1 *General Location of South Shore Shoreline Segments*

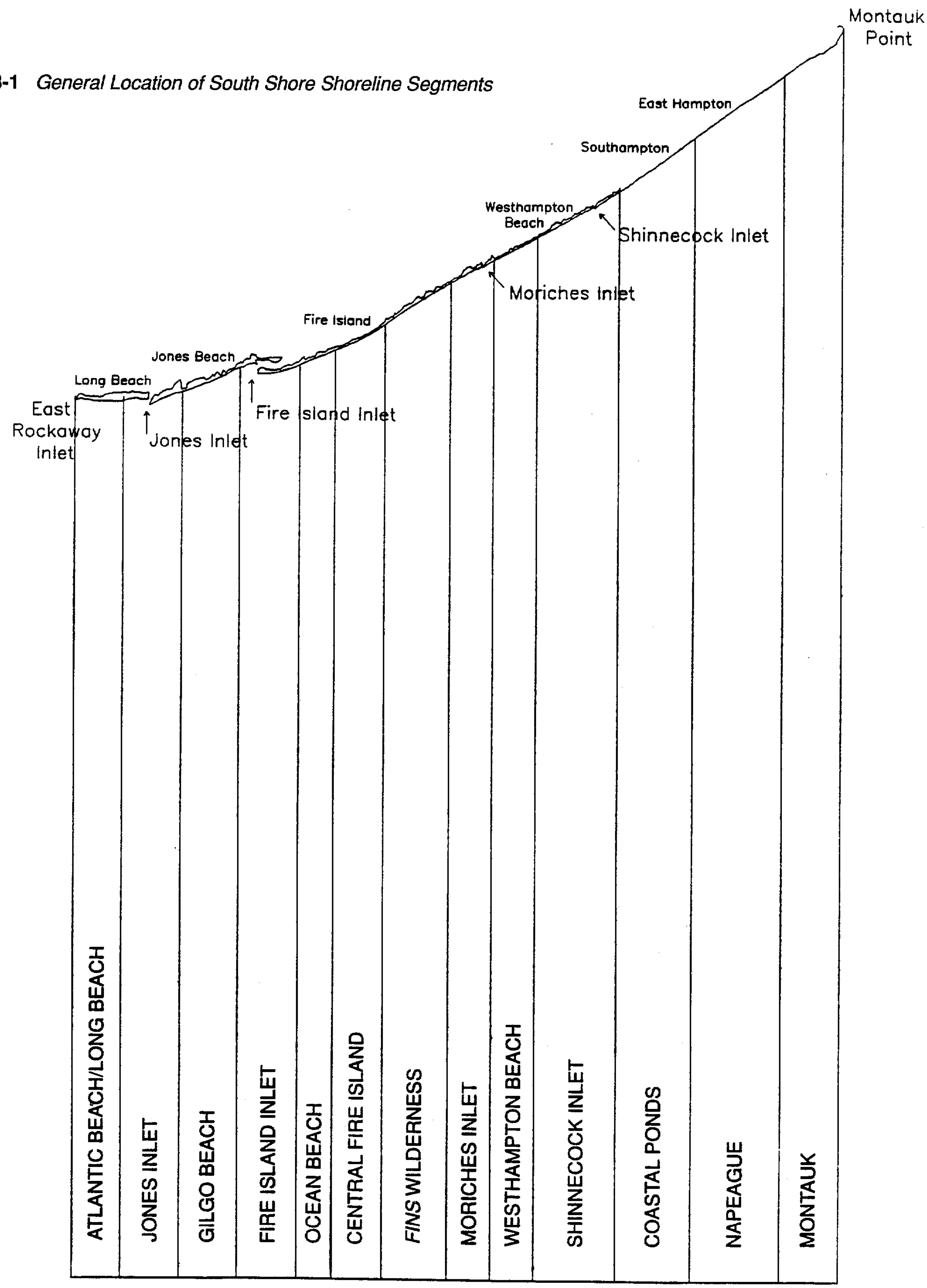


TABLE 3-1

Shoreline Segment Names, Boundaries and Land Use Plan Map Reference Number(s).

Shoreline Segment Name	*Segment Boundaries*	*Land Use Plan Map Number(s)*
ATLANTIC BEACH/LONG BEACH	Jetty at East Rockaway Inlet to the easternmost groin at Long Beach	No . 1
JONES INLET	Easternmost groin at Long Beach to the easternmost parking lot at Jones Beach near Zach's Bay	No. 2
GILGO BEACH	Easternmost parking lot at Jones Beach near Zach's Bay to the west side of Cedar Beach	No. 3 & 4
FIRE ISLAND INLET	West side of Cedar Beach to the west boundary of Kismet	No. 4
OCEAN BEACH	West boundary of Kismet to the east boundary of Point O'Woods	No. 5
CENTRAL FIRE ISLAND	East boundary of Point O' Woods to east boundary of Davis Park	No. 5 & 6
FINS WILDERNESS	East boundary of Davis Park to west boundary of Smith Pt. County Park	No. 6 & 7
MORICHES INLET	West boundary of Smith Pt. County Park to east boundary of Cupsogue County Park	No. 7 & 8
WESTHAMPTON BEACH	East boundary of Cupsogue County Park to the Village of Westhampton Beach - Village of Quogue boundary	No. 8 & 9
SHINNECOCK INLET	Village of Westhampton Beach - Village ofQuogue boundary to Halsey Neck Lane in Village of Southampton	No. 9, 10 & 11
COASTAL PONDS	Halsey Neck Lane in Village of Southampton to the eastern boundary of the Village of East Hampton	No. 11, 12 & 13
NAPEAGUE	Eastern boundary of the Village of East Hampton to the eastern boundary of Hither Hills State Park	No. 13 & 14
MONTAUK	Eastern boundary of Hither Hills State Park to Montauk Pt.	No. 14 & 15

- Do nothing
- Shore hardening
- Groins
- Breakwaters
- Beach nourishment/dune building
- Sand bypassing
- Relocation/retreat
- Insufficient data to decide

Team participants were allowed to select combinations of the above as a single alternative.

The deliberations and findings made by the coastal engineers and geologists form the basis of the discussions on the preferred erosion management options for each shoreline segment included in this chapter. The options are subject to important qualifications. The teams were asked to make a preliminary independent assessment of the most appropriate options for managing erosion based on the available, often incomplete or dated, technical information. The shoreline segments discussed earlier were selected to be large enough to allow for the development of a comprehensive, regional erosion management strategy. Very small stretches of the coast, on the order of hundreds of yards in length, cannot be managed independently in a regional strategy. However, in certain cases extenuating circumstances such as site-specific land use, social/economic factors, and/or pre-existing structures may require erosion management decisions to be made on this smaller scale. Although such cases were not ignored, a detailed analysis of site-specific erosion control options for relatively small stretches of coast is beyond the scope of this program. Local exceptions to the preferred strategy as detailed for each shoreline segment may be required; however, such smaller-scale projects should be compatible with the regional approach.

On the other hand, the shoreline segments were not made so large as to preclude discrimination among segments where different tactics should be applied. Care must be taken to insure that any options implemented in one segment are compatible with those in adjacent segments. Because the coast operates as a dynamic system, changes in one segment, whether natural or man-made, may require a revision of selected erosion management options in other segments. The recommendations made in this program are not static, and should be periodically adjusted to accommodate expected, or unexpected, changes.

3.4 Generic Hazard Management Recommendations - Longshore Transport, Inlet Management and Closure of New Inlets

The segment-by-segment analysis that was conducted to select preferred management options recognized that several erosion-related problems transcended segment boundaries, and that resolution of the problems would require a consistent approach applied to the entire shoreline of the study area. The relative success of the preferred management options keyed to each of the 13 shoreline segments depends on the premise that the generic erosion control strategy recommendations described below will be implemented along the south shore coast as a whole.

- *Longshore Transport.* The integrity and continuity of the longshore transport of sand must be maintained through each segment. Where the transport of sand has been or will be interrupted, a mechanism for bypassing or restoring sand transport must be inaugurated and maintained. In segments where the continuity of long shore transport has been disrupted in the recent past, some additional nourishment may be necessary to re-establish the sand budget. Sand trapped in tidal deltas at stabilized inlets oraccumulated in shoals seaward of groin fields may need to be relocated back on to the beach. A prudent management strategy could employ dune building and overwash mitigation strategies as an inexpensive means of helping to maintain the longshore transport system. All of the preferred options identified for the coastal segments must incorporate appropriate plans for sand bypassing. This strategy would also apply to the western boundary of the study area. The continuity of longshore transport across East Rockaway Inlet to New York City beaches to the west should be maintained.
- *Inlet Management.* Proper management of inlets is of critical importance since inlets play a dominant role in the processes affecting coastal change. Many of the most severe coastal erosion problems along the south shore are associated with inlets. The loss of large volumes of sand into inlet deltas appears to be a principal cause of shoreline recession. In addition, the stabilization of the inlets has resulted in large accumulations of sand updrift of the jetties. Based on long-term shoreline changes, the erosion and accretion processes associated with south shore inlets seem to increase in magnitude from east to west.

  Presently, most inlet dredging projects are undertaken in response to navigation concerns. In keeping with the longshore transport recommendation above, effective management programs for inlets should be designed not only to stabilize channels for navigation, but also to incorporate provisions for maintaining the longshore transport of sand across the inlets. *Inlet bypassing is the single most important erosion management strategy recommended for the south shore,* and should be implemented at East Rockaway Inlet, Jones Inlet, Fire Island Inlet, Moriches Inlet and Shinnecock Inlet.

  Longshore transport is not unidirectional along the south shore especially in the vicinity of inlets. Both the eastward and westward drift of sand must be accommodated at different times. The development of the most appropriate, cost-effective bypassing plan would require a detailed analysis of the physical characteristics of each inlet. Such a plan should provide for the periodic dredging and bypassing of sand to downdrift beaches on a regular basis; structures may be included in the plans for some inlets to facilitate the bypassing operations. Impoundment basins and/or small, perhaps tapered, groins in the area immediately downdrift of the inlet could help retain material on the beach in the shadow of the downdrift jetty (where such jetties exist), and prevent sand from being transported back into the inlet by localized reversals in the direction of longshore transport caused by wave refraction.

At existing inlets, historical shoreline migration rates showing the degree of downdrift recession after the inlet formed could be used in conjunction with profile measurements to estimate the quantity of sand that would be needed to replace that amount lost as a result of the disruption of the longshore transport. This information could then be used to evaluate the volume of sand that should be artificially bypassed to provide the downdrift area with a supply of sand equal to that entering the updrift area in the vicinity of the inlet. The results of this type of analysis could then be used to modify bypassing requirements and help identify the most efficient bypassing techniques.

- *Closure of New Inlets.* The formation of new inlets along the barrier island section of the south shore is of critical concern, and could severely affect biological resources and human uses of the south shore bays and adjacent shorelines. As indicated in section 2.1.11, the disruption of barrier island migration by inlet processes may be of secondary importance compared to the impacts associated with the formation of new inlets. New inlets could cause substantial, rapid changes in the coastal environment and have more immediate management implications especially in terms of the 35 year planning horizon of this program.

Impacts associated with new inlets could include:

— increased flooding and erosion on the mainland shoreline due to increased water levels and wave action in the bays;
— changes in shoaling patterns, water circulation, temperature, and salinity that could significantly alter existing bay ecosystems; and
— disruption of the longshore transport of sand along the ocean shoreline that would result in increased downdrift erosion.

In addition, new inlets would also change the tidal exchange between the bay and ocean at stabilized inlets. The expected increased rate of shoaling would adversely affect channel maintenance operations and could eventually preclude the use of existing inlets for navigation purposes. Given the investment society has already made in the existing inlets and the magnitude and nature of the changes associated with the formation of new inlets along the south shore, the occurrence of these features would be unacceptable from a management standpoint. Steps should be taken to prevent new inlets from forming. If they do form, and do not close naturally, they should be closed artificially. This can be accomplished most economically if action is taken promptly while the inlet is small.

In addition to the three general recommendations previously mentioned, an erosion management monitoring program should be implemented for the south shore. The details of the recommended monitoring program are described in Chapter 4.

3.5 Coastal High Risk Zone

The *Coastal High Risk* zone includes that area encompassed by any of the following: the **V** zone on *Flood Insurance Rate Maps* (FIRMs); the *Coastal Erosion Hazard Area* as identified on maps prepared by New York State Dept. of Environmental Conservation, and theJones Beach, Fire Island, Westhampton Beach Barrier Islands and the Southampton barrier spit.

Private interests owning structures and/or property on the Jones Beach, Fire Island and Westhampton Beach barrier islands and Southampton spit should bear the burden of the loss of such structures and/or property due to erosion and flooding. Within this Coastal High Risk Zone, there is minimal public interest in making government expenditures for maintaining private development.

When private structures located within the Coastal High Risk Zone are damaged to a level greater than 50% of their replacement value due to either severe storm occurrence or long-term shoreline erosion, action should be taken to prohibit re-development in those locations and configurations that would result in recurring public costs to cover repeated damages or threaten the integrity of the barrier islands. Should regulation and other actions described in Section 4.2 when implemented fail to prevent re-development, government should acquire the damaged structures and private property at fair market value as a last resort. Fair market value should also reflect relocation costs. It must be emphasized that the prohibition on re-development in the Coastal High Risk Zone would be implemented as structures are lost over time to either chronic erosion or as a result of a severe storm event. Since it is impossible to predict the locations where such losses will occur in advance, re-development patterns associated with these locations are not shown on the Land Use Plan Map. It is anticipated that the process by which portions of the Coastal High Risk Zone are transformed into open space will be evolutionary in nature. This process will be further delayed if hazard management program recommendations for sand by-passing and inlet maintenance are implemented.

It is recommended that post-storm community re-development plans be prepared in advance to deal with those instances where a severe storm event destroys a large portion of a community and government can neither prevent re-development through regulation nor acquire properties because of a lack of financial resources. Such plans will help to ensure that re-development will minimize exposure to repeated flood and erosion losses. In general, the intensity of private re-development located in coastal areas should not increase above levels shown on the Land Use Plan maps.

No public expenditures for infrastructure should be made that would encourage private development or increase the intensity of such uses on the coastal barriers. The focus of public expenditures for infrastructure repair, erosion control, etc., should be to provide access to water dependent uses in these areas, e.g., parks, public bathing beaches, marinas, and commercial fishing facilities.

3.6 Sea level Rise and Natural Resource Protection

The discussion in section 2.1.7 indicates that the degree to which sea level rise contributes to the total erosion occurring along the south shore is of secondary importance in comparison to other processes operating in the area, especially when considered in the context of this program's 35 year planning horizon. Moderate increases in the rate of sea level rise would probably have a relatively small impact on the observed rate of erosion compared to the impacts caused by storms and disruptions in the longshore transport resulting from man's activities. From a planning perspective, the submergence of low lying areas around the south shore bays due to sea level rise is probably a more critical problem than the potential for increased ocean front erosion. A study of the implications of sea level rise along back bay shorelines should be initiated. It is concluded that a cautious approach toward shoreline management that preserves options for dealing with potential acceleration in the rate of sea level rise is the most prudent path to take at this time.

Impacts of accelerated sea level rise could include:

- beach erosion and dune line recession;
- mobilization of *new* sediment in the littoral system, which may be lost to restore areas;
- gradual inundation of coastal structures, e.g., bulkheads, revetments, docks;
- flooding of low lying coastal areas and extension of flood zone areas inland;
- displacement of coastal habitats, e.g., tidal wetlands;
- increased salinity in tributaries; and
- interference with gravity flow systems, e.g. storm water drainage.

The potential impacts of sea level rise on bays and coastal ponds would probably be most dramatic in the displacement and possible elimination of coastal habitats, including freshwater wetlands and tidal wetlands. The mechanisms responsible for these effects are described as follows (Titus, Henderson and Teal 1984):

> *....Sea level rise increases the frequency of tidal flooding throughout a salt marsh, causing the system to migrate upward and landward. If no inorganic sediment or peat is added to the marsh, the seaward portions become flooded so frequently that marsh grass drowns and marsh soil erodes; portions of the high marsh become low marsh; and upland areas immediately above the former spring tide level are flooded at spring tide and become high marsh.*
> *....The net impact of sea level rise on total marsh acreage also depends on the slopes of the marsh and upland areas. If the land has a constant slope throughout the marsh and upland, the area lost to marsh drowning will equal the area gained by the landward encroachment of spring high tides. Throughout most marshes, however, the slope above the marsh is steeper than the marsh; thus, a rise of sea level will cause a net loss of marsh acreage.*

Shoreline development can undermine the ability of wetlands to adjust to a rising sea level. Efforts to protect structures via bulkheading and other hard structures could prevent the landward migration of wetland systems, thus exacerbating tidal wetland losses.

Planning at the state and local levels can help address the problems posed by rising seas. Public awareness is of the utmost importance. Permit procedures and environmental impact analyses can be used to help assure that wetlands have room to migrate landward. This focuses on the need to maintain buffer areas between shoreline habitats and upland areas (Titus 1984). The policy of strategic retreat from vulnerable coastal areas in light of potential acceleration in the rate of sea level rise and subsequent flooding of low lying coastal areas is the rational approach to follow. Where engineered shoreline structures, roads, bridges, and causeways are required, they should be designed with sea level rise in mind. The alternative of gradual retreat is involuntary retreat as a result of disaster situations.

> *....Although retreat from the shoreline should not be adopted as a simple, rigid rule for all situations, the time has come to adopt it as a general policy, around which other policies and regulations would be shaped. Stated simply, whenever possible, wherever possible, and as soon as possible development should be moved away from the shoreline. (Matthiessen 1989:13)*

The land use and hazard planning recommendations in this report, e.g., gradual elimination of development in the Coastal

High Risk Zone, are in conformance with the philosophy previously stated.

While it is not recommended that wholesale abandonment of existing public facilities and private development located in coastal areas should occur in advance of actual sea level rise acceleration, structures should be removed from vulnerable locations over the long-term when subject to substantial damage from erosion and flooding impacts.

The generic and segment-specific erosion and flood-related recommendations in this chapter are compatible with regulatory efforts to protect south shore natural resources and New York State Designated Significant Fish and Wildlife Habitats as described in Chapter 2. With regard to erosion management, the implementation of the recommendations over the long-term will help to stabilize south shore bay/coastal pond environments and, hence, ensure continued use for recreational and commercial purposes. Efforts to protect the integrity of the barrier beaches and spits may lead to opportunities for the creation of wetland environments through the judicious placement of dredge spoil.

3.7 Bulkhead Construction and Armoring of Coastal Bluffs

Structural solutions to coastal erosion problems found primarily along the headland portion of the south shore are discussed in this section with a view toward showing how different types of information can be used to improve the decisionmaking process. The situations presented involve the proposed construction of a bulkhead on an ocean beach to protect a structure, and the proposed armoring of the toe of a coastal bluff.

A number of questions should be addressed in the permit review process for the installation of a bulkhead to protect a private home on the open ocean coast against storm damage.

- What is the cause of the erosion problem resulting in the need for the structure? Is there a public works project or other structure updrift exacerbating the problem? Is the structure filling a gap between other structures? Will it advance the line of building? In general, these are management related questions that would be answered with information on land use conditions in the area.
- Is the shoreline experiencing long-term retreat? At what rate? When will the shoreline reach the structure? The answers to these questions can be obtained from the analysis of long-term shoreline trends. This information allows one to project the long-term impacts of the proposed action, especially in terms of its potential effects on future beach width. If the shoreline shows chronic landward migration, the stabilization of the back beach area could result in a narrowing of the beach as the shoreline moves landward. If the water line migrates landward of the structure it could have adverse impacts on adjacent properties that may be unacceptable or require mitigative measures. If, on the other hand, the shoreline is relatively stable, the impacts associated with the potential narrowing of the beach over the long-term would most likely be minimized or eliminated.
- What is the active beach profile or short-term variability of the beach? How frequently will storms expose the bulkhead, and to what extent will it be exposed? By preventing erosion of the dune or upland during storms, will the structure be depriving the beach and adjacent areas of sand, thus aggravating erosion? The information from beach profile surveys, water level measurements, wave observations and studies of the regional geology (sediment grain size distributions) provides the answers to these questions.

  These answers are important for several reasons. In certain areas, erosion of the upland or the dune (depending on the topography and composition of the material) may provide sand to the adjacent areas through erosion during storms. If this is the case, the bulkhead, by preventing the movement of this material, may cause a local sand deficit equal to the volume of sand that would be lost if the structure was not there. This in turn may adversely affect adjacent areas by depriving them of material they would normally receive during extreme conditions. Where this volume of sand is a significant component of the local sediment budget, the installation of the bulkhead may be conditioned on stipulations that require the owner to mitigate potential adverse impacts by artificially placing a quantity of sand equal to that lost to the system on a yearly basis, as is done in certain situations in Florida. Where the dune volume is minimal or upland erosion is not a significant source of suitable sediment (due to volume or composition), these impacts on adjacent areas could be minimal and the project may be warranted.

  A knowledge of the changes in shoreline configuration (from profile measurements) in response to physical factors (waves and water level variations) could be used to predict how often the structure would be exposed and provide an estimate of the potential impacts on the beach and adjacent areas over time. This information could then be employed to develop appropriate set back requirements for locating structures to minimize adverse impacts. Obviously, this type of information would also be beneficial in developing structural design criteria (toe penetration requirements, height, strength of materials, etc.).
- What magnitude of storm is the house (i.e., the structure to be protected) designed to withstand? What is the specific purpose of the structure (to protect the

house or dune)? In Florida, if the house is built to 100-year Federal Flood Insurance standards, shore hardening is usually not permitted, since the house alone should withstand a major storm without the structure. Shore hardening devices generally are not favored for the protection of dunes only, and may not be warranted if that is their stated purpose. These structures may be a viable alternative to protect older houses that do not meet present flood standards. In Florida, if the structures are allowed, they are required to be placed as close to the house as possible (usually landward of the dune if there is one) and, depending on the particular situation, may have to incorporate mitigative measures, such as toe scour protection.

- Will the structure inhibit the recovery or growth of the dune by interrupting the aeolian sediment transport? What structural changes should be made to ameliorate adverse impacts on dune building processes? Is artificial dune restoration necessary?
- What is the land use configuration in the vicinity of the project? What are the uses of the beach, and who needs access (fishermen, bathers, etc.)? Will the structure significantly change the configuration of the beach (in terms of beach width, for example) and, if so, inhibit access or use?

Although the situation considered above involved the installation of a specific type of shoreline hardening device (a bulkhead), the questions asked and information needed to answer these questions would also be required to evaluate other types of shore hardening devices commonly used in coastal areas.

The second situation considered is the proposed armoring of the toe of a coastal bluff with a revetment to protect an individual upland structure. Because there are a number of similarities between this type of project and the previously described situation involving bulkheading, many of the considerations in categories previously mentioned would be pertinent. However, there are also fundamental differences between the two situations. Among the more important differences are the following:

- unlike the dunes, bluffs are a relic feature and cannot be expected to recover after an erosional event;
- the erosion of bluffs may have a more important role in the sediment budget (depending on their size and composition) than the role of dune erosion; and
- the erosion processes on bluffed coasts may be significantly different than those occurring along other parts of the shore.

In addition to the questions and information described in the discussion on the bulkhead, the following questions should be considered in assessing a proposal to armor the toe of a bluff:

- Is the structure addressing the primary causes of erosion? In many cases, other factors such as groundwater may be a more dominant cause of erosion than undercutting at the toe in bluffed areas. Although a geotechnical analysis would be required to make a full analysis of the exact processes causing the erosion and their relative magnitude, some measure of the importance of undercutting may be obtained by examining profiles and aerial photographs. Recession of the toe over the long-term, or the presence of scarps at the base of the bluff after storms would tend to indicate that wave undercutting is occurring and some type of toe protection might be necessary to slow own the erosion. If processes acting within or on the bluff face are the cause of the erosion, coastal engineering structures at the toe would have little effect. This analysis could also help identify possible factors, such as lawn watering, septic leakage, etc., which may be exacerbating the problem and rectified relatively easily.
- What is the rate of erosion and the height of the bluff? What is the composition of the material? How rapidly is material eroded from the bluff removed from the beach? Information from profiles, historic recession rates and data on regional geology would be required to answer these questions. This information and data could be used to determine if the bluff is indeed supplying the type of material needed to maintain the beach and longshore sediment transport system and, if so, at what rate. If erosion of the bluff is not a significant source of material found along the downdrift beaches, because the material is too fine or the material is too large to be moved by the processes acting in the area; or the volume eroded is small (due to a low recession rate or low bluff height), then these impacts would probably be minimal and the project may be justified. However, if bluff erosion is a significant source of beach-sized material, the proposed armoring may have adverse impacts on surrounding areas. This information could so be used to develop mitigative measures, such as requiring the applicant to supply a quantity of beach compatible material from an upland site equal to the volume lost due to the armoring.
- Could the building to be protected be relocated or setbacks established to preclude the need for the structure? Information on the bluff composition, profile (height) and lot size would be required to determine a prudent setback and whether relocation is feasible.
- Where along the bluff does the erosion occur? Does the beach have to be eroded before the bluff is attacked? This information could be obtained from post-storm surveys and/or aerial photographs, wave and water level data, and data on regional geology. In some areas of California, the erosion of bluffs during storms often occurs at a point below the elevation of the beach after the beach has been removed by the waves. If this does happen in an area, armoring of the toe of the bluff above the elevation of the active

beach profile, as is often proposed, would provide little benefit, and special consideration would have to be given to the design of the structure in terms of required depth of penetration.

3.8 Detailed Recommendations by Shoreline Segment

3.8.1 Atlantic Beach/Long Beach Segment

3.8.1.1. Existing Land Use and Shore Protection Structures: Both the Village of Atlantic Beach and the City of Long Beach are highly urbanized with year-round populations, as of January 1, 1989, of 1,939 and 36,519 respectively. The predominant land use is moderate density residential development (5-10 dwelling units/acre) followed by high density residential development (>10 dwelling units/acre). The moderate density residential development consists principally of single family units and 2-3 story condominiums. The high density residential development consists principally of high-rise (5-10 story) apartments and condominiums located in the vicinity of Shore Road, East and West Broadway. High density single family residential development is located in West Long Beach between Clayton and New York Avenues.

Recreation and open space uses in this segment include Silver Point County Park, which is leased to concessioners who run two private beach clubs containing 1674 cabanas and 250 lockers. Access to the park, which accounts for approximately 50% of the ocean shoreline owned by Nassau County, is limited to club members. There are no maintenance costs incurred by the County for Silver Point County Park, since all costs for operation and maintenance of the park are the obligation of the concessioners. The income derived by the County from the concessioners was $789,352 in 1989. In addition, there are public bathing beaches south of the boardwalk in both the Village and City. The beaches in this segment are heavily utilized although beach attendance has not been recorded. The City of Long Beach receives $1,151,000 in direct revenue from the issuance of seasonal and daily beach passes.

The City of Long Beach in cooperation with the Town of Hempstead has implemented a dune construction program. The City requires that material from building excavations be placed in the vicinity of the proposed dunes. The material is then graded and snow fencing is erected upon the graded material in a "Y" formation to capture windblown sand. In addition, the piles of sand are planted with beach grass to provide stability. Dunes have been constructed from the City's eastern boundary to the eastern terminus of the boardwalk and from the western terminus of the boardwalk west to the City's western boundary.

In addition to the dune construction program, Federal, state and local governments have constructed 43 groins to provide erosion and hurricane protection. These groins extend from Lido Beach to Atlantic Beach. Table 3-2 summarizes the erosion control construction activities undertaken along Long Beach Island.

Commercial activity in the Village of Atlantic Beach is recreation-oriented consisting primarily of private beach clubs located on Ocean Blvd. Retail activity dominates the Long Beach commercial area located on East and West Park Street.

3.8.1.2 Land Use Plan Goals: Since residential land use in this shoreline segment is classified as intermediate and high density within a highly urbanized setting, little opportunity exists to minimize vulnerability from coastal storms or erosion by re-directing development or re-development away from flood and/or erosion prone areas. Thus, the land use plan goals recognize this fact and envision the continuance of intermediate and high density residential uses. This goal would permit re-development at higher densities utilizing clustering of single family units away from more vulnerable coastal locations, such as in West Long Beach. This goal requires that maximum protection from coastal storms be provided.

A second land use goal involves the continued use of beaches for recreation/bathing activities. Appropriate units of government should ensure that adequate beach is available for such activities.

3.8.1.3 Coastal Hazard Planning Policies: The coastal hazard planning policies for the Atlantic Beach/Long Beach segment reflect the land use plan goals identified above. Since these goals recognize that intermediate and high density uses will continue, the appropriate policy to implement these goals is to maintain the shoreline location, that is, the land/sea interface, not necessarily at precisely the existing location, but at a point to be determined by detailed study. This policy would serve to protect structures from erosion hazards, and could maximize protection of structures from the hazards associated with coastal flooding.

The second coastal hazard planning policy applicable to this segment requires the maintenance of beaches of adequate width for recreation activities. This policy will require that all municipalities involved must refine their recreation planning activities to determine existing peak beach attendance and capacity, and balance this attendance with the desire and/or need to utilize beach area for dune creation. It will also require the establishment of a locally suitable beach attendance density standard that is compatible with beach recreation and dune protection objectives.

3.8.1.4 Policy Justification: This shoreline segment is highly urbanized and almost fully developed as evidenced in the description of existing land use. Residential land use densities are among the highest in the bi-county region. It is also important to note that as of 1980, 92.2% of the housing stock in this segment is occupied year-round. Thus, it is imperative that the shoreline of this segment be stabilized to afford protection to more than 15,700 housing units. In addition, this shoreline segment contains a full complement of infrastructure including roads, bridges and utilities. As for the extensive back bay tidal

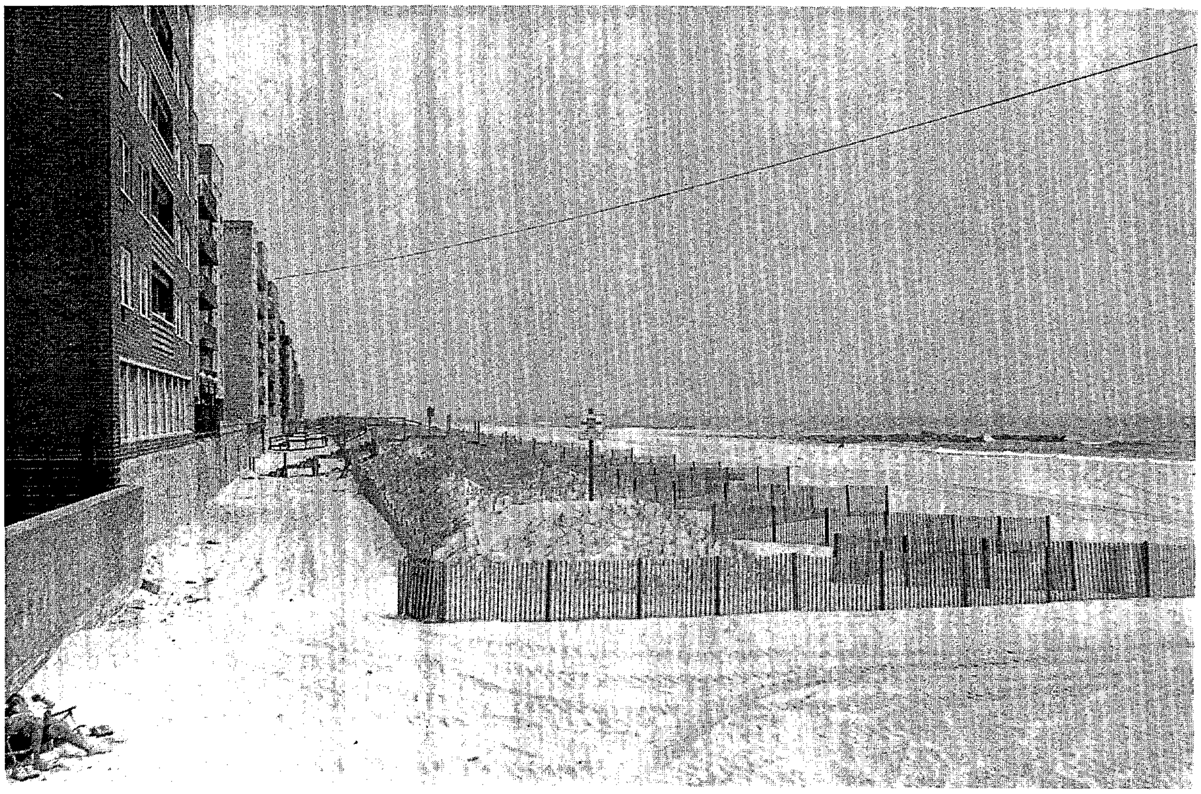


FIGURE 3-2 - *City of Long Beach, May 1989. Recently constructed dunes immediately east of boardwalk*

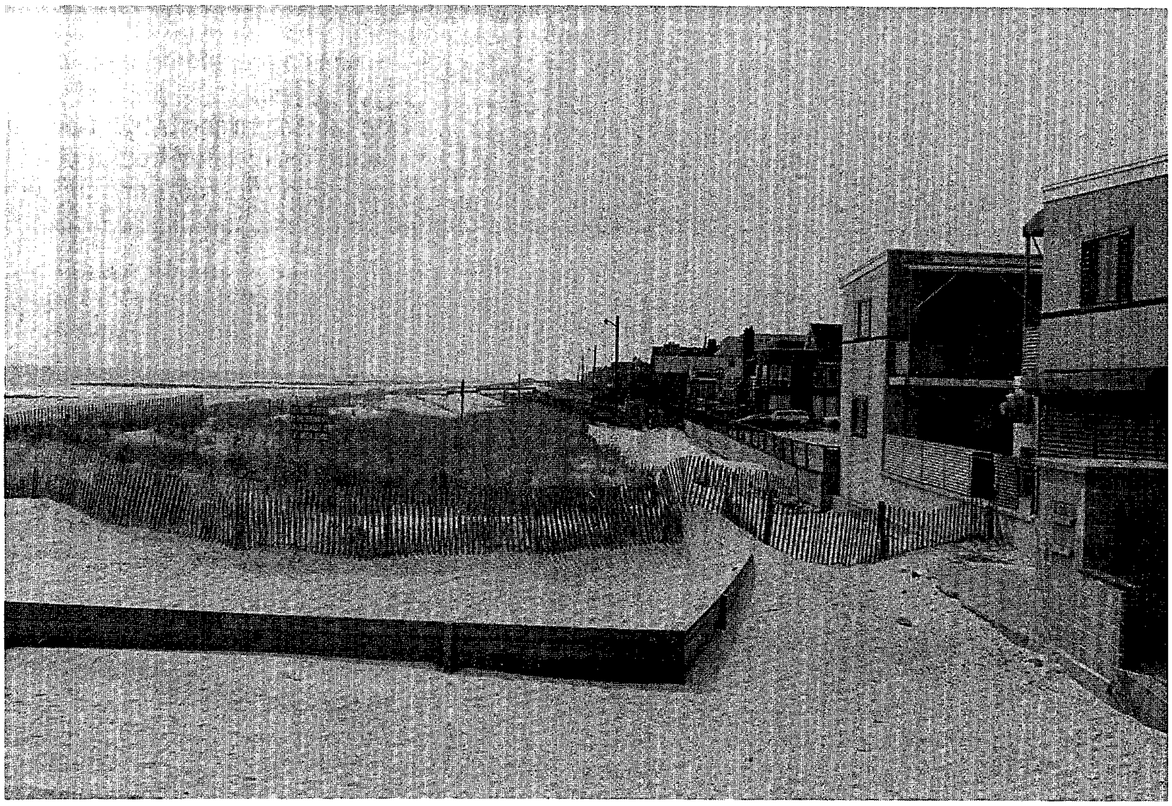


FIGURE 3-3 - *City of Long Beach, May 1989. Dunes constructed immediately west of boardwalk*

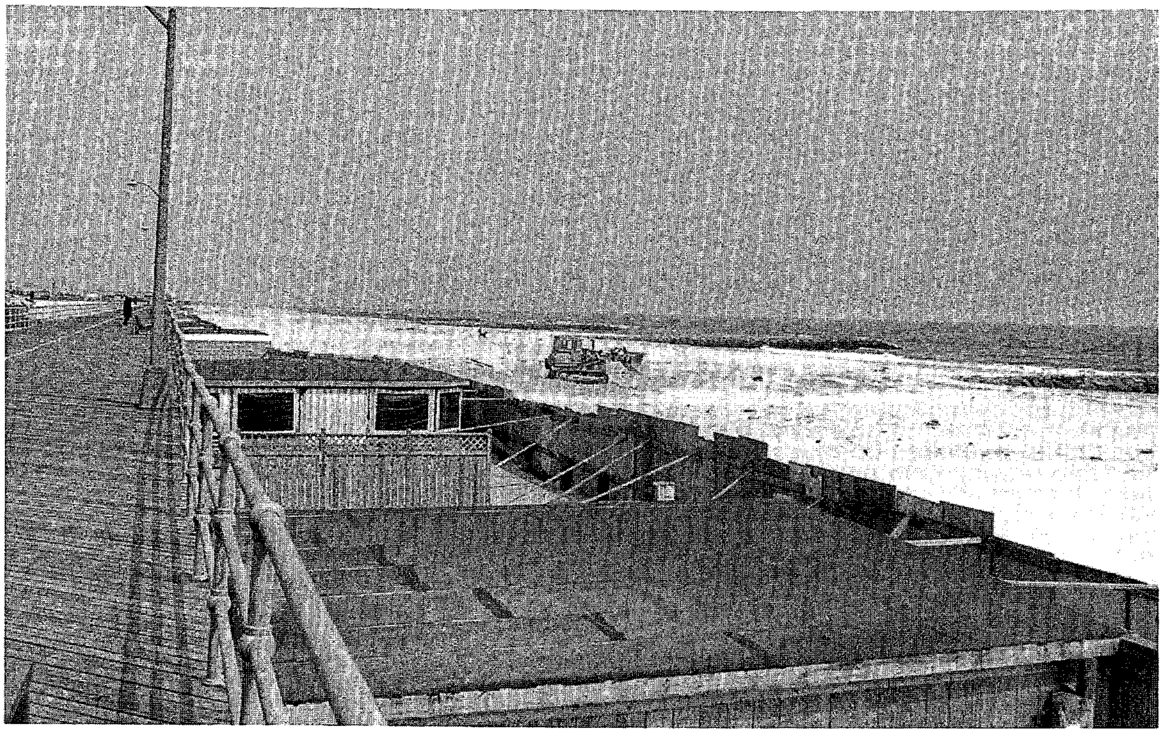


FIGURE 3-4 - *Village of Atlantic Beach, May 1989. Removal of windblown sand adjacent to cabanas and concession stands*

FIGURE 3-5 - *City of Long Beach, May 1989. Man-made dunes fronting high density residential use east of boardwalk.*

TABLE 3-2

Long Beach Barrier Island: Partial Shoreline Construction History.

Project	*Date*	*Description*	*Area*	*%Complete*	*Cost*
FEDERAL-U.S. ARMY CORPS OF ENGINEERS					
1. East Rockaway Inlet Channel Improvement	1930	Dredge channel 12 ft. deep 250 ft. wide, .6 mile long. Construct 4,250 ft. jetty on eastern side.		100%	$603,969
2. East Rockaway Inlet to Jones Inlet Beach Erosion Control and Hurricane Protection	1965-Proposed 1972-plan dropped	Multiple purpose beach erosion control and hurricane protection plan featuring: hurricane barriers, reconstruct groins, construct new groins and closure levees, and periodic beach nourishment.	10 miles of ocean shoreline	0% project not authorized	$45,000.000 (proposed)
3. Lido and Long Beach	1962	Emergency beach rehabilitation project.	4,500 feet ocean shoreline	100%	$260,000
STATE AND LOCAL					
Atlantic Beach	1954-58	14 Stone Groins, 4 Contracts Total	100%	$2,400,500	
Atlantic Beach	1959-60	Hydraulic Fill of 382,320 cu. yds.	100%	317,172	
East Atlantic Beach	1950-51	2 Stone Groins	100%	207,000	
East Atlantic Beach	1949	Hydraulic Fill	100%	80,599	
Long Beach (West End)	1955	Hydraulic Fill	100%	81,000	
City of Long Beach	1960	2 Stone Groins	100%	474,340	
City of Long Beach	1945-46	3 Stone Groins	100%	276,866	
City of Long Beach	1946-47	2 Stone Groins	100%	208,727	
Jones Inlet (Fed. Coop.)	1953-59	Stone Jetty Hydraulic Fill of 334,397 cu. yds.	100%	$3,645,049	
Pt. Lookout	1952-53	3 Stone Jetties	100%	750,000	
Pt. Lookout	1972	Hydraulic Fill of 130,000 cu. yds.	100%	258,000	

Source: Appears as Table 3-4 in Long Island Regional Planning Board (1984).

wetlands of West and Middle Hempstead Bays, they should remain undeveloped/undisturbed in order to provide maximum flood protection to the highly urbanized mainland to the north.

3.8.1.5 Preferred Erosion Management Options: The high degree of development and the large number of groins already in place along this segment of the coast requires a strategy of beach nourishment and maintenance of the existing groins in order to meet the planning objectives of maintaining both the shoreline position and adequate recreational beach. Because the beach elevation and volume in this area are relatively low, the present beach probably provides minimal storm protection. To provide a high degree of protection against storm damage, the groins would most likely have to be extended to increase the beach width and height and to provide adequate room for dune building.

There is little quantitative information on the behavior of beaches in this area. An assessment of the costs and benefits associated with alternative approaches requires a more detailed analysis of physical processes and beach changes, and the development of site specific structural designs.

The lack of a protective dune system in portions of Long Beach, the Village of Atlantic Beach and the unincorporated portion of Atlantic Beach means greater exposure to the destructive forces of severe storm events. Hurricane protection is necessary for this segment, since the existing beach has a low profile and volume. Dune construction would add to hurricane/flooding protection; groin extension would also provide the needed beach width for dune construction. Seawalls are not recommended, since they may hamper maintenance of recreational beaches of adequate width.

3.8.2 Jones Inlet Segment

3.8.2.1 Existing Land Use and Shore Protection Structures

The Jones Inlet segment covers the eastern third of Long Beach barrier island, including the hamlet areas of Lido Beach and Point Lookout, and the western portion of Jones Island barrier beach up to and including the most easterly parking lot (#6) of Jones Beach State Park. Lido Beach and Pt. Lookout are the only two residential areas within this segment. These two year-round residential communities consist primarily of single and two-family residential structures on lots of 1/4 acre or less in size; their January 1989 population is estimated at 4,900. In 1980, there were 1332 single and two-family residential structures (120 in the **V** zone and 1212 in the **A** Zone), as well as 426 dwelling units (378 in the **V** and 48 in the **A** Zone) within multi-family residential structures, located in Lido Beach and Point Lookout (Long Island Regional Planning Board 1984). A small strip of commercial development (approximately 60,000 sq. ft.) along Lido Blvd. in Point Lookout serves local needs. Marine commercial activity, including four marinas with about 400 boat slips, is located adjacent to Reynolds Channel in Point Lookout.

This segment is heavily used by the public for beachfront recreational activity. There are five oceanfront parks (one owned by the County of Nassau and four by the Town of Hempstead) with a combined parking lot capacity of 8,800 parking spaces located on the eastern one-third of Long Beach Island. The entire portion of Jones Island within this coastal segment is within the boundaries of Jones Beach State Park. The nine major parking fields provide a total of approximately 22,000 automobile parking spaces for the 10 million people who visit Jones Beach State Park every year. Along the back bay area of Jones Island and a portion of Long Beach, in the vicinity of Lido Beach, there are extensive tidal wetland areas. In addition, there are many tidal wetland islands throughout Middle and East Hempstead Bays, as well as Oyster Bay.

With the exception of three stone groins at Point Lookout and the stone jetty on the east side of Jones Inlet, this coastal segment is free of shore protection structures. The Town of Hempstead Dept. of Conservation and Waterways has had a long standing program of constructing dunes, planting beach grass on dunes, and erecting snow fencing on the beach during the off-season. These efforts have proven to be effective in trapping windblown sand.

3.8.2.2 Land Use Plan Goals: For the most part, the land use plan map closely resembles existing land use conditions. This coastal segment has the highest number of beach visitations on Long Island and, considering the large public investment in beach facilities and access infrastructure to such facilities, will continue to provide oceanfront access to a large segment of the public. The land use plan recommends maintenance of existing heavily used public recreation facilities, including Town of Hempstead and County of Nassau beach facilities and Jones Beach State Park. The plan also reflects the existing residential development at Lido Beach and the existing residential development and commercial activity at Point Lookout.

3.8.2.3 Coastal Hazard Planning Policies: Two hazard planning policies are applicable to this segment:

- maintain the location of the shoreline, i.e. land/sea interface; and
- maintain adequate beaches for recreation activities.

3.8.2.4 Policy Justification: The large public beach facilities (town, county and state) located in this segment are heavily utilized by metropolitan area residents. The development and maintenance of large beach facilities and roadway access represents a major public investment. Since the initiation of construction of Jones Beach State Park in the late 1920s, a substantial public investment has been made in the infrastructure of the park. A massive report compiled by *American Appraisal Associates* (AAA) lists all of the fixed assets owned by New York State as of 1987. The replacement cost calculated by AAA for all of the buildings at Jones Beach State Park is $55 million. LISPC staff feel this estimate is extremely low, consider-

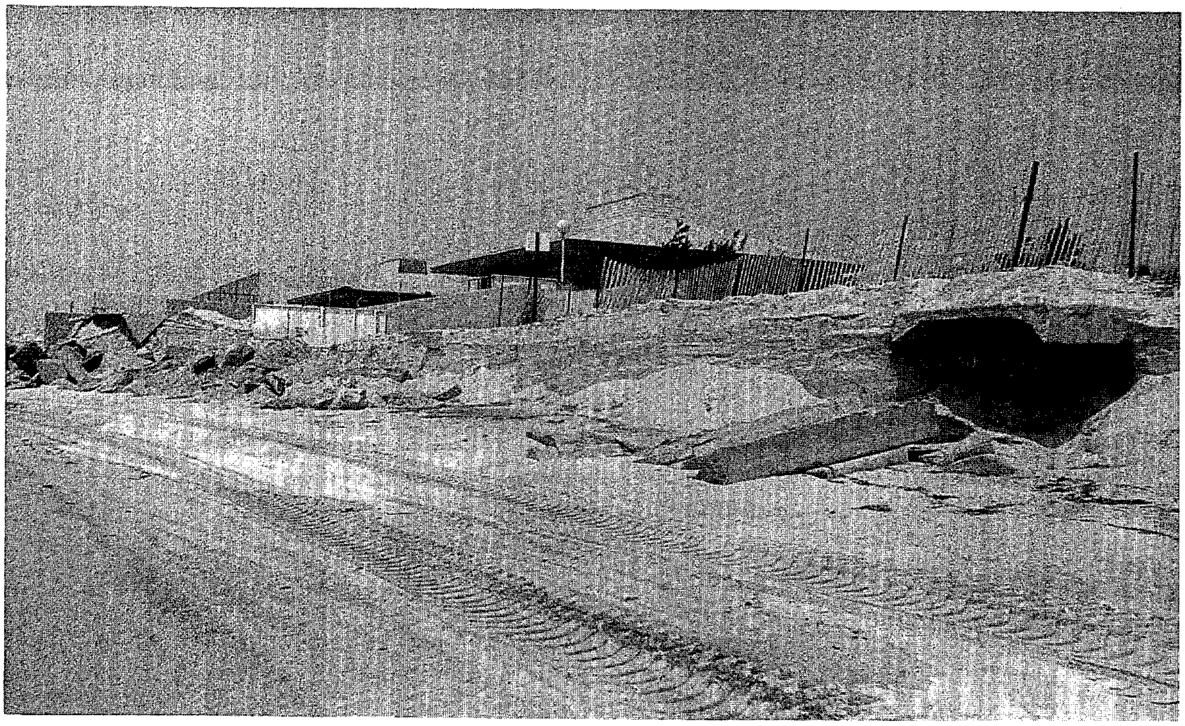


FIGURE 3-6 - *Point Lookout, May 1989. Town of Hempstead recreation pavilion damaged by erosion of feeder beach west of Inlet*

FIGURE 3-7 - *Point Lookout, May 1989. Sand starved feeder beach*

ing that this replacement cost figure includes reproduction-in-kind of the unique monumental buildings at Jones Beach including the Marine Theatre, East and West Bath Houses and Water Tower (Francis Hyland pers. comm.). New York State has spent $30 million since 1982 renovating facilities at Jones Beach State Park.

3.8.2.5 Preferred Erosion Management Options: The preferred erosion management option for the portion of the shoreline downdrift (west) of Jones Inlet involves the coupling of beach nourishment and dune building with sand bypassing using material from the dredging projects in Jones Inlet. Provisions should be made to place the material on the beach (as opposed to offshore) and far enough to the west so the sand is not transported eastward back into the inlet by localized wave refraction associated with the inlet shoals. Costs for inlet bypassing operations are highly dependent on the distance material has to be transported.

The net westerly littoral drift rate at Jones Inlet is estimated to be approximately 550,000 cubic yards per year. Longshore transport of sand in this area may be rapid and variable in direction due to the localized effects of the inlet processes. As a result, any beach fill projects should be monitored closely and the results used to adjust bypassing operations. Because of the accretionary trend associated with the jetty on the updrift portion of the shoreline east of the inlet, no action is needed in this area at this time.

Severe erosion of the feeder beach immediately west of the three groins at Point Lookout is undermining a Town of Hempstead beach pavilion. This problem is due to a number of potential factors, including the location and volume of shoals in Jones Inlet (ebb tidal delta), the alignment of the Jones Inlet navigation channel, the trapping of sand by the east jetty and updrift transport toward Jones Inlet.

The east jetty at Jones Inlet, which was completed in 1959, was constructed by the Federal Government to stabilize the inlet and reduce shoaling in its entrance. Prior to the construction of the Federal jetty, the inlet was migrating to the west and was variable in width. Navigation within the natural channel of the inlet was limited due to the ocean bar traversing the entrance at 7 feet below MLW. The inlet has stabilized and not moved further west as a result of the construction of the east jetty. The trapping capacity of the jetty was estimated to be 7,000,000 cubic yards. Using a linear regression analysis of past trends, the *Corps of Engineers* (COE) estimated that the jetty was fully impounded with sand by the end of 1985, and from that time on the inlet navigation channel shoaled at a rate of approximately 165,000 cubic yards per year. COE records show that the predominant location of the shoal was at the southern end of the channel near the seaward end of the east jetty.

The COE has maintained the navigation channel on an annual basis and even more frequently. The portion of the channel through the outer bar is generally dredged to a total depth of 16 feet below MLW. The 16 foot depth represents a 12 foot project plane, 2 foot advance maintenance and a 2 foot contractual overdredge allowance. Actual construction by large dredges in the inlet results in average depths after contract of about 16.8 feet. While the authorized width is 250 feet, the reality of the inlet regime and regional shoaling rate result in construction of a channel 350 feet in width.

The Jones Inlet Federal navigation channel has required maintenance dredging in 18 of the 30 years from 1960 through 1989. Of the 3.2 million cubic yards dredged due to maintenance work, 55% was disposed of offshore; 33% was used for beach nourishment (Point Lookout/Lido Beach); 6% was placed upland (Meadow Island); and 6% was sidecasted (Table 3-3). In addition, the material dredged during the 1963 channel realignment (331,371 cubic yards) was placed on the beach east of the inlet.

A model analysis of wave refraction in Jones Inlet is needed. COE navigation and beach protection projects should be coupled to provide for sand bypassing at Jones Inlet with placement of material on the beach face as opposed to offshore. The COE has concluded that a deposition basin 750 feet wide and 16 feet deep is the best overall method of maintaining the inlet (U. S. Army Corps of Engineers 1985). It would provide a clear 250 feet wide channel for a longer time between maintenance cycles (about 2 years); would have less potential risk to adjacent shorelines, and is reversible should unforeseen circumstances occur. It is also cost-effective and would reduce the Federal Government's average annual cost through reduction of annual mobilization and demobilization costs. Disposal would be essentially the same as for current practices, i.e., disposal at Point Lookout, at an area and time mutually acceptable to both the Town, NYSDEC and the Federal government.

3.8.3 Gilgo Beach Segment

3.8.3.1 Existing Land Use and Shore Protection Structures: The Gilgo Beach segment includes the middle section of Jones Island from the eastern end of parking field #6 at Jones Beach State Park up to, but not including, the Town of Babylon bathing facilities at Cedar Beach and Overlook. Although this entire stretch of barrier beach is publicly owned, it is not heavily developed with beach facilities except for the Town of Oyster Bay (Tobay) facility and the Town of Babylon beach and boat basin at Gilgo. Tobay and Gilgo Beach have a parking lot capacity of approximately 2,500 and 500 parking spaces, respectively. Both town beach facilities have parking lots located north of Ocean Parkway with an underpass providing pedestrian access to the ocean shorefront. No buildings or shore protection structures are situated in this segment seaward of Ocean Parkway, except for the recently constructed Tobay Beach pavilion.

All along the back bay area of Jones Island are extensive tidal wetlands as well as numerous tidal wetland islands in Oyster

TABLE 3-3.

Pay Quantity and Disposal Area for Maintenance Dredging of the Jones Inlet Federal Navigation Channel.

	PAY QUANTITY AND DISPOSAL AREA			
Fiscal Year	*Offshore*	*Beach*	*Upland*	*Sidecasted*
1960	54,700			
1961	132,100			
1962	54,200			
1963	(1)			
1964		150,600		
1965	44,900			
1966	(2)			
1967				
1968				
1969				
1970	173,500			
1971				
1972	158,100		195,500	
1973		453,500		
1974	166,200			6,400
1975	90,700			50,000
1976	34,800			16,300
1977	22,300			56,400
1978	152,400			47,000
1979	199,100			
1980		156,931		
1981				
1982		93,478		
1983				
1984				
1985		196,880		
1986				
1987	449,000			
1988				
1989				
1990	(3)			
Totals	**1,732,000**	**1,051,389**	**195,500**	**176,100**
Percent of Total Volume	*55%*	*33%*	*6%*	*6%*

(1)Channel realigned - 331,371 cubic yards dredged and placed on beach east of inlet.

(2)Insufficient data.

(3)Projection for FY 1990 - 300,000 cubic yards to be dredged and disposed of at the Town of Hempstead beach.

Source:Campbell, Thomas J. et al. (1983) and Thomas M. Creamer pers. comm.

Bay and Great South Bay. Dune formations and beachfront are the predominant natural features along the Jones Island oceanfront. Of note in this segment are Cedar Beach and Tobay Beach Sanctuary which are relatively large breeding/nesting areas of colonial waterbirds, especially terns and piping plovers.

A portion of Jones Island and some adjacent bay islands contain the residentially developed communities of West Gilgo Beach, Gilgo Beach, Oak Beach, Oak Island and Captree Island. The communities of West Gilgo and Gilgo Beach are located in the Gilgo Beach segment, while Oak Beach lies in the Fire Island Inlet segment. The structures in these communities are privately owned, but are located on land leased from the Town of Babylon. In three of these areas (West Gilgo Beach, Oak Island and a portion of Oak Beach) homeowner associations lease all or large portions of the communities from the Town of Babylon. The homeowner associations, in turn, have leased parcels to individuals who have subsequently constructed single family homes.

The Town has leased property on the barrier island within these communities since the late 1800s. In the mid-1970s the Town renewed the leases on the existing barrier and bay island residential lots for a period of 25 years. Although the current leases do not expire until the turn of the century, the Town is now considering new long-term leases (possibly for 35 years), effective from date of agreement, not necessarily when the leases expire.

It is important to note that all of the development on the barrier island is located entirely in the **V** zone as defined by FEMA and much of the development pre-dates floodplain management regulations required of communities participating in the National Flood Insurance Program. Hence, development in the wave velocity zone (**V** zone) can be subject to damage not only from stillwater flooding, but also from wave action.

Of the 418 residential structures located on the barrier and bay islands in the Town of Babylon, 246 (59%) are used on a seasonal basis according to the 1980 Census. The 1960 Census data list 351 of the 402 homes (87%) on the barrier and bay islands in the Town of Babylon as seasonal. Conversion of seasonal dwellings to year-round residences on town-owned land has been on the rise and can be expected to continue considering the existence of year-round utility service and vehicular access to the mainland via nearby bridge access.

The *Town of Babylon Dept. of Environmental Control* (TOBDEC) conducted a survey of the town-owned vacant lots on the barrier and bay island in December of 1988 to determine their suitability for development (Town of Babylon Dept. of Environmental Control 1988). None of the 322 vacant lots on the barrier and bay islands were considered suitable for habitation due to the potential for loss of life and damage to structures from a major storm. However, TOBDEC identified a total of 18 vacant lots at West

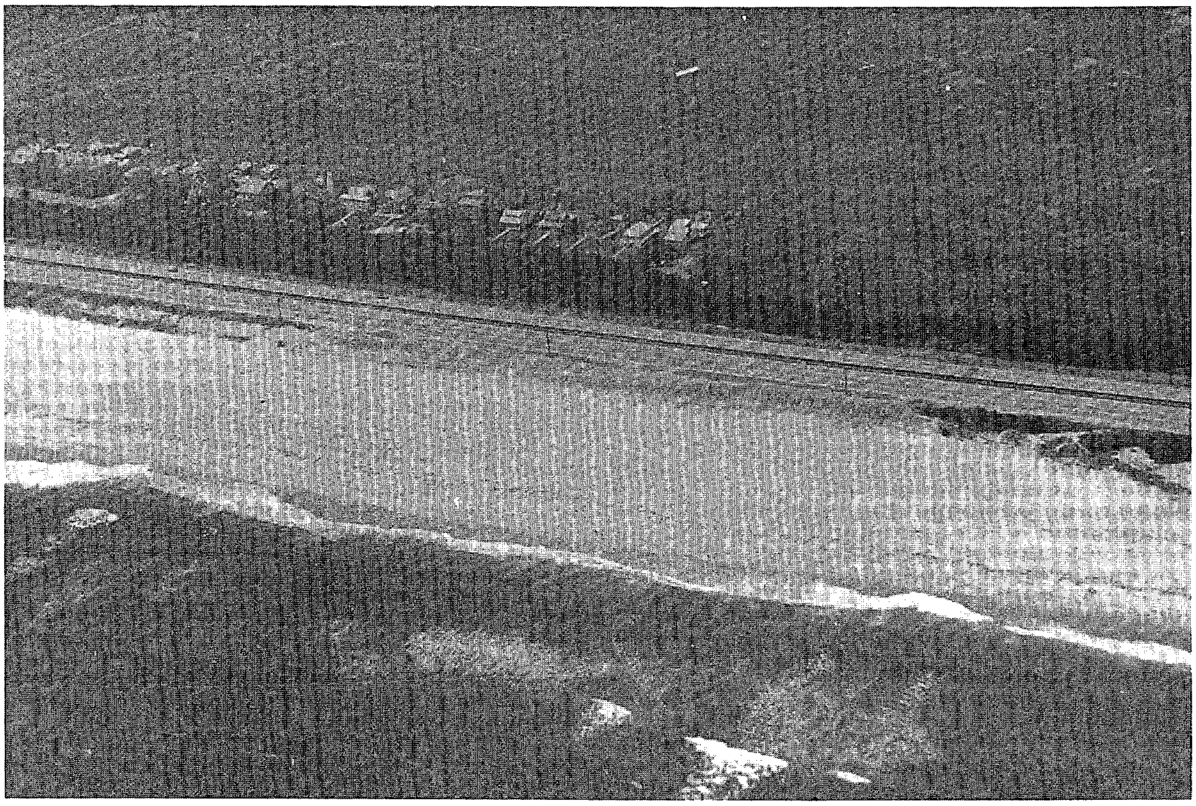


FIGURE 3-8 -*Eroded portion of Gilgo Beach, July 1989*

FIGURE 3-9 - *Gilgo Beach, March 1973. View looking west with Gilgo pavilion in background*
Photo courtesy of LISPC

FIGURE 3-10 - *Tobay Beach, May 1989. Recently reconstructed pavilion located seaward of Ocean Parkway*

FIGURE 3-11 - *Jones Beach State Park, December 1974. Erosion and subsequent abandonment of Parking Field #9 Photo courtesy of LISPC*

Gilgo Beach and Oak Beach (west end) where impacts from construction were considered minor.

3.8.3.2 Land Use Plan Goals: Although this entire segment is publicly owned, the land use plan shows some change from existing land use conditions at West Gilgo and Gilgo Beach. The Town of Babylon should phase out all leases on town-owned property on the barrier and bay islands. Consideration should also be given to government acqusition of structures situated on leased land based on fair market value. Fair market value should also reflect relocation costs. Government should not encourage residential occupancy within the Coastal High Risk Zone for the following reasons:

- potential for loss of life and damage to structures from occurrence of severe storm events (leaseholder development on Jones barrier island is located in the **V** zone and thus subject to damage not only from stillwater flooding, but also from wave action)
- the barrier island is an inherently fragile, dynamic landform
- possible contamination of glacial aquifer and surface water from on-site waste disposal systems
- damage to leaseholder property from severe storm events could increase cost to the public for various forms of disaster assistance.

A full discussion of these reasons can be found in LIRPB (1984), Town of Babylon DEC (1988), and Town of Babylon DEC (1989). After the phase-out of the leases and the removal of the structures, the Town could provide facilities for additional public recreational use and implement programs for natural resource protection where appropriate.

The State and towns of Oyster Bay and Babylon should maintain existing open space and recreational facilities at Tobay and Gilgo Beaches. Should the newly constructed ocean beach pavilion at Tobay be lost to erosion and/or storm damage, reconstruction of a new pavilion should not occur south of Ocean Parkway.

3.8.3.3 Coastal Hazard Planning Policies: Maintain the location of the shoreline i.e, land/sea interface.

3.8.3.4 Policy Justification: The fixed location of Ocean Parkway, its proximity to the eroding ocean beach, and the narrowness of the barrier island preclude any retreat option for this segment of shoreline. The location of two functioning sewage treatment plant outfall pipes, which traverse this segment of barrier island, in addition to the above mentioned reasons dictate that the continuity of the barrier beach be maintained and that the ocean shoreline not be allowed to retreat to the point where it threatens to undermine Ocean Parkway or the integrity of the STP outfall pipe(s). It is necessary to maintain the continuity of the Jones Beach barrier island not only for the operation of Ocean Parkway, but also to prevent flooding of the mainland, disruption of the longshore transport of sand, undesirable salinity changes in the bay, increased shoaling at existing inlets, and additional shore erosion problems (downdrift of any newly formed inlets).

The 108" diameter outfall pipe from the Cedar Creek STP at Seaford crosses the barrier island between Zachs Bay and Tobay and extends 2.5 miles offshore. The Cedar Creek STP service area contains over one-half million residents in southeastern Nassau County and currently treats sewage amounting to 55 mgd. The STP is now being upgraded to handle a design flow of 76 mgd projected for the year 2005. At the present time, the top of the outfall pipe lies 8 feet below the sand at the surf zone and does not appear to be threatened by coastal erosion. The top of the 72" diameter outfall pipe from the Southwest Sewer District STP, however, has only 2-3 feet of sand cover in the surf zone and, as a result, the County of Suffolk plans to undertake a construction project in the fall of 1990 to protect the outfall from further beach erosion. The Dept. of Public Works intends to install sheet steel bulkheading on both sides of the pipe and cover the pipe with a concrete cap (Edward Davida pers. comm.). The protective measure will cover approximately 700 feet of pipe from the dunes seaward. The outfall pipe extends 2.5 miles offshore from the barrier beach and was constructed in 1982 at a cost of $41 million. The Southwest Sewer District covers portions of Babylon, Islip and Huntington, and the STP is designed to process 30 mgd of sewage for approximately 250,000 people. Nearly 80% of the houses in the SWSD are now connected to the STP.

Ocean Parkway connects with the Robert Moses Causeway, Wantagh, Meadowbrook and Loop Parkways and provides beach users direct vehicular access from either Nassau or Suffolk County to any of the south shore beach facilities from Jones Beach State Park to Robert Moses State Park. Since the removal of the tolls on the parkways leading to Ocean Parkway some years ago, Ocean Parkway has also served as an alternate route for commuters who, in the absence of Ocean Parkway, would probably resort to using Southern State Parkway. If the Jones Beach barrier island were allowed to erode to the point where Ocean Parkway becomes severed, not only will beach access be impacted, but commuters using Ocean Parkway would have to use alternate, congested routes such as Southern State Parkway. LISPC, NYSDOT and NYSDEC have been trying to prevent Ocean Parkway from being undermined from erosion and, as a result, have spent $1.7 million over the last several years on emergency measures to ensure the integrity of Ocean Parkway.

3.8.3.5 Preferred Erosion Management Options: The most preferred approach to the beach erosion problems in this segment is periodic beach nourishment and dune building utilizing sand bypassed from Fire Island Inlet. The need for bypassing sand from Fire Island Inlet to maintain the beaches in this area was also identified by other investigators (Morton et al. 1986) based on detailed survey studies of the area. The materials should be placed on the beach far enough west to prevent it from being transported back into the inlet by local wave refraction patterns associated with shoaling at the inlet. Continued monitoring of the fill operations and beach behavior should be done to better define estimates of the actual amount of material that should be bypassed to provide protection. It is anticipated that the beach to the west of the inlet in 1990-1991 by NYSDEC and CDE and should cover the outfall pipes.

The Ocean Parkway and the two sewage outfalls that cross the beach in this area are of particular concern. If beach nourishment associated with bypassing is not implemented, relocation or shore hardening may be required if the parkway is to be maintained. If nothing is done, debris from the collapse of the road could affect the beach in much the same manner as a shore hardening structure. Any alternative involving abandonment or relocation of the parkway should also incorporate provisions for the removal of concrete debris. Structural solutions involving sheet piling and armoring would most likely be necessary to ensure the protection and integrity of the SWSD outfall pipe in the absence of regularly implemented beach nourishment projects. If this structure became exposed due to continued erosion of the beach it would tend to act as a groin. Additional beach fill would be needed to minimize potential adverse impacts. The fill would have to extend over a substantial portion of this section of shoreline to be effective, perhaps 1 to 1.5 miles, and would require periodic renourishment.

3.8.4 Fire Island Inlet Segment

3.8.4.1 Existing Land Use and Shore Protection Structures: The Fire Island Inlet segment covers the eastern end of Jones Beach barrier island and the western end of Fire Island. This segment is all publicly owned and contains a number of recreational facilities owned and operated by the Town of Babylon (Cedar Beach, Overlook Beach, Cedar Beach Boat Basin and Oak Beach), N.Y.S. (Captree State Park Boat Basin and Robert Moses State Park) and the Federal government (that portion of FINS containing the Fire Island Lighthouse). Similar to the preceding coastal segment, the residential community of Oak Beach and two commercial establishments are privately owned, but exist in this coastal segment on land leased from the Town of Babylon. (See section 3.8.3.1 for description of barrier beach and bay island leases.)

The Robert Moses Causeway provides vehicular access from the mainland to the Town of Babylon and LISPC recreational facilities within this coastal segment. The Town of Babylon recreational facilities within this segment have a combined parking lot capacity of 1,700 parking spaces. The four large parking fields at Robert Moses State Park provide automobile parking spaces to accommodate the 3 million people who visit the park each year. In this segment there are a number of large tidal wetland islands in Great South Bay as well as tidal wetlands along the back bay areas of Jones Island and Fire Island. The predominant natural features found along the ocean shoreline of both Jones and Fire Island are dune formations and beachfront.

The entrance to Fire Island Inlet is the site of two large coastal structures built by the Federal government. The jetty constructed at Democrat Point, Fire Island in 1940-1941 successfully halted the historical westward shift of the inlet entrance for approximately a decade. For over a century prior to construction of the jetty, the inlet entrance had migrated westward at a rate in excess of 200 feet per year. In response to the severe erosion at Oak Beach resulting from tidal currents, the COE constructed a 1/2 mile closure dike (now known as the Sore Thumb) in 1959 across the channel adjacent to Oak Beach. A series of short groins were also constructed along the Oak Beach shoreline. The Sore Thumb has successfully alleviated the severe tidal scour along the shore of Oak Beach, but the sand dike had to be revetted in late 1960 (Galvin 1985; Kassner and Black 1983).

3.8.4.2 Land Use Plan Goals: Although this entire segment is publicly owned, the land use plan shows some change from existing land use conditions at Oak Beach. It is recommended that the Town of Babylon phase out all leases on town-owned property on the barrier and bay islands. After the phase-out of the leases and the removal of the structures, the Town could provide facilities for additional public recreational use and implement programs for natural resource protection where appropriate.

The State and the town of Babylon should maintain existing recreational facilities at Cedar Beach, Overlook Beach, Cedar Beach Boat Basin, Oak Beach, Captree State Park and Robert Moses State Park.

3.8.4.3 Coastal Hazard Planning Policies:

- Maintain the location of the shoreline, i.e.,land/sea interface.
- Maintain adequate beaches for recreation activities.

3.8.4.4 Policy Justification: Similar to the Gilgo Beach segment, the fixed location of Ocean Parkway and the Robert Moses Causeway bridge, the proximity of Ocean Parkway to the shoreline at Oak Beach, and the narrowness of the barrier island at Oak Beach preclude any retreat option for this coastal segment. It is necessary to protect the large public investment in infrastructure that allows for the heavy usage of both Town and State recreational facilities located on the barrier islands. As mentioned in the Gilgo Beach segment, a break in Ocean Parkway will not only impact beach users, but also commuters. It is necessary to maintain the continuity of the barrier island for the operation of Ocean Parkway and Robert Moses State Park, but also to prevent flooding of the mainland, disruption of the longshore transport of sand, undesirable salinity changes in the Great South Bay, increased shoaling at Fire Island Inlet, and additional shore erosion problems (downdrift of any newly formed inlets).

3.8.4.5 Preferred Erosion Management Options: The recommended approach to the beach erosion problems in this segment is periodic sand bypassing at the inlet with beach

FIGURE 3-12 - *Overlook Beach, July 1989. Excessive accretion of sand and ponding rendered beach unsafe for bathers*

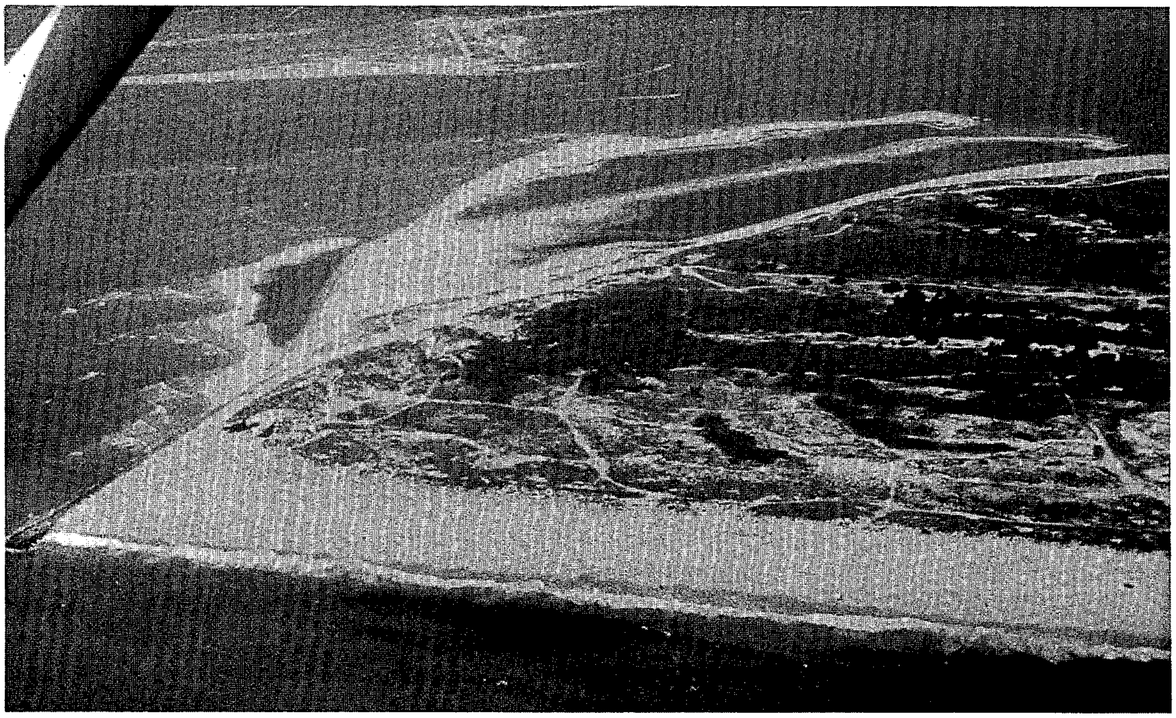


FIGURE 3-13 - *Fire Island Inlet, July 1989. Accretion of sand at Democrat Point and shoaling in Inlet*

nourishment for the shoreline west of the inlet. Although it may be more economical to facilitate routine bypassing operations by using a system of breakwaters to form an impoundment area, such a determination would require a more in-depth analysis of the relatively complicated inlet system and site-specific conditions. Much of the information needed to perform such an analysis is contained in reports prepared by the U.S. Army Corps of Engineers for this area.

Similar to the situation at Jones Inlet, the portion of shoreline immediately updrift of Fire Island Inlet appears to be accreting based on the available long-term shoreline change data. As a result, no action is required for this area at this time.

The structural failure of the Sore Thumb revetted sand dike has raised the question whether the coastal structure should be removed or restored. It appears that removal would reduce sand transport to the west, creating a negative impact on downdrift beaches. Given the uncertainty of the impacts, removal may be worse than restoration. The impact of removal or restoration on shoreline stability should be assessed through application of suitable hydrographic/sediment transport models.

Erosion at Oak Beach is current induced; the bypassing of sand at Fire Island Inlet will not exacerbate this condition. While the deposition of massive concrete rubble along the shore at Oak Beach provides some level of protection, an engineered shore hardening structure would provide both a higher level of protection and aesthetic benefits as well.

3.8.5 Ocean Beach Segment

3.8.5.1 Existing Land Use and Shore Protection Structures: This segment includes Kismet, the Village of Saltaire, Fair Harbor, Lonelyville, Atlantique, Robbins Rest, Corneille Estates, Village of Ocean Beach, Seaview, Ocean Bay Park and Point O'Woods. The primary land use in these communities is residential at a density ranging from 5-10 dwelling units per acre. The vast majority of residences in these communities is used only during the summer vacation season. Indeed, according to the 1980 census, the year-round population of all Fire Island communities is approximately 500 people. However, it is estimated that the summer resident population swells to approximately 21,600. It should also be noted that municipal investment in infrastructure is minimal since vehicle use is severely restricted by permit. Access to the communities is gained via ferry service or private boat. Boardwalks link residences to one another and the beach.

Although this segment is primarily developed, theNational Park Service owns several naturally vegetated ocean to bay strips of land. They are located within the hamlet of Kismet and east of Atlantique. Wetlands exist adjacent to Clam Pond, a portion of which is owned by the Village of Saltaire. The Town of Islip owns and maintains a 184 slip marina and beach facility at Atlantique. Both the Village of Ocean Beach and Saltaire own property for recreational activities within their boundaries. Most communities provide lifeguard protection along their oceanfront and a few also provide this service for bay bathing activities as well.

The most common beach stabilization measure employed in this segment is the use of snow fencing to trap windblown sand in an attempt to enhance or create dunes. The Village of Ocean Beach has constructed two small groins and has created dunes using unsightly concrete rubble as core material. Some communities have sought permits to scrape sand off the summer berm and use it to create dunes.

3.8.5.2 Land Use Plan Goals: The land use plan for this segment recognizes the presence of single family, seasonally used dwelling units, but also recognizes the hazards and large potential liabilities faced by all units of government due to coastal occupancy. Therefore, the long-term land use plan seeks to phase out occupancy of Fire Island in the event that dwelling units are destroyed as a result of erosion and/or severe storms. This is in accord with recommendations for the Coastal High Risk Zone discussed in section 3.5. Government should not intervene to protect or otherwise enhance this occupancy. Government intervention is warranted only when the continuity of the barrier island is threatened. Thus, another goal for this segment is to maintain the continuity of the barrier.

3.8.5.3 Coastal Hazard Planning Policies: Although the ultimate goal is to phase out development on the Fire Island, it is anticipated that existing residents may request permits for coastal erosion measures to protect their property. Therefore, an appropriate coastal hazard planning policy for this coastal segment is to emphasize regulation of private activity as the primary means for protecting structures and coastal features. Several communities in this segment have requested permits for such erosion control measures as beach scraping, installation of *seascape* and construction of dunes consisting of a concrete rubble core. Government agencies must be in a position to properly regulate these activities based upon a better understanding of the causes and effects of observed shoreline behavior. An adequate understanding of the coastal processes and shoreline responses is essential for addressing a number of critical questions that affect the selection of management options in different areas. Reliable estimates of such factors as the erosional risk, storm vulnerability and the expected degree of recovery after an erosional event for different areas are essential components of any coastal erosion management program.

The second policy applicable to this segment relates to the creation of new inlets by erosional forces or severe storm events. It is imperative that the existence and continuity of the barrier island be maintained. It will be necessary to closely monitor weak points in the barrier to prevent the opening of a new inlet. It will also be necessary to close a new inlet as soon as possible, if it does not close naturally.

3.8.5.4 Policy Justification: Development located on barriers will be subject to the full force of severe storm events. Indeed,

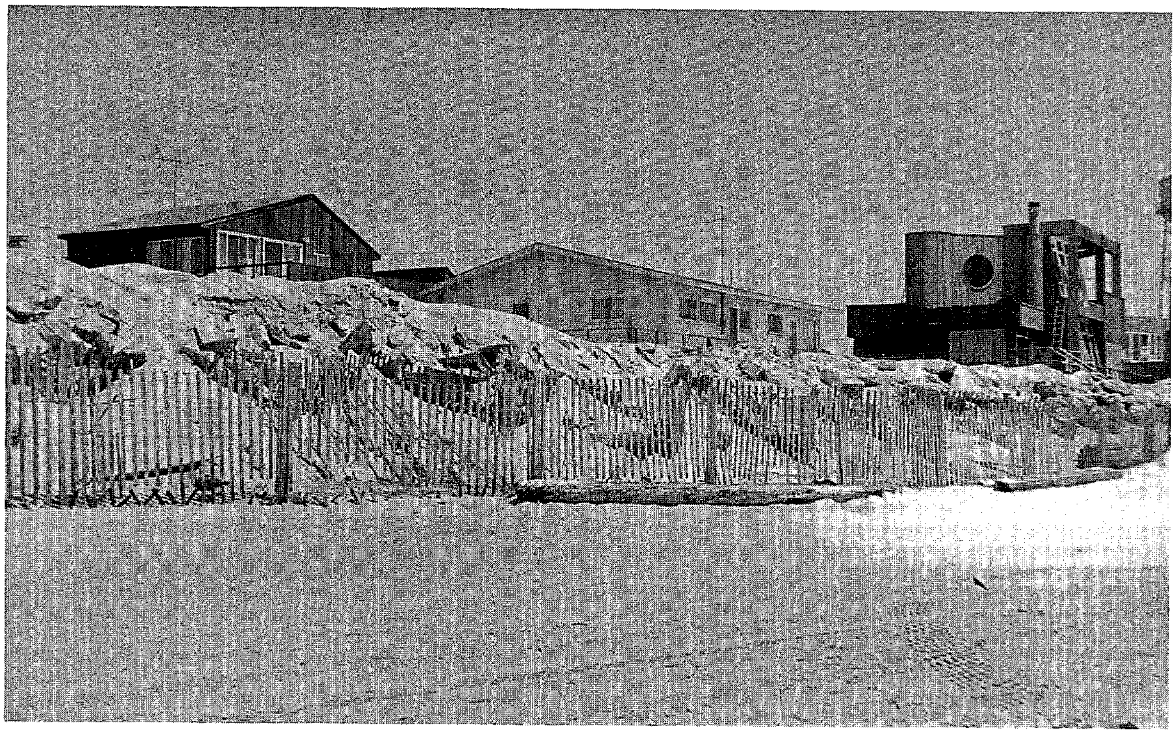


FIGURE 3-14 - *Village of Ocean Beach, June 1989. Partially constructed rubble-core dunes*

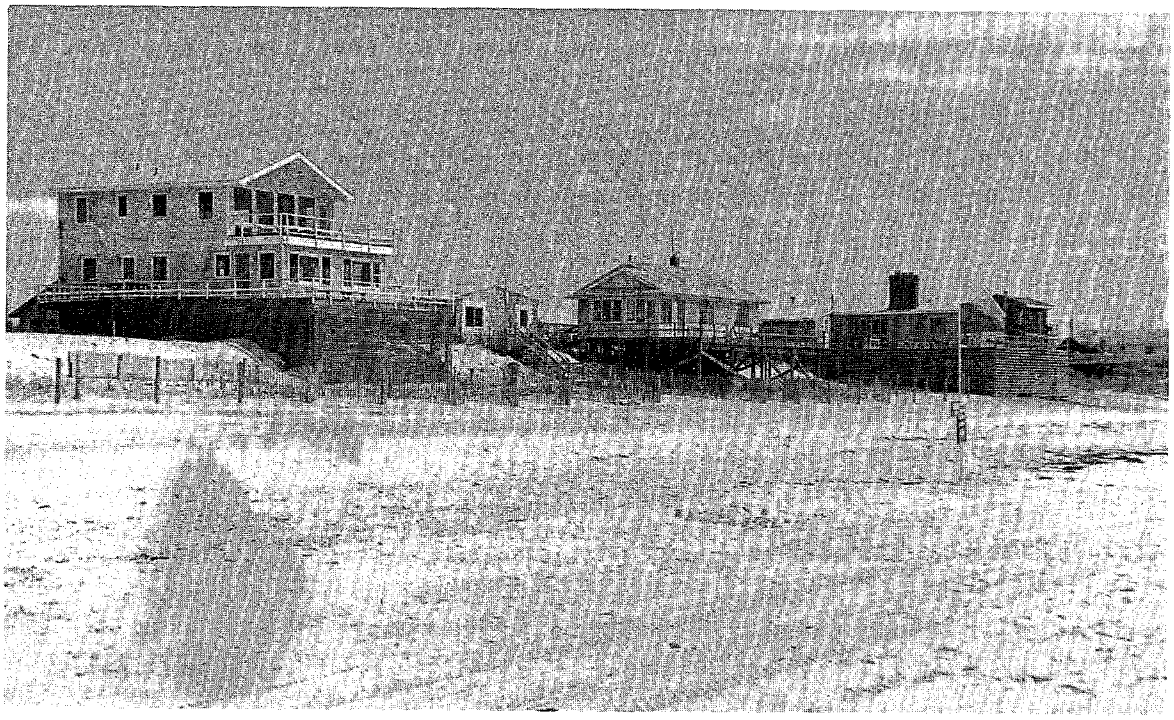


FIGURE 3-15 - *Dunewood, June 1989. Lack of protective dune*

major losses have been associated with hurricanes and northeast storms in the last 50 years (Long Island Regional Planning Board 1984). Residential occupancy of the barrier will probably result in increased requests for government aid to stabilize the shoreline as structures become threatened.

It is necessary to maintain the existence and continuity of the barrier for several reasons. First, a new inlet will cause sand to be lost from the littoral system causing adverse downdrift impacts. Second, a new inlet may cause shoaling in existing inlets; and, third, a new inlet may increase bay salinity levels, thus causing adverse environmental impacts on the hard clam fishery.

3.8.5.5 Preferred Erosion Management Options: Erosion management in this shoreline segment should be limited to beach nourishment and dune building. The density of development has precluded the implementation of structure relocation and/or the enforcement of setback requirements.

A relatively high erosion rate was identified in this segment. Profile data taken between 1955 and 1979 indicate large sand volume losses in the area offshore of this segment, probably the result of littoral forces eroding relict ebb tidal delta deposits associated with Fire Island Inlet when it was located several miles to the east of its current location. As this source of sand is depleted, erosion rates along this segment may increase rapidly in the future.

Identification of the most effective alternative will require a detailed cost-benefit analysis, and an answer to a more fundamental question: *"Why is there apparently a high erosion rate here?"* Although the problem may be alleviated by better management of other coastal compartments, the causes of erosion and the physical processes operating at the site need to be diagnosed to determine the exact nature of the problem and potential means for addressing it.

This segment suffers from the lack of a protective dune system in some communities. In an attempt to *create* dunes, the Village of Ocean Beach has deposited concrete rubble seaward of the oceanfront homes, covered the rubble with sand and planted beach grass on the piles of sand. The NYS Dept. of Environmental Conservation issued a permit for this activity with the condition that the rubble be encased in wire fencing. Fire Island National Seashore personnel objected to this activity because it is incompatible with the Fire Island National Seashore Land Protection Plan which states:

> *...If the dune is to provide any protection from storms, it must be maintained in a natural condition with native vegetation.*

Seashore personnel indicated that hard core dunes are merely shore hardening structures. Such structures if located on an eroding beach may, after a severe storm event, become exposed and inhibit sand transport patterns to the detriment of downdrift property owners.

The policy of reliance on regulation of private activity leads to the question, *"What private or local community erosion control efforts would result in the greatest protection for oceanfront dwellings and yet minimize adverse downdrift impacts?"* Dune creation, possibly utilizing the technique employed by the Town of Hempstead in which snow fencing is placed in a **Y** formation, and the trapped sand is planted with beach grass the following spring, could be initiated. This technique, however, requires adequate beach width especially if vehicles are going to continue to be given permits to drive on the beach face. It is problematical whether this technique can be implemented given the off-season vehicular beach traffic in this area.

In general, *soft* solutions should be considered the primary response; groins and shore parallel structures should be used only in those situations where the continuity of the barrier is threatened. Homeowners wishing to provide additional protection for their structures should consider meeting current flood insurance program standards concerning elevation on pilings. Revetments, if permitted at all, should be built at the most landward position possible, to minimize exposure and for storm protection purposes (rather than as a technique for dealing with chronic erosion). Before government considers approval of permits for the construction of process altering or shore parallel structures it will be necessary to understand the causes and effects of observed shoreline behavior. This is necessary in order to estimate the effectiveness and potential impacts of any proposed solution.

Beach scraping and replacement of sand in front of oceanfront homes has been conducted at some Fire Island locations. This activity removes sand from the active littoral zone and places it in temporary storage, and can result in steepening of the beach profile. If conducted on a community-wide basis, the approach offers a small degree of temporary protection until the constructed dune is removed by storm wave attack. If the down- and updrift areas can withstand the beach loss as a result of shoreline adjustment, then this approach is acceptable. Supervision and monitoring of this activity are required.

Another coastal erosion problem in this segment relates to the two groins located in the Village of Ocean Beach. These groins have impacts on adjacent beaches; the zone of influence can extend more than four to five times the length of the groins (250 ft.) in both the up- and downdrift directions. Beaches near the groins may now be in equilibrium. The communities of Robbins Rest, Corneille Estates and Seaview are found in an area that is experiencing an erosion trend, which may be due to the fact that a relict ebb tidal delta offshore is no longer supplying sand to the beach. Groin removal would not alter this situation.

3.8.6 Central Fire Island Segment

3.8.6.1. Existing Land Use and Shore Protection Structures: There are five developed, seasonally used communities in this shoreline segment (Cherry Grove, Fire Island Pines, Water Island, Blue Pt. Beach and Davis Park). Moderate density (5-10 d.u./acre) residential land use is the primary land use in these communities. In contrast to the Ocean Beach segment, the communities located in the Central Fire Island segment are separated by areas of open space owned by the National Park Service. In fact, the Fire Island National Seashore has two areas that are open to the public. One is Sunken Forest, a nature sanctuary; and the other is Sailor's Haven, a public marina and beach facility. Public access to the beach is achieved via ferry from the mainland to the communities in addition to two town parks, including an 80 slip Town of Islip marina and beach facility at Barrett Beach and a 214 slip Town of Brookhaven marina and beach facility at Davis Park.

The most common beach stabilization measure employed in this segment is the use of snow fencing to trap windblown sand in an attempt to enhance or create dunes. Some communities have sought permits to scrape sand off the summer berm and use it to create dunes. The community of Fire Island Pines has installed plastic seaweed in an offshore location in an attempt to trap sand to build an offshore bar to dissipate wave action.

It is important to note that over one-half of this barrier island segment is undeveloped. It has predominately maritime shrubland vegetation, fresh and tidal wetlands in the back bay areas, as well as a double dune system in some locations (e.g., Sunken Forest) that have remained intact.

3.8.6.2 Land Use Plan Goals: The land use plan goals for this segment are similar to those applicable to the Ocean Beach segment. This discussion can be found in section 3.8.5.2.

3.8.6.3 Coastal Hazard Planning Policies: The coastal hazard planning policies for this segment are the same as those applicable to the Ocean Beach segment. This discussion can be found in section 3.8.5.3.

3.8.6.4 Policy Justification: The policy justification is also the same as that for the Ocean Beach segment (section 3.8.5.4).

3.8.6.5 Preferred Erosion Management Options: Because of the relatively low overall density of development and low, long-term shoreline erosion rate, setback and relocation strategies should be pursued. The selection of this approach is predicated on the assumption that bypassing operations at the inlets to the east would be implemented.

However, it was also noted that certain areas in this segment may be susceptible to breaching and inlet formation during storms. As described previously, the formation of new inlets would probably have a number of impacts including: shoaling of the stabilized inlets, increased flooding and erosion on the bay shoreline due to increased water level elevations, changes in environmental conditions in the bay (i.e. water circulation, shoaling, salinity and water temperatures) and increased downdrift erosion due to the disruption of the longshore transport of sand. These types of changes would probably be substantial and could severely affect the biological resources and human uses of the present bay environment (including the mainland shoreline), as well as the barrier island and the existing stabilized inlets. Because of the nature and magnitude of the associated impacts, the occurrence of new inlets would be unacceptable in terms of the present uses of the mainland shoreline, bay and barrier island. Management programs should incorporate provisions for preventing the formation of new inlets and for closing new ones as quickly as possible.

Specific areas particularly susceptible to breaching (as indicated by such factors as island width, elevation, dune morphology, and back bay bathymetry) should be identified. Because the presence of wetlands on the bay side of the barrier appears to inhibit inlet breaching, the creation of wetlands in areas experiencing bay side erosion is one approach to this problem. Material from bay dredging projects, which usually is not suitable for ocean front beach nourishment, may be used to raise the bay bottom up to an elevation that would allow for wetland creation along the bay shoreline. Although ocean beach nourishment may not be practical for the entire length of shore, dune building efforts should also be considered to minimize the potential for breaching.

The principal coastal erosion problem in this segment is the lack of a protective dune system in some communities. The policy of reliance on regulation of private activity leads to the question, *"What private or local community erosion control efforts would result in the greatest protection for oceanfront dwellings and yet minimize adverse downdrift impacts?"* For the response to this question see the discussion on *soft* solutions, groins and shore parallel structures, and beach scraping in section 3.8.5.5.

3.8.7 Fire Island National Seashore Wilderness Segment

3.8.7.1 Existing Land Use and Shore Protection Structures: This segment includes the area extending from east of Davis Park to Smith Point County Park. The area is owned almost exclusively by the National Park Service (NPS) where there are a few residential structures in existence. However, these structures will be removed by the NPS after 1992. There are four public access points in this segment: Watch Hill, Bellport Beach (Village facility), Old Inlet and Smith Point. No vehicular access is permitted during summer months. Seasonal ferry service is provided to Watch Hill and Bellport Beach where lifeguard protection is provided. All recreation activities are of low intensity. Recreational vehicle access to the NPS wilderness area west of Smith Point is strictly regulated during off-season months. The predominant land use category found in this segment is open space. There are extensive maritime shrubland vegetation and dune systems as well as tidal wetlands

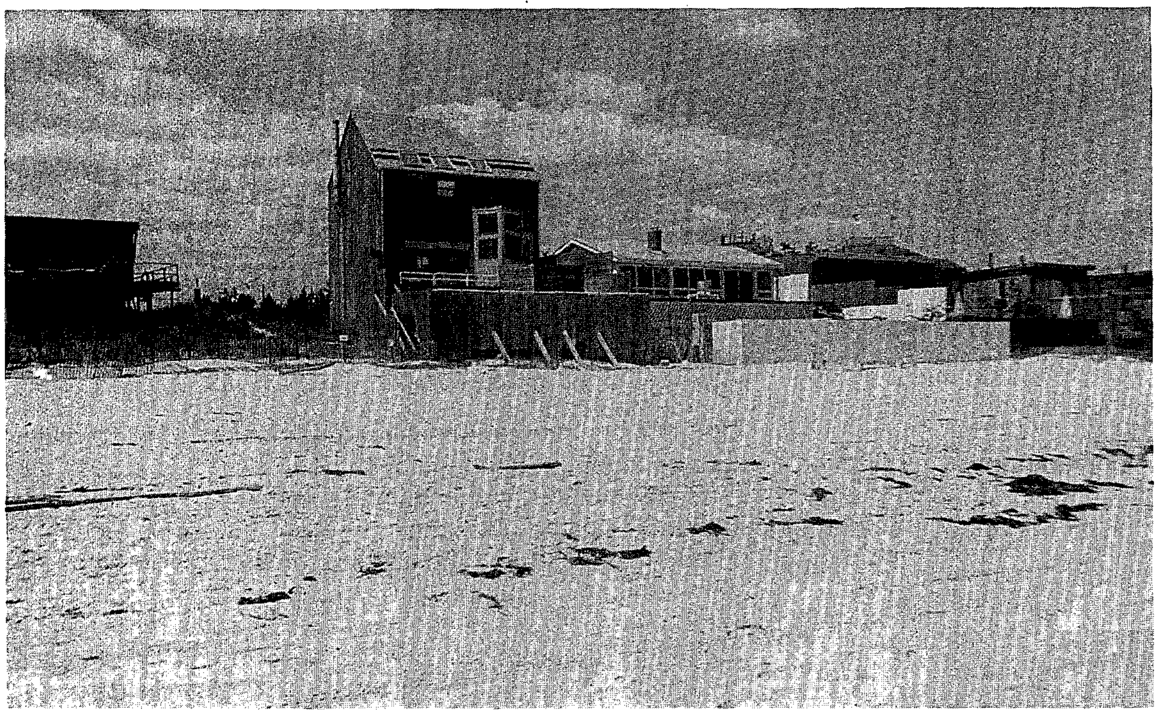


FIGURE 3-16 - *Fire Island Pines, June 1989. Note housing and pools in what once was the primary dune line*

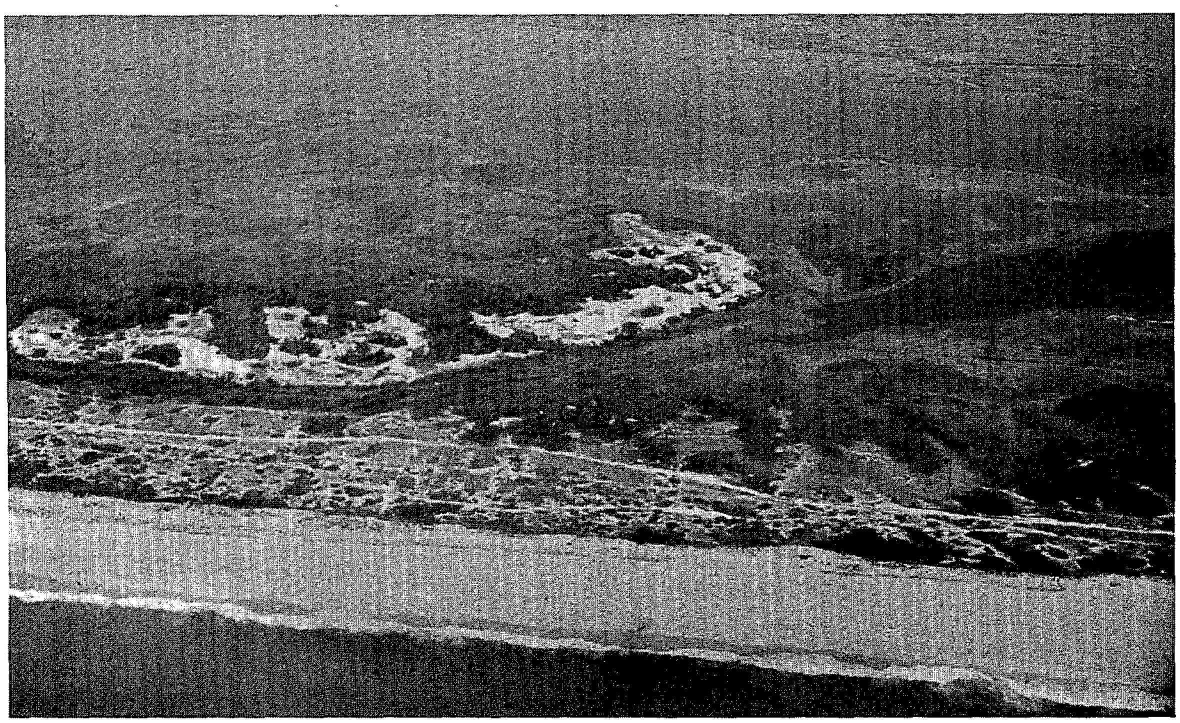


FIGURE 3-17 - *Fire Island National Seashore Wilderness Area, July 1989. Dunes up to 25 feet in height and extensive wetland areas*

throughout the segment. There are no shore hardening structures employed within in this segment.

3.8.7.2 Land Use Plan Goals: The land use plan goal for this segment is to retain open space as the predominant land use.

3.8.7.3 Coastal Hazard Planning Policies: The coastal hazard policy applicable to this segment relates to the creation of new inlets as a result of erosion or severe storms. It is imperative that the existence and continuity of the barrier island be maintained. Barrier islands protect back bay environments and development from direct wave attack. Thus, it will be necessary to closely monitor weaknesses in this portion of Fire Island to prevent the opening of a new inlet. It will also be necessary to close a new inlet as soon as possible should it not close naturally.

3.8.7.4 Policy Justification: It is necessary to maintain the existence and continuity of the barrier island for several reasons.

First, a new inlet will cause sand to be lost from the littoral system causing adverse downdrift impacts. Second, a new inlet may cause shoaling in existing inlets; and, third, a new inlet may increase bay salinity levels thus causing adverse environmental impacts to the Great South Bay hard clam fishery.

3.8.7.5 Preferred Erosion Management Options: Because of the very low overall density of development limited primarily to recreation facilities, and the low, long-term shoreline erosion rates in this segment, the recommended coastal erosion management option is for very limited government intervention. This recommendation is predicated on the assumption that bypassing operations at the inlets to the east would be implemented.

However, it was also noted that certain areas in this segment may be susceptible to breaching and inlet formation during storms. As described previously, the formation of new inlets would probably have a number of impacts including: shoaling of the stabilized inlets, increased flooding and erosion on the bay shoreline due to increased water level elevations, changes in environmental conditions in the bay (i.e. water circulation, shoaling, salinity and water temperatures) and increased downdrift erosion due to the disruption of the longshore transport of sand. These types of changes would probably be substantial and could severely affect the biological resources and human uses of the present back bay environment, (including the mainland shoreline) as well as the barrier island and the existing stabilized inlets. The occurrence of new inlets would most likely be unacceptable in terms of the present uses of the mainland shoreline, bay and barrier island. Management programs should incorporate provisions for preventing the formation of new inlets and for closing new ones as quickly as possible.

In this segment, a specific area particularly susceptible to breaching (as indicated by such factors as island width, elevation, dune morphology, and back bay bathymetry) is Old Inlet. Because the presence of wetlands on the bay side of the barrier appears to inhibit inlet breaching, the creation of wetlands in areas experiencing bay side erosion is one approach to solving this problem. Material from bay dredging projects, which usually is not suitable for oceanfront beach nourishment, may be used to raise the bay bottom up to an elevation that would allow for wetland creation along the bay shoreline. Although ocean beach nourishment may not be practical for the entire length of shore, dune building efforts should also be considered to minimize the potential for breaching in these areas.

3.8.8 Moriches Inlet Segment

3.8.8.1 Existing Land Use and Shore Protection Structures: The Moriches Inlet segment covers all of Smith Point County Park on the eastern end of Fire Island and all of Cupsogue County Park on the western end of Westhampton Barrier Island. Although the entire segment is owned by the County of Suffolk and dedicated for park purposes, public access is limited to Smith Point County Park (and Great Gun Beach located within the confines of the park). The 220 acre Cupsogue County Park, which has a beach pavilion and 500 car parking lot, has been inaccessible to the public since 1984 because of repeated washovers of Dune Road. Smith Point County Park covers approximately 2,300 acres and annually draws over one-half million bathing beach visitors. The family campgrounds and outer beach camping account for additional visitations to the park. The 5,000 car parking lot at Smith Point County Park is accessible via Smith Point Bridge/William Floyd Parkway. Travel by 4-wheel drive vehicles between the former Forge River Coast Guard Station and Moriches Inlet is limited to the *Burma Road* because of ocean shoreline erosion. Extensive back bay tidal wetlands exist along this segment with a few tidal wetlands situated within Moriches Bay itself. The dune formations are the most dominant natural feature along this relatively undeveloped oceanfront.

This segment is free of shore protection structures with the exception of the east and west jetties at Moriches Inlet, which were reconstructed in 1987 and 1988, respectively, as a result of the implementation of Moriches Inlet Navigation Project. The project was authorized by Congress under the River and Harbor Act of 1960.

In January 1980, a coastal storm caused a break in the barrier island at Cupsogue County Park approximately 1000' east of the Moriches Inlet jetties. Under a COE Emergency Action, the 2,600' breach in the barrier island was repaired in February 1981 with 1.2 million cubic yards of sandfill. The repair of the breach was a major concern of Suffolk County, and to help forestall the occurrence of a similar event in the future, the County elected to participate with the State of New York in the construction of a rock revetment in 1981-1982 on the bayside of the closure area, beginning at the east jetty of Moriches Inlet and extending 1600' eastward.

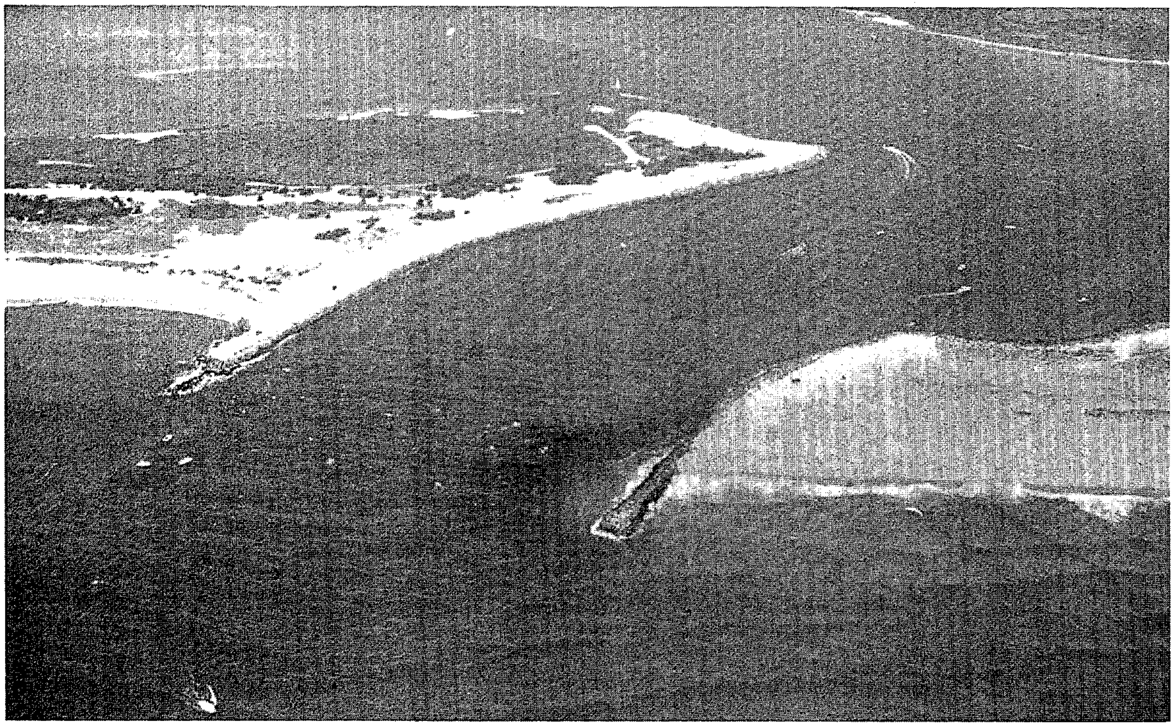


FIGURE 3-18 -*Moriches Inlet, July 1989. Note scour area immediately west of the Inlet*

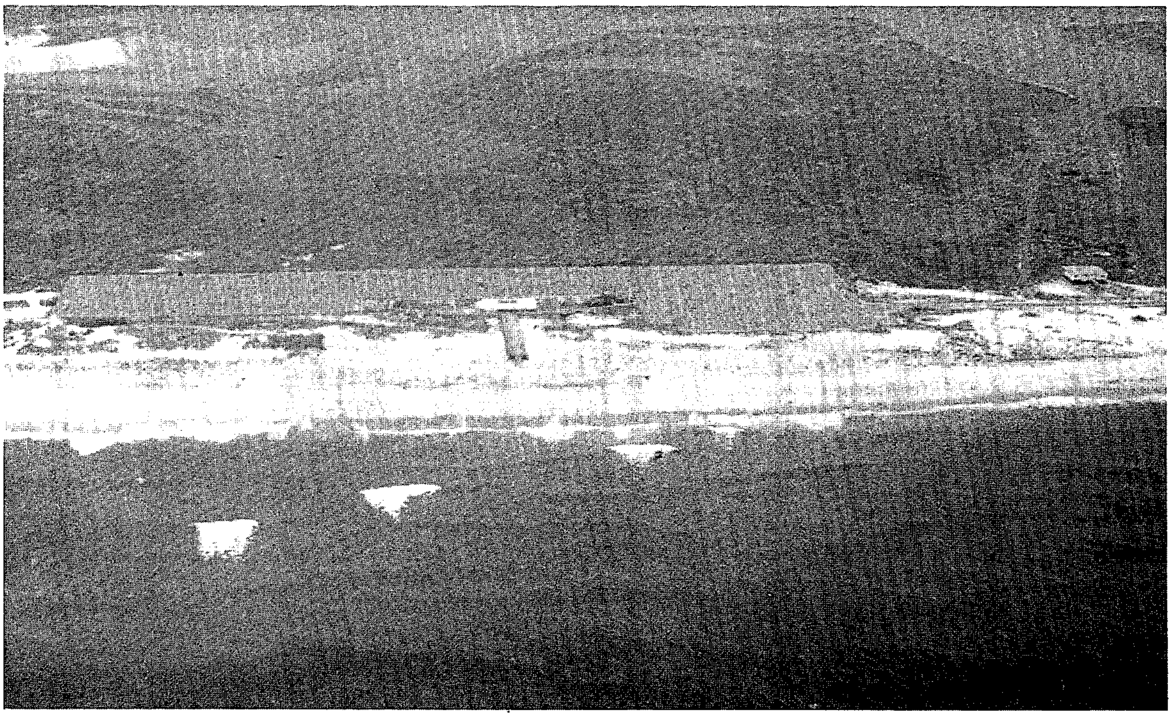


FIGURE 3-19 - *Cupsogue County Park, July 1989. Facility is currently inaccessible due to severe erosion west of the Westhampton Beach groin field*

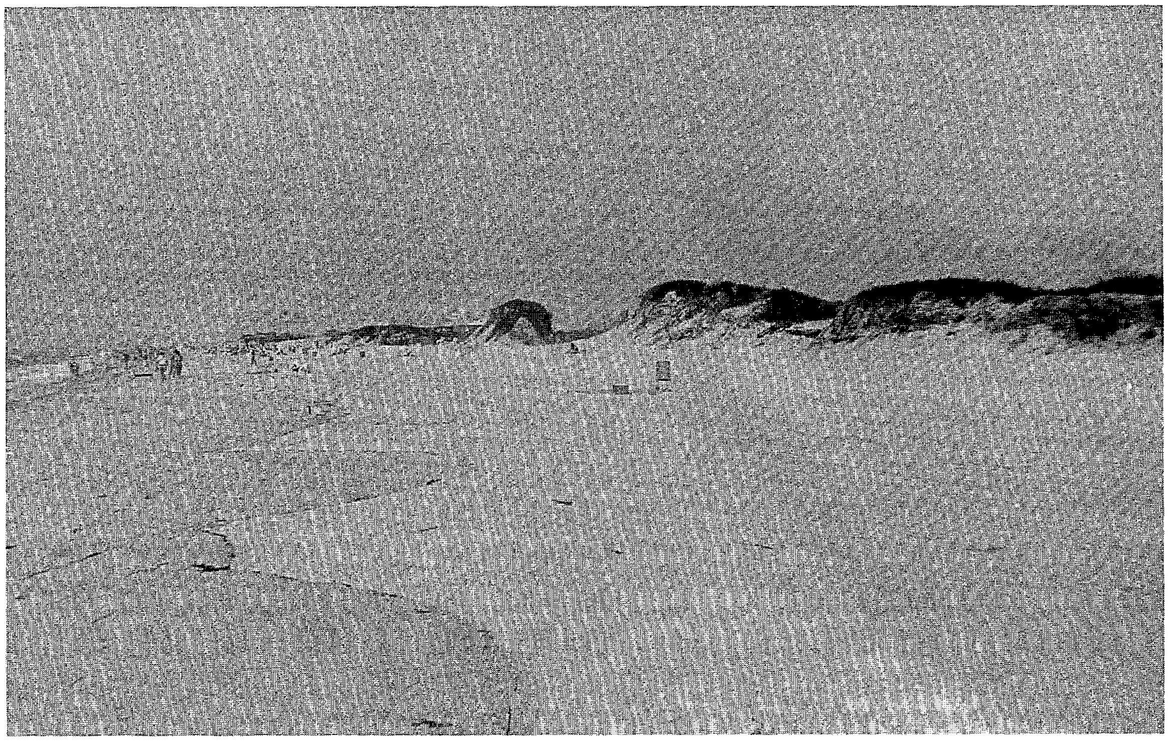


FIGURE 3-20 - *Smith Point County Park, July 1989. Note dune blow-outs*

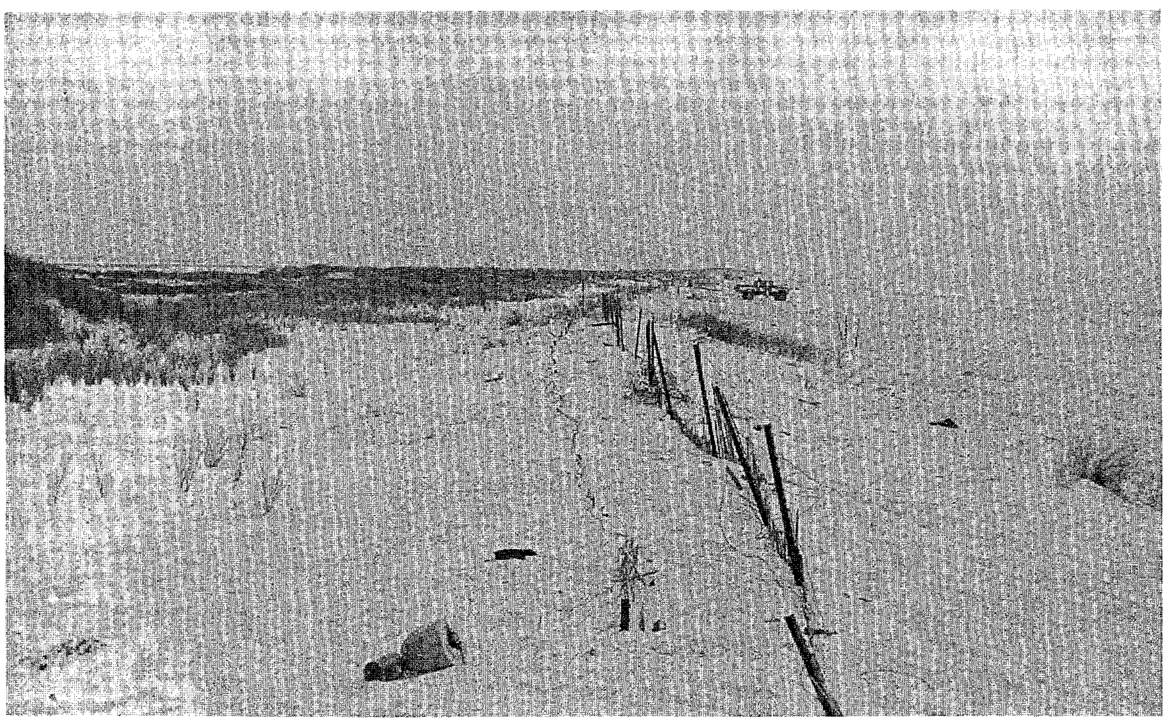


FIGURE 3-21 - *Smith Point County Park, July 1989. Looking east at former site of Forge River Coast Guard Station. Note extremely low dune profile and close proximity of Ocean and Bay*

3.8.8.2 Land Use Plan Goals: The land use plan calls for recreational use and maintenance of existing facilities at Smith Point and Cupsogue Beach County Parks. Vehicular access to Cupsogue Beach via Dune Road should be re-established.

3.8.8.3 Coastal Hazard Planning Policies: Maintain existence and continuity of barrier islands.

3.8.8.4 Policy Justification: The two recreational facilities comprising this segment are the only active bathing beach facilities on the Atlantic Ocean that are owned and operated by Suffolk County. Continuity of the barrier islands with provision for vehicular access to the County parks is essential for the maintenance and resumption of recreational activity at Smith Point and Cupsogue Beach County Parks, respectively. Besides the recreational aspect, it is necessary to maintain the existence and continuity of the barrier island to mitigate flooding of the mainland (which is in close proximity along Narrow Bay), disruption of the longshore transport of sand, undesirable salinity changes in Moriches Bay, increased shoaling at Moriches Inlet, and additional shore erosion problems (downdrift of any newly formed inlets).

3.8.8.5 Preferred Erosion Management Options: Sand bypassing at Moriches Inlet is the most preferred approach for addressing shoreline erosion problems at Smith Point County Park west of the inlet. Due to the narrow width of the barrier island and the lack of protective dunes and tidal wetlands at certain locations, a number of potential overwash sites exist at Smith Point County Park, particularly around the site of the former Forge River Coast Guard Station located south of the William Floyd Estate. Dune building, as well as marsh creation on the bay side, can be used to minimize the potential for new inlets in areas susceptible to breaching. If monitoring indicates that additional action is necessary, supplemental beach nourishment in conjunction with relocation of threatened park buildings would be a reasonable approach for this area.

Historical shoreline data show that the beach west of Moriches Inlet has experienced severe erosion. The quantity of sand lost from the beach in recent time is about equal to the net longshore transport rate, estimated at 350,000 cubic yards per year. Sand bypassing at Moriches Inlet will not restore the volume of sand that has been lost to the beach, but will help to stabilize the existing configuration of the shoreline.

Moriches Inlet, historically, has been a temporary coastal feature. Just prior to 1931, neither Moriches nor Shinnecock Inlets existed. A storm opened Moriches Inlet in 1931 and a hurricane opened Shinnecock Inlet in 1938. Moriches Inlet closed naturally in 1951, so during the period 1938 to 1951, both inlets were open and unjettied. By 1953, two jetties were built at Shinnecock Inlet and two jetties were built across the barrier island near the location where Moriches Inlet was closed in 1951. From 1951 to 1953, therefore, Shinnecock Inlet was open and Moriches Inlet was closed. In 1953 Moriches Inlet was reopened by dredging a cut across the barrier island between the jetties. Since 1953, both inlets have been open and jettied. At both inlets the jetties are approximately parallel and spaced about 800' apart (U. S. Army Corps of Engineers 1983).

The County of Suffolk has been heavily involved in the stabilization of Moriches Inlet and the maintenance of the shoreline on the barrier beach in the vicinity of the inlet. Table 3-4 illustrates that since 1934, Suffolk County was directly involved in 12 construction and dredging projects in the inlet area. Over 2.3 million cubic yards of material were dredged from the inlet and deposited on adjacent beaches. In addition to the projects shown in Table 3-4, Suffolk County cooperated with NYS and the Federal government in 1980 in the execution of an $11 million emergency project for closure of the breach flanking the east jetty of the inlet. In 1981-82, the County also participated with NYS in the construction of a 1,600' rock revetment at the site of the breach. The County contribution for the closure of the

TABLE 3-4

Suffolk County Dredging and Construction Projects at Moriches Inlet.

County Year	*Activity*	*Expenditure*
1931	Moriches Inlet opened.	
1934	Land crane evacuation at inlet.	$1,000
1947	Revetment construction west side, and dredging.	200,000
1952	Construction of east jetty.	307,517
1952	Construction of west jetty.	412,140
1953	Channel dredging; 747,310 cu. yds spoiled on east side of inlet.	190,442
1954	Extension of both jetties.	340,000 (bid price)
1958	Channel dredging; 365,715 cu. yds. spoiled on east side.	141,897
1966	Channel dredging, northwest cut; 677,850 cu. yds. spoiled on west side.	464,367
1969	Channel dredging; 150,957 cu. yds. spoiled on east side.	101,896
1973	Channel dredging; 138,315 cu. yds. spoiled on east side.	91,565
1978	Channel dredging; 218,478 cu. yds. (113,606 spoiled at Pikes Beach; 104,862 cu. yds. spoiled on east side of inlet).	594,310
1987	Emergency fill of scour area just east of rock revetment; 20,000 cu. yds.	57,200

Source:Suffolk County Dept. of Public Works, Yaphank, New York.

breach and the construction of the rock revetment was approximately $1 million and $0.6 million, respectively.

In addition to the recent reconstruction of the jetties at Moriches Inlet, the Moriches Inlet Navigation Project will provide for the dredging of a navigation channel through the inlet in the spring of 1990. Maintenance of the navigation channel will include sand bypassing at the inlet at scheduled intervals. Part of the project maintenance costs will cover a monitoring program to ascertain the rate of shoaling in the inlet, the results of which will be utilized to determine the frequency and volume of future dredging operations in the inlet. The bypassed sand will be deposited approximately one mile west of the inlet, beyond the shadow effect, in the nearshore zone (16' - 18' depth of water) by use of a hopper dredge (Gilbert Nersesian pers. comm.).

Scouring of the bayside of the barrier island immediately east of the rock revetment adjacent to the east jetty at Moriches Inlet will continue to occur to the extent where channel currents impinge on the shoreline. The configuration of the flood tidal delta and bay bottom bathymetry will generally determine the location of the scour area. Scour line growth should be monitored. Armoring the unprotected bay shoreline will be necessary if scouring remains active.

3.8.9 Westhampton Beach Segment

3.8.9.1 Existing Land Use and Shore Protection Structures: The principal land use in this shoreline segment is medium density residential use. Overall segment shoreline length is approximately 33,000 ft.; of this total, 25,000 ft. (75%) is occupied by medium density residential use; 3,500 ft. (11%) by low density residential use; 3,000 ft. (9%) by commercial-recreation use; 500 ft. (1%) by open space and recreation use and 1,000 ft. (3%) by high density residential use. There are tidal wetland areas interspersed with some residential development along the back bay area in this segment and only a few tidal wetland islands exist in Moriches Bay. Significant losses of beach and dune formations are evident in this segment.

Erosion has been a significant and persistent problem since the area was severely impacted by flooding during the 1938 hurricane. The area also experienced severe flooding during the March 1962 northeast storm. In response to the shore erosion and flooding problem, the COE began work on the Fire Island Inlet to Montauk Point Beach Erosion Control and Hurricane Protection Project, which resulted in a two stage construction of 15 groins located within the Village of Westhampton Beach and the Town of Southampton. Stage one consisted of a field of 11 groins that was completed in October, 1966. In stage two of the project, an additional field of 4 groins was built immediately west of the 11 groins and completed in November 1970. The original project design included groin stabilization to Moriches Inlet; it was not designed for incremental construction. Absent the protection provided by the groins, erosion in the 700 and 800 block portion of Dune Road proceeded at a rapid rate. The area was impacted again by the northeast storms of February 1978 and March 1984. Records kept by the Office of the Fire Marshall, Town of Southampton, show that 18 houses have been destroyed since 20 December 1982, and about 30 additional houses, located in extremely vulnerable locations, are now uninhabitable. There have been frequent breaches and washovers along this section, leaving the Town of Southampton with large road maintenance and security expenditures. In addition, access to Cupsogue County Park has been severed. A summary of beach erosion control projects can be found in Table 3-5.

3.8.9.2 Land Use Plan: The long-term program goal is to terminate residential occupancy of Westhampton Beach west of the westernmost groin to Cupsogue County Park. The section of barrier between the westernmost groin and the Town of Southampton park at Pikes Beach has been regularly overtopped and is the most likely site for a break in the barrier. Removal of residential structures will eliminate exposure to repeated flood losses and claims, provide opportunities to expand recreational facilities and aid government efforts to implement projects designed to maintain the continuity of the barrier island. Purchase of privately owned lots between Cupsogue County Park and the westernmost groin by government is advisable.

It is recommended that for the remainder of the Westhampton Beach segment, redevelopment should not be permitted. This is in accord with recommendations for the Coastal High Risk Zone discussed in section 3.5 It is recommended that post-storm community redevelopment plans be prepared in advance to deal with those instances where a severe storm event destroys a large portion of Westhampton Beach and government can neither prevent redevelopment through regulation nor acquire properties because of a lack of financial resources. Such plans will help to ensure that redevelopment will minimize exposure to repeated flood and erosion losses. The Village of Westhampton Beach has zoned almost all of the barrier beach R-1 Residential, which allows for single family dwellings on lots of 40,000 square feet. Most residential lots on the barrier beach within the Village are slightly less than 1 acre in size. Motels and condominiums existing on the barrier beach within the Village are now considered as non-conforming uses by the Village.

3.8.9.3 Coastal Hazard Planning Policies: The coastal hazard planning policy applicable to this coastal segment is to maintain the integrity of the barrier recognizing that the location of the shoreline to be maintained in the critical erosion area remains to be determined.

3.8.9.4 Policy Justification: The coastal erosion planning policies for this segment recognize the extremely fragile condition of the barrier island west of the westernmost groin. As noted in Tanski and Bokuniewicz (1988) the do nothing approach

FIGURE 3-22 - *Area west of the Westhampton Beach Groin Field, July 1989. Barrier at this point is only 300-500 ft. wide and has been subject to repeated washover*

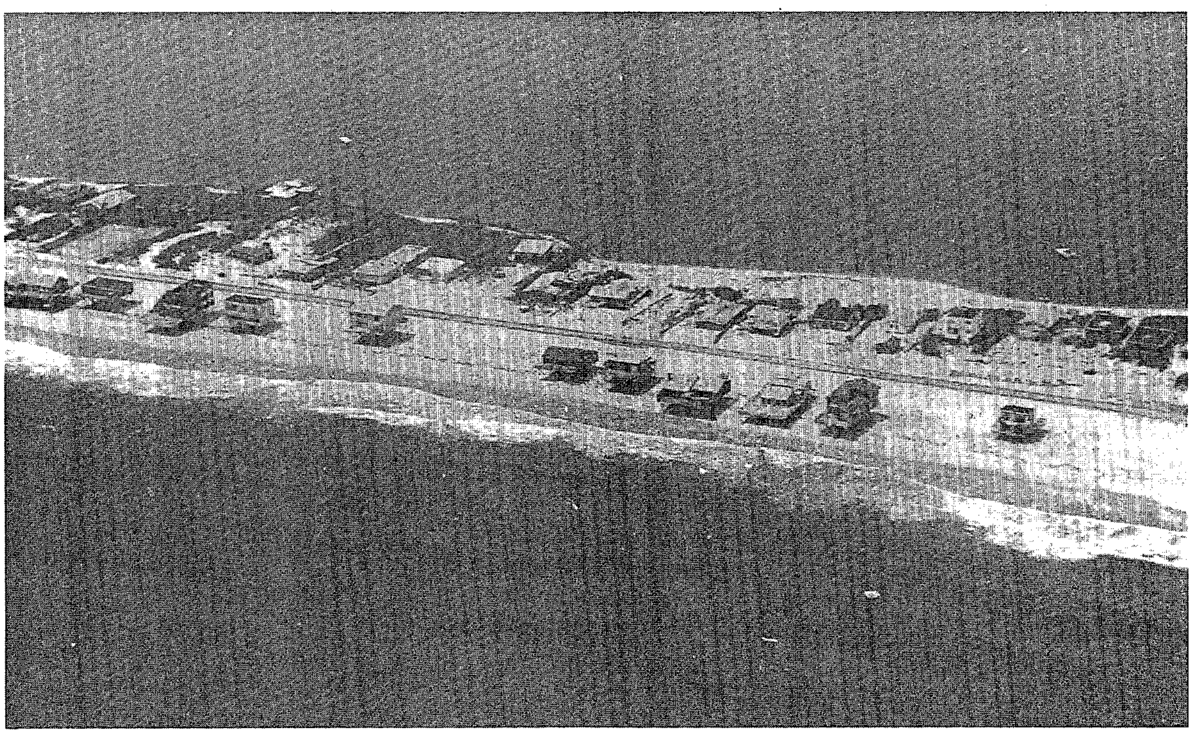


FIGURE 3-23 - *Westhampton Beach, July 1989. Note severe erosion downdrift of westernmost groin*

FIGURE 3-24 - *Eastern portion of Westhampton Beach groin field, July 1989. Note extensive beach width and medium and high density development*

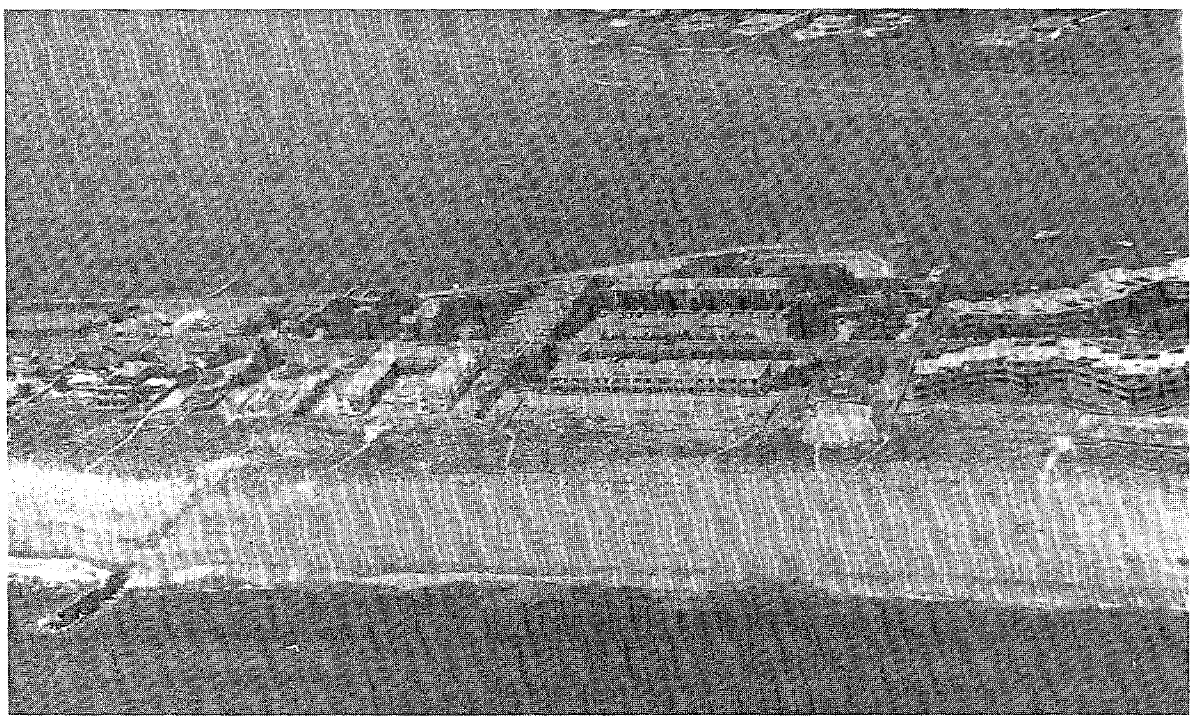


FIGURE 3-25 - *Eastern portion of Westhampton Beach groin field, July 1989.*

TABLE 3-5

Westhampton Barrier Island:Shoreline Construction History.

Project	*Date of Study or Authorization*	*Description*	*Area*	*% Complete*	*Cost*
FEDERAL-U.S. ARMY CORPS OF ENGINEERS					
1.a. Phase 1-Fire Island Inlet to Montauk Pt. Beach Erosion Control and Hurricane Protection	1960a	11 stone groins constructed in 1966; 4 additional groins constructed in 1970; 2 million yd^3 of sand used to fill in groin field and rebuild beach	3.5 miles	100%	$6,000,000
b. Phase II- Interim Project at Westhampton Beach	1977s	4 million yd^3 to fill existing field; 4 million yd^3 to nourish beach east of western-most groin-widen beach to 100 ft. increase dune to 16 ft.	2 miles	0%	$50-75 million (proposed) (1984 Cost Estimate)
c. Phase III	1977s	Beach and dune construction for remainder of Island; up to 8 additional groins are authorized	12 miles	0%	$55-80 million (proposed) (1984 Cost Estimate)
2. Emergency Shore Protection	1962i	Repair of beach and dune erosion 370,000 yds. of sand fill	5 miles	100%	$970,000
3. Moriches Inlet Channel Improvement	1960s	Excavate entrance channel, inner channel, repair existing jetties, construct 300 ft. deposition basin, place dredged sand downdrift of inlet		0%	$20,000,000 (proposed) (1984 Cost Estimate)
4. Emergency Fill Project	1983i	1600 ft. stone revetment built and sand filled		100% (70% Fed.)	$1,500,000
5. Emergency Shore Protection	1984i	Dune Road rebuilt and 125,000 yd^3 used to create dune protection	1.3 miles	Anticipated Completion 6/84	$900,000 (Anticipated Cost)
STATE AND LOCAL					
1. Emergency Dune Repair	1938i	Dune fill by Suffolk County following hurricane of 1938; bulkheading on west side of Shinnecock to stabilize inlet		100%	$180,000
2. Westhampton Beach	1951i	Dune fill and beach grass to close inlet formed by storm		100%	$193,000
3. Westhampton Beach	1958i 1967i	380,000 yd^3 and 250,000 yd^3 of dune fill		100%	$184,300
4. Westhampton Beach	1983i	Emergency bulldozing of sand to open and maintain Dune Rd.		100%	$40,000

a - authorization date
s - study date
i - implementation date

Source:Appears as Table 3-14 in Long Island Regional Planning Board (1984).

would decrease the width of the island west of the groins. Temporary inlets and massive washovers would drive this portion of the island landward during major storms. In addition, as the barrier west of the groin field recedes, the land and structures to the east behind the westernmost groins may be threatened by scouring and flanking around the groins during severe storm events. This erosion could eventually cause the groins to fail in sequence from west to east. The shifting of the barrier west of the groin field would lead to breaching and the formation of new inlets. In addition, a new inlet would sever vehicular access to Cupsogue County Park.

It is necessary to maintain the location of the barrier for several reasons. First, a new inlet will cause sand to be lost from the littoral system causing adverse downdrift impacts. Second, a new inlet may cause shoaling in existing inlets; third, a new inlet may increase bay salinity levels thus causing adverse environmental impacts; and fourth, a new inlet may increase the proablility of mainland flooding.

3.8.9.5 Preferred Erosion Management Options: The groin field and its associated downdrift impacts are of primary concern in this segment. A more detailed analysis of the situation at Westhampton Beach and the options available for dealing with this problem are contained in a separate report by Tanski and Bokuniewicz (1988). Some action is needed to avoid a breach in the area downdrift of the groin field. Incorporating artificial beach fill and dune building, in conjunction with a modification of the groin field in some form, could resolve the erosion problem at this site.

Surveys indicate that the groins have trapped approximately 2 million cubic yards of sand in an offshore shoal suggesting that artificial bypassing of some of this material could be used to help restore longshore transport and the downdrift beaches. Complete restoration of the downdrift beach to pre-groin field conditions may not be feasible due to the extent of the past erosion, however, a continuous shoreline is necessary. Modification of the groin field to enhance bypassing may be feasible. Attempts to modify these structures would require more detailed studies to adequately ascertain the potential impacts before this option was employed.

Closure of a breach west of the groin field could be accomplished most effectively and economically if action was taken while the inlet was small. For this reason, a contingency plan for filling any breaches in this area should be developed until longer-term measures are implemented.

3.8.10 Shinnecock Inlet Segment

3.8.10.1 Existing Land Use and Shore Protection Structures: The Shinnecock Inlet segment extends from the boundary between the Villages of Westhampton Beach and Quogue to Halsey Neck Lane in the Village of Southampton. The predominant land use within this segment is seasonal, low density residential development in the Villages of Quogue and Southampton, and either vacant or recreational and open space for those areas between the Villages of Quogue and Southampton.

Two federally designated *Coastal Barrier Resources System* units (CBRS) are located in this segment. The Tiana Beach CBRS unit, which is situated between the Village of Quogue and the Tiana Beach holding, owned by Suffolk County, encompasses about 1.5 miles of ocean shoreline that is characterized as primarily vacant. The Southampton CBRS unit, also approximately 1.5 miles in length, lies east of Shinnecock Inlet within the Village of Southampton, and is now almost fully developed with huge, seasonal homes on lots 2-5 acres in size.

The County of Suffolk has a large undeveloped holding of 475 acres at Tiana Beach; Town of Southampton bathing beach facilities are located to the west and east of the County property. The Shinnecock East County Park, approximately 60 acres in size and located between the inlet and the Village of Southampton, is heavily utilized for camping by those county residents owning off-road vehicles. The Village of Southampton owns a number of ocean beach access points along the barrier spit as well as some wetlands on the bay side of the spit. NYSDEC is acquiring most of the remaining privately owned wetlands on the barrier spit. There are extensive County-owned tidal wetlands along the back bay area of the Tiana Beach barrier island, as well as some tidal wetlands interspersed with residences along the back bay area of the Southampton barrier spit mentioned above. The predominant natural feature along the oceanfront of both the Tiana and Southampton barrier beach and spit is the dune formations and associated maritime shrubland vegetation. There are several tidal wetland islands located in Shinnecock Bay near the barriers.

The home port of the Shinnecock commercial fishing fleet is located immediately west of Shinnecock Inlet on the bay side of the barrier island. Approximately $1 million of federal and county funds were spent in 1984 to construct the commercial fishing dock which accommodates about two dozen commercial fishing vessels.

Access from the mainland to Dune Road, which runs the entire length of the Westhampton barrier island, is via Jessup Lane Bridge and Beach Lane Bridge in the Village of Westhampton Beach, Post Lane Bridge in the Village of Quogue, and the newly constructed Ponquogue Bridge near Shinnecock Inlet, which cost approximately $12.5 million as of December 1989. Access to Dune Road east of Shinnecock Inlet is through the Village of Southampton.

This segment is free of shore protection structures with the exception of the east and west jetties at Shinnecock Inlet, which were constructed in 1953-54. Implementation of the Shinnecock Inlet Navigation Project in the near future, which was authorized by Congress under the River and Harbor Act of 1960, will provide for the rehabilitation of the jetties.

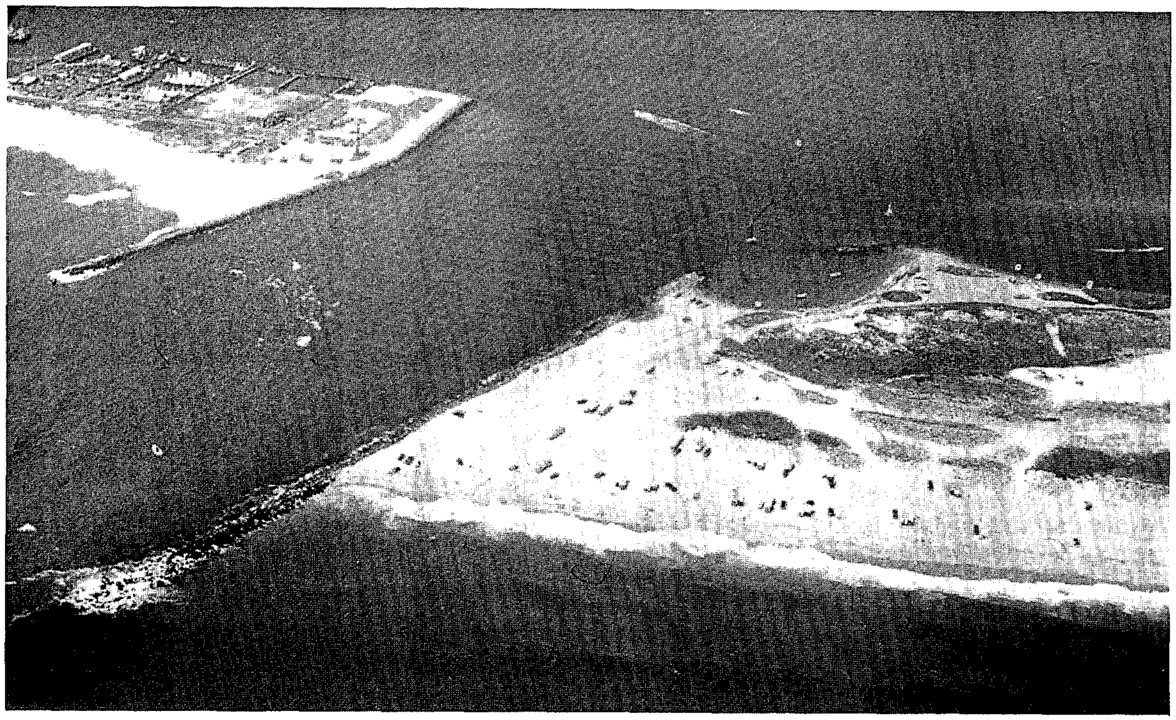


FIGURE 3-26 - *Shinnecock Inlet, July 1989. Note accretion and erosion on east and west sides of Inlet respectively*

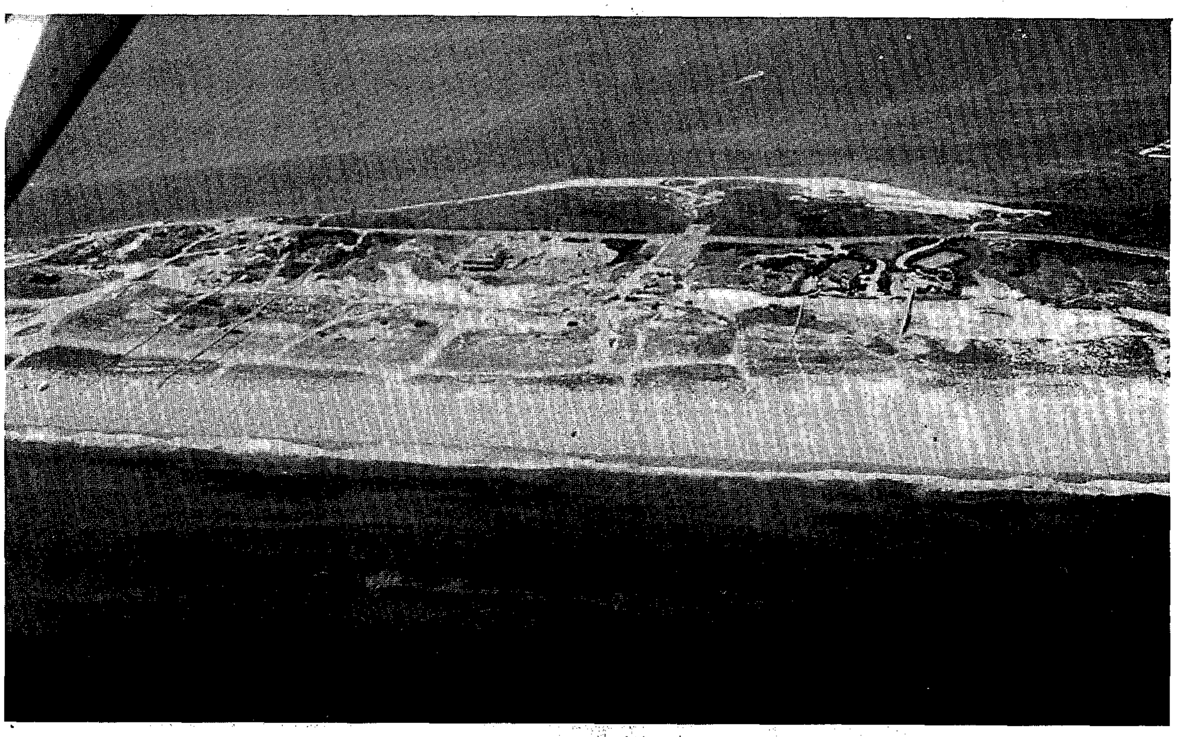


FIGURE 3-27 - *Southampton Barrier Spit, July 1989. Note extensive beach width immediately updrift of Shinnecock Inlet and newly constructed mansions located in CBRA designated area*

3.8.10.2 Land Use Plan Goals: The existing low density residential use in the Villages of Quogue and Southampton remains unchanged in the plan. It is recommended that all of the undeveloped land north of Dune Road within the Village of Quogue and stretching eastward to Tiana Beach, in addition to some of the oceanfront land within the Tiana Beach CBRA unit and immediately east, be acquired by the public for recreation and open space purposes. The plan also reflects an expansion of the County-owned docking facilities accommodating commercial fishing vessels and the establishment of the Okeanos marine research facility west of Shinnecock Inlet.

3.8.10.3 Coastal Hazard Planning Policies:

- Maintain existence and continuity of barrier island and spit.
- Emphasize regulation of private activity as the primary means for protecting structures and coastal features.

3.8.10.4 Policy Justification: It is necessary to maintain the existence and continuity of the barrier island to mitigate flooding of the nearby mainland, disruption of the longshore transport of sand, undesirable salinity changes in Shinnecock Bay, increased shoaling at Shinnecock Inlet, and additional shore erosion problems (downdrift of any newly formed inlets).

Maintenance of the shoreline position with public money is unnecessary where there is minimal government infrastructure to be protected. However, that portion of the shoreline immediately west of Shinnecock Inlet is experiencing the worst erosion within this segment and is also the area with the greatest public investment in infrastructure. Therefore, it will be necessary to maintain the shoreline position between Ponquogue Bridge and Shinnecock Inlet.

Seasonal residences in the Villages of Quogue and Southampton are located on parcels of sufficient size to permit their landward retreat in the event of a receding shoreline. It is recognized that property owners may wish to protect their property, although in doing so, they should not adversely impact coastal processes to the detriment of adjacent or nearby shoreline areas. It is anticipated that property owners within this shoreline segment will request permits for the construction of erosion control measures should their property be threatened.

3.8.10.5 Preferred Erosion Management Options: Beach nourishment in conjunction with regularly scheduled sand bypassing at Shinnecock Inlet is the recommended alternative for dealing with shoreline erosion problems west of the inlet. Because the beach immediately west of the inlet is subject to increased erosion due to disruptions and reversals of sediment transport associated with the shadowing effect of the inlet, this area may require special efforts. Frequent filling in this area or the use of structures such as small tapered groins, may be required to retain bypassed material on the beach and prevent it from returning to the inlet. As with the other inlets, a detailed analysis would be needed to identify the most effective bypassing procedures.

Similar to Moriches Inlet, Shinnecock Inlet historically has been a temporary coastal feature. The County of Suffolk, along with the Town of Southampton, New York State and COE, have been involved in the stabilization of Shinnecock Inlet and the maintenance of the shoreline on the barrier beach in the vicinity of the inlet. Table 3-6 lists all of the government projects at Shinnecock Inlet since it opened in 1938.

Congress recently passed an appropriation bill that included $5.3 million for implementation of the Shinnecock Inlet Navigation Project, which calls for rehabilitation of the jetties and a major dredging of Shinnecock Inlet. The entire project is expected to cost $11.8 million. Of that amount, $9.2 million will be paid by the Federal Government (U. S. Army Corps of Engineers 1987).

Maintenance of the navigation channel will include sand bypassing at the inlet at scheduled intervals. Part of the project maintenance costs will cover a monitoring program to ascertain the rate of shoaling in the inlet, the results of which will be utilized to determine the frequency and volume of future dredging operations in the inlet. It is anticipated that the dredge spoil from this project will be deposited on the beach west of the inlet, or if in the surf zone, at a depth no greater than 8-10 feet. Dredge spoil will also be placed at the bay end of the east jetty behind 1,000' of revetment to be constructed at this location because of a scour problem.

Severe erosion immediately west of Shinnecock Inlet threatens access to a publicly-owned commercial fishery dock and other private marine commercial uses. With implementation of the Shinnecock Inlet Navigation Project, regularly scheduled sand bypassing at Shinnecock Inlet will help to alleviate this severe erosion condition, which is due to currents and wave diffraction at the stabilized inlet. Fill will probably not remain on the beach for a long period. A breakwater and/or short groins to retain material could be considered at this location as conditions dictate.

The available data indicates that the porticn of the shoreline east (updrift) of the inlet is accreting due to the influence of the eastern jetty suggesting that no action is needed at the present time.

3.8.11 Coastal Ponds Segment

3.8.11.1 Existing Land Use and Shore Protection Structures: This segment extends from Halsey Neck Lane in the Village of Southampton to the eastern boundary of the Village of East Hampton. The primary land use in this segment is low density residential (less than 1 d.u./acre). The majority of residences in this segment are used only during the summer vacation season. There are also small areas of open space (primarily town and village parks) and areas of agriculturally used land. Access is primarily at the road ends along the ocean front.

TABLE 3-6

Government Projects at Shinnecock Inlet.

Year	*Project*	*Agency*
1947	Stone revetment and groin, west side, 800' and 130' long, respecively	NYS, Suffolk County and Town of Southampton
1951	Channel 9' deep, 100' wide, 2,000' long at inner sand bar resulted in 110,500 cubic yards of spoil used as beach nourishment	Suffolk County
1953-54	Construction of east jetty 1,363' long, riprap 700' long. West jetty 850' long, extension to total length of 946'	NYS, Suffolk County and Town of Southampton
1968	Dredging of 270,300 cubic yards of spoil	Suffolk County
1969	Dredging of 113,000 cubic yards of spoil	Suffolk County
1973	Dredging of 250,900 cubic yards of spoil	Suffolk County
1982	The pile crib revetment was replaced by a rubble mound jetty on west side of Inlet and 170' of original jetty was reconstructed	Suffolk County
1984	Emergency dredging performed by hopper dredge resulted in the removal of shoals hazardous to navigation immediately seaward of the Inlet. Approximately 176,000 cubic yards of dredged material was deposited by the hopper dredge in the surf zone west of the Inlet	U.S. Army Corps of E ngineers
1988-89	Emergency dredging of 83,240 cubic yards of material in ocean just south of jetties. Spoil placed downdrift of inlet close to shore	Suffolk County

Sources: U. S. Army Corps of Engineers (1987).
Suffolk County Planning Dept. (1985).

There is a substantial dune system along most of the entire length of this segment. Coastal ponds and their associated freshwater wetlands are dispersed along this segment, a few of which are tidally influenced on an intermittent basis. Property owners, especially in the Villages of Southampton and East Hampton, have constructed rock revetments and sheet steel bulkheads to protect their residences. Four publicly funded groins have been constructed in the vicinity of Georgica Pond. There is some evidence indicating that these groins have caused erosion downdrift at Wainscott Beach.

3.8.11.2 Land Use Plan Goals: The goal for this segment envisions low density residential use as the predominant land use. Parcels in this segment are significantly larger than that located on the barrier islands, and therefore, there is room to re-locate structures away from the shoreline should they be threatened by erosion. In addition, Figure 3-1 reveals that this shoreline segment is one of the most stable. Indeed, portions of this segment have exhibited long-term shoreline accretion.

3.8.11.3 Coastal Hazard Planning Policies: The coastal hazard planning policy for this coastal segment is to emphasize regulation of private activity as the primary means for protecting structures and coastal features. Residents in this segment have requested permits for such erosion control measures as rock revetments and sheet steel bulkheads to protect their property. Government regulators must be in a position to properly regulate this activity based upon a better understanding of the causes and effects of shoreline behavior. An adequate understanding of the coastal processes and shoreline responses is essential for addressing a number of critical questions that affect the selection of management options in different areas. Reliable estimates of such factors as the erosional risk, storm vulnerability and the expected degree of recovery after an erosional event for different areas are essential components of any coastal erosion management program.

3.8.11.4 Policy Justification: Reliance is placed on the regulation of private activity, which is the primary means for protecting structures and coastal features because:

- residences in this segment are on parcels of sufficient size to allow retreat;
- this coastal segment has exhibited long-term stability;
- there is generally no broad public interest associated with government actions to maintain the shoreline in this segment; and
- there is minimal investment in existing public infrastructure.

It is recognized that property owners may wish to protect their property, although in doing so, they should not adversely impact coastal processes to the detriment of adjacent or nearby shoreline areas.

3.8.11.5 Preferred Erosion Management Options: Although beach nourishment and dune building are generally the preferred options for this segment, the lack of adequate information on the sources, rate, timing, and direction of sand transport along the eastern portion of the south shore resulted in different perceptions of the nature of the problem and alternatives for dealing with it. Of particular concern was whether erosion of the

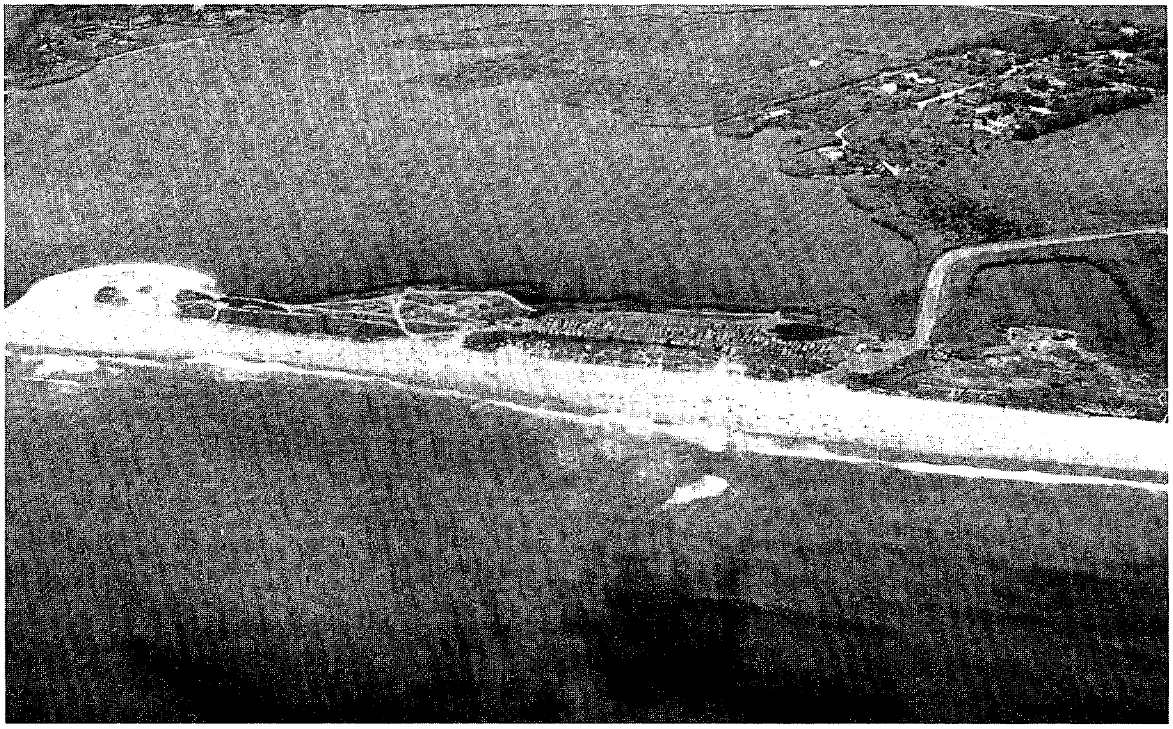


FIGURE 3-28 - *Sagaponack Lake, July 1989. Typical coastal pond surrounded by low density residential use.Note flood tidal delta in lake*

FIGURE 3-29 -*Bluffs at Montauk, July 1989*

shoreline in this area supplied the entire downdrift sand transport system, or whether there is an offshore source contributing to the sediment budget. Available data were insufficient to resolve this question.

Unlike the coast to the west, the lack of a major inlet in this segment and the one further east precludes the use of inlet bypassing as a viable option for addressing erosion on a regional basis. However, maintaining the continuity of longshore transport is still important. Proper management of the coastal ponds found in this area could help alleviate some of the more localized erosion problems associated with these features. Sand lost from the near-shore system from overwash and formation of flood-tidal deltas as a result of storm events and dredging activities should be returned to the beach to help restore the transport of material along the beach. This should be done after major storms, and/or in conjunction with the periodic dredging that is usually undertaken to control water levels and water quality in the ponds.

Effective beach nourishment projects cannot be implemented by individual property owners; smaller-scale measures are the only feasible alternatives for individuals or small communities. Relocation/retreat and instituting appropriate setbacks are the recommended alternatives in cases involving individual structures. They are particularly suitable in this segment because lots are generally large. State participation in a recently-implemented program (known as the Upton-Jones Amendment) of the National Flood Insurance Program could provide incentives for homeowners to relocate. This program allows the use of flood insurance funds for voluntarily moving erosion-threatened structures.

A special erosion problem encountered in this segment is at Wainscott Beach. It appears that both improper inlet management and the groins immediately to the east at Georgica Pond have caused erosion of this beach.

Periodic inlet maintenance at Georgica Pond should be controlled to mitigate downdrift erosion. The alternative of shortening the two existing federal groins should also be considered. As far as beach protection is concerned, pond inlets should be closed after flushing is obtained. Channels should not be allowed to stay open more than a week or two.

The construction of rock revetments and other shore parallel structures by homeowners attempting to protect their individual properties is another special erosion problem in this segment. Revetments are relatively benign as compared to groins, but they do accelerate erosion in areas adjacent to the structures during storms. During severe storms, revetments can be exposed and undermined. If built in an eroding beach situation, narrow beach width could be a problem; a revetment could function like a groin if located in the surf zone.

Section 3.7 identifies topics that should be addressed in the regulatory process involving the construction of bulkheads. Homeowners should be required to construct revetments as far landward as possible, while avoiding disturbance of any dunes. New structures should be built on piles, rather than relying on revetments for protection. If a revetment is destroyed, the right to re-build it should not be guaranteed in any permit process. In general, revetments should not be a problem over the short-term. If the shoreline recedes over the long-term, such structures will be exposed continuously, and subject to failure due to severe storms.

3.8.12 Napeague Segment

3.8.12.1 Existing Land Use and Shore Protection Structures: This segment extends from the eastern boundary of the Village of East Hampton to the eastern boundary of Hither Hills State Park. The primary land use in this shoreline segment is open space and recreation. Open space can be found principally in Amagansett, Napeague and Hither Hills. The Town of East Hampton, the Nature Conservancy and the Federal government are the major owners of open space in the vicinity of Amagansett. The Federal government has designated nearly 5,000 feet of ocean-front shoreline as a Coastal Barrier Resources System unit in Napeague. This open space is used primarily as a nature sanctuary. New York State owns approximately 12,500 linear feet of shoreline at Napeague State Park and approximately 7,500 linear feet of shoreline at Hither Hills State Park. The shoreline length of this segment is approximately 47,000 feet, of which 56% or 26,500 feet is in the open space and recreation category. Both state parks have limited facilities and are therefore not intensely used. Attendance at Napeague State Park was approximately 170,000 in 1988. Attendance figures for Hither Hills State Park, which provides camping facilities, were combined with those for Montauk Point State Park. Attendance at both parks totaled approximately 1.3 million people. Approximately 30% of this attendance, or 387,000, can be attributed to Hither Hills State Park.

The remainder of the segment shoreline is in low and medium density residential use and commercial-recreation use. It should be noted that these residences are used primarily during the summer vacation season. The commercial-recreation use is located immediately west of Hither Hills State Park and occupies approximately 1500 linear feet of shoreline.

3.8.12.2 Land Use Plan Goals: Low intensity recreation/open space land use is the recommended predominant land use in the Napeague segment. In addition, low density residential use should be the predominant residential use in this segment. No expansion of the existing commercial-recreation uses should occur.

3.8.12.3 Coastal Hazard Planning Policies: The planning policy for this coastal segment is to emphasize regulation of private activity as the primary means for protecting structures and coastal features. It is not recommended that New York State take any measures to protect the two parks in state ownership, since little infrastructure and few facilities are found here. The one exception is the need to prevent further bluff erosion at the site of the Montauk Point lighthouse, which is discussed in the next segment.

3.8.12.4 Policy Justification: Reliance is placed on the regulation of private activity, which is the primary means for protecting structures and coastal features, because there is generally no broad public interest associated with government actions to maintain the shoreline in this segment, and there is minimal investment in existing public infrastructure. It is recognized that property owners may wish to protect their property, although in doing so, they should not adversely impact coastal processes to the detriment of adjacent or nearby shoreline areas.

3.8.12.5 Preferred Erosion Management Options: Although beach nourishment and dune building are generally the preferred options for this segment, the lack of adequate information on the sources, rate, timing, and direction of sand transport along the eastern portion of the south shore resulted in different perceptions of the nature of the problem and alternatives for dealing with it. Of particular concern was whether erosion of the shoreline in this area supplies the entire downdrift sand transport system, or whether there is an offshore source contributing to the sediment budget. Available data were insufficient to resolve this question.

Relocation/retreat and instituting appropriate setbacks where possible are the preferred alternatives for protection of private structures. Shorefront lots are generally large in this segment. For more information on this topic see section 3.8.11.5.

3.8.13 Montauk Segment

3.8.13.1 Existing Land Use and Shore Protection Structures: In land use terms, the Montauk segment can be characterized as being primarily low density residential; however there is a significant amount of open space, vacant land and commercial land use. In terms of shoreline length approximately 21,000 feet (48%) is utilized by low density residential; 16,500 feet (38%) by open space and recreation; 3,500 feet (8%) in the vacant category; and 3,000 feet (7%) by commercial activity.

Montauk State Park represents the largest parcel of open space in this segment and was visited by approximately 900,000 people in 1988. The park shoreline is primarily high bluffs which is the predominant natural feature in this segment. Shore protection structures found in this segment are located at Montauk Point and Ditch Plains. Gabions have been utilized at Montauk Point to protect the toe of the bluff from wave attack and there is a small groin in Ditch Plains immediately east of the East Hampton Town Park.

3.8.13.2 Land Use Plan Goals: The land use plan goal for this segment is to minimize the intensity of uses along the shoreline. Thus, where possible, recreation/open space land use should be expanded. This can be accomplished by government acquisition of a 34-acre oceanfront site immediately west of Montauk hamlet. In addition, low density residential use should be the predominant residential use in this segment. This would allow consideration of retreat/relocation as an alternative response to shoreline erosion.

3.8.13.3 Coastal Hazard Planning Policies: It is anticipated that residents may request permits for coastal erosion measures to protect their property. Therefore, the appropriate coastal hazard planning policy for this coastal segment is to emphasize regulation of private activity as the primary means for protecting structures and coastal features.

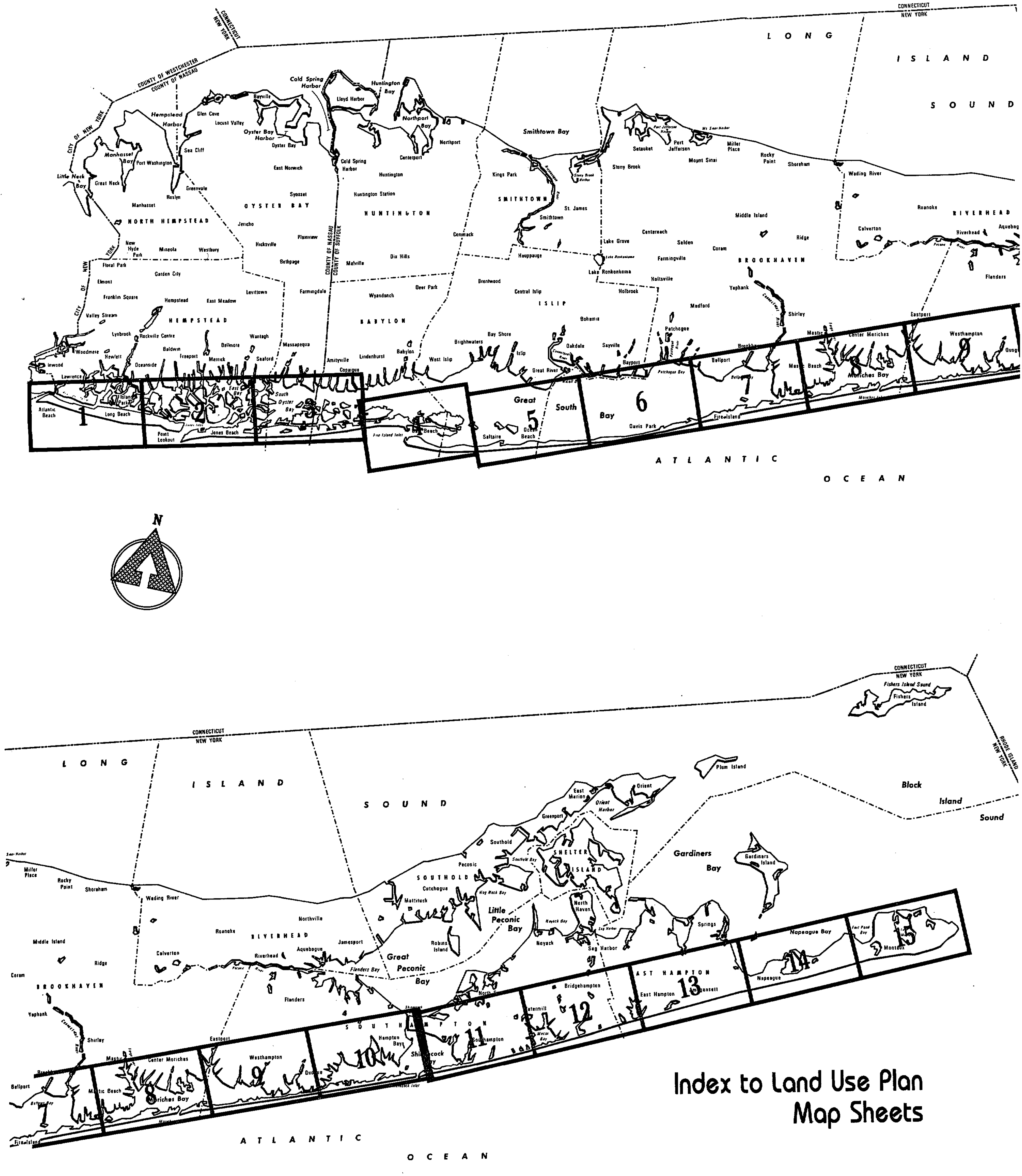
3.8.13.4 Policy Justification: The policy justification is similar to that for the Napeague segment found in section 3.8.12.4.

3.8.13.5 Preferred Erosion Management Options: No single erosion management alternative is recommended in this segment. This is largely due to questions regarding the role of bluff erosion in supplying sand to the littoral system. Although the available data indicate the volume of material supplied by bluff erosion to longshore transport is relatively small compared to estimates of the rate of sand transport further west, more detailed information on the composition, height, and actual recession rates of the bluffs, as well as better wave information, would be required to make a more precise determination of the actual contribution of bluff erosion to the sediment budget and thus, the most suitable options for this area.

Relocation and the institution of setbacks are viable options due to the generally larger lot sizes and less dense development found in this area, but where this strategy is not possible, shore hardening alternatives might also be appropriate. The decision to allow shore hardening, however, must be made for each site based on the bluff height, composition, recession rate, location of the structure, and an analysis of the type and amount of sand that could be moved by the longshore transport system in a particular area. Topics that should be addressed in the regulatory process governing structural bluff protection are discussed in section 3.7.

The special erosion problem in this segment is located at Montauk Point where bluff erosion threatens Montauk Lighthouse. A project to stabilize the bluff through grading, vegetation planting, drainage control and toe protection is underway with support provided by the private sector and NYS Office of Parks, Recreation and Historic Preservation. Armoring the Montauk bluffs will reduce the volume of sand made available to the littoral zone, but only to an insignificant degree. Should erosion control measures fail, relocation of the lighthouse should be considered and studied. Stabilizing the promontories to the west could help retain the pocket beaches located between these features.

LAND USE PLAN



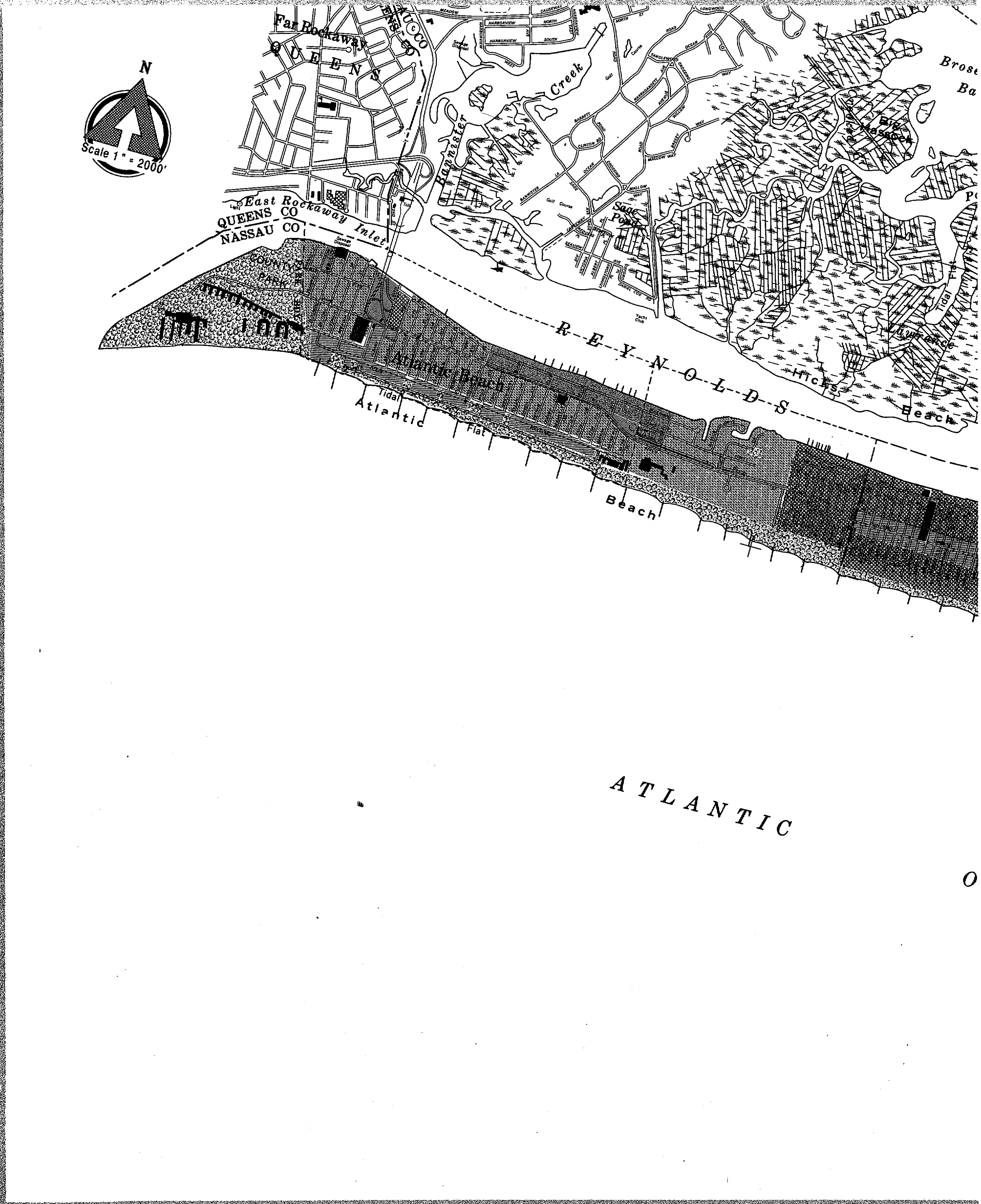
Index to Land Use Plan Map Sheets

-LEGEND-

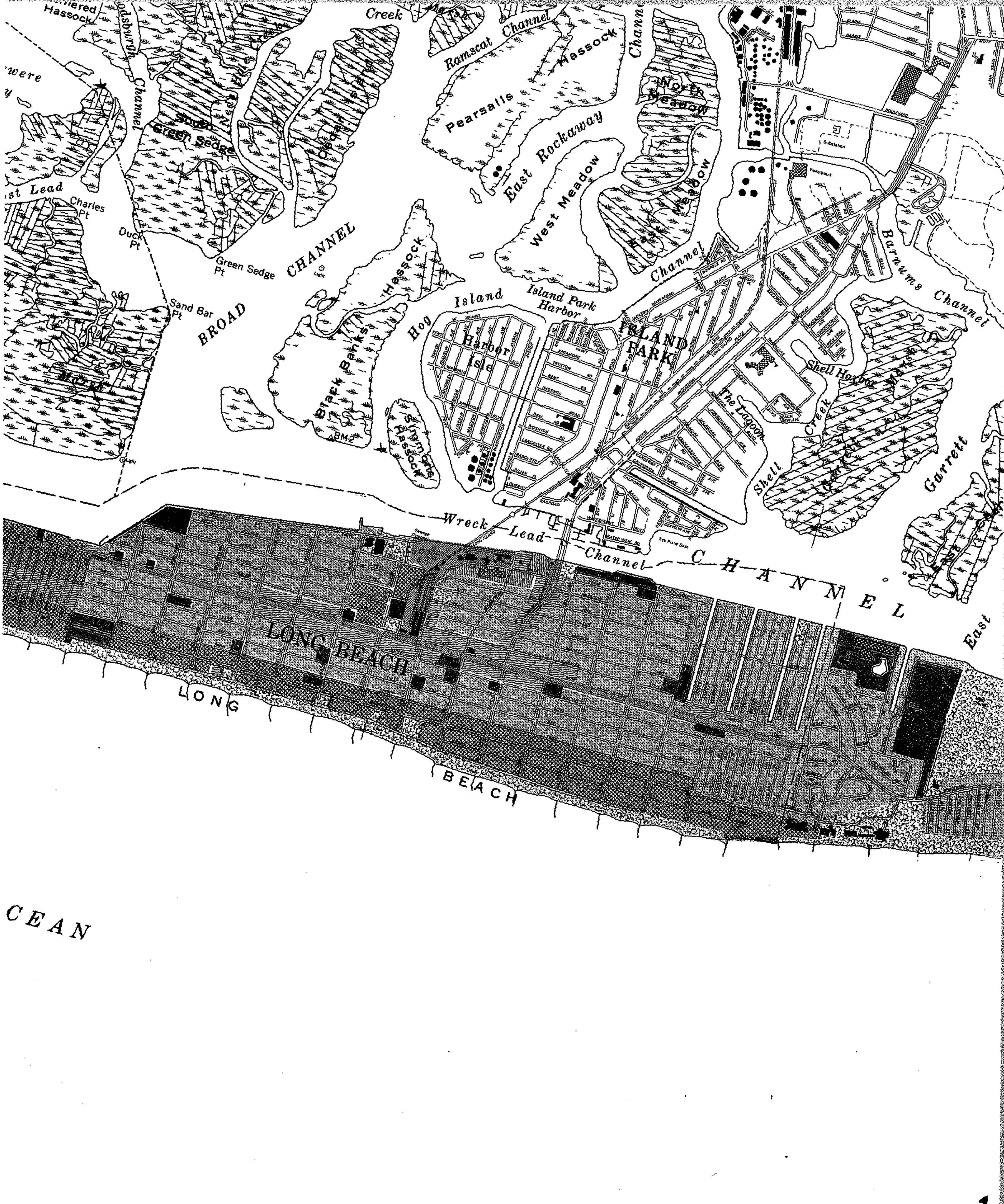
Residential

- 1 D.U. & Less/Acre
- 2-4 D.U./Acre
- 5-10 D.U./Acre
- 11 D.U. & Over/Acre

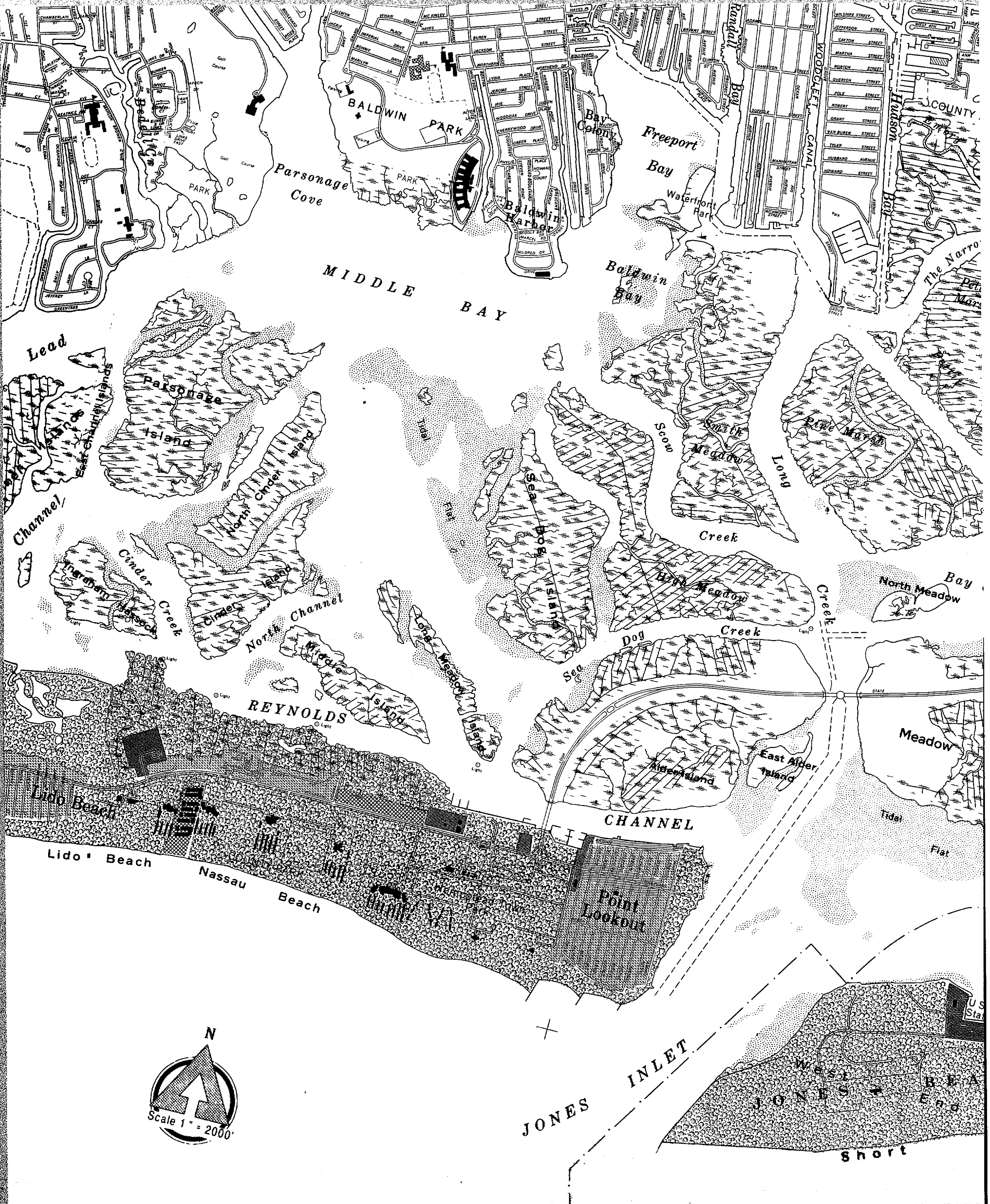
- Commercial
- Industrial
- Institutional
- Open Space & Recreational
- Transportation & Utilities



N
Scale 1" = 2000'
Far Rockaway
QUEENS
East Rockaway Inlet
QUEENS CO
NASSAU CO
Bannister Creek
Sage Pond
COUNTY PARK
Atlantic Beach
Tidal Flat
Atlantic Beach
REYNOLDS
Hicks Beach
Tidal Flat
Lawrence
ATLANTIC
O



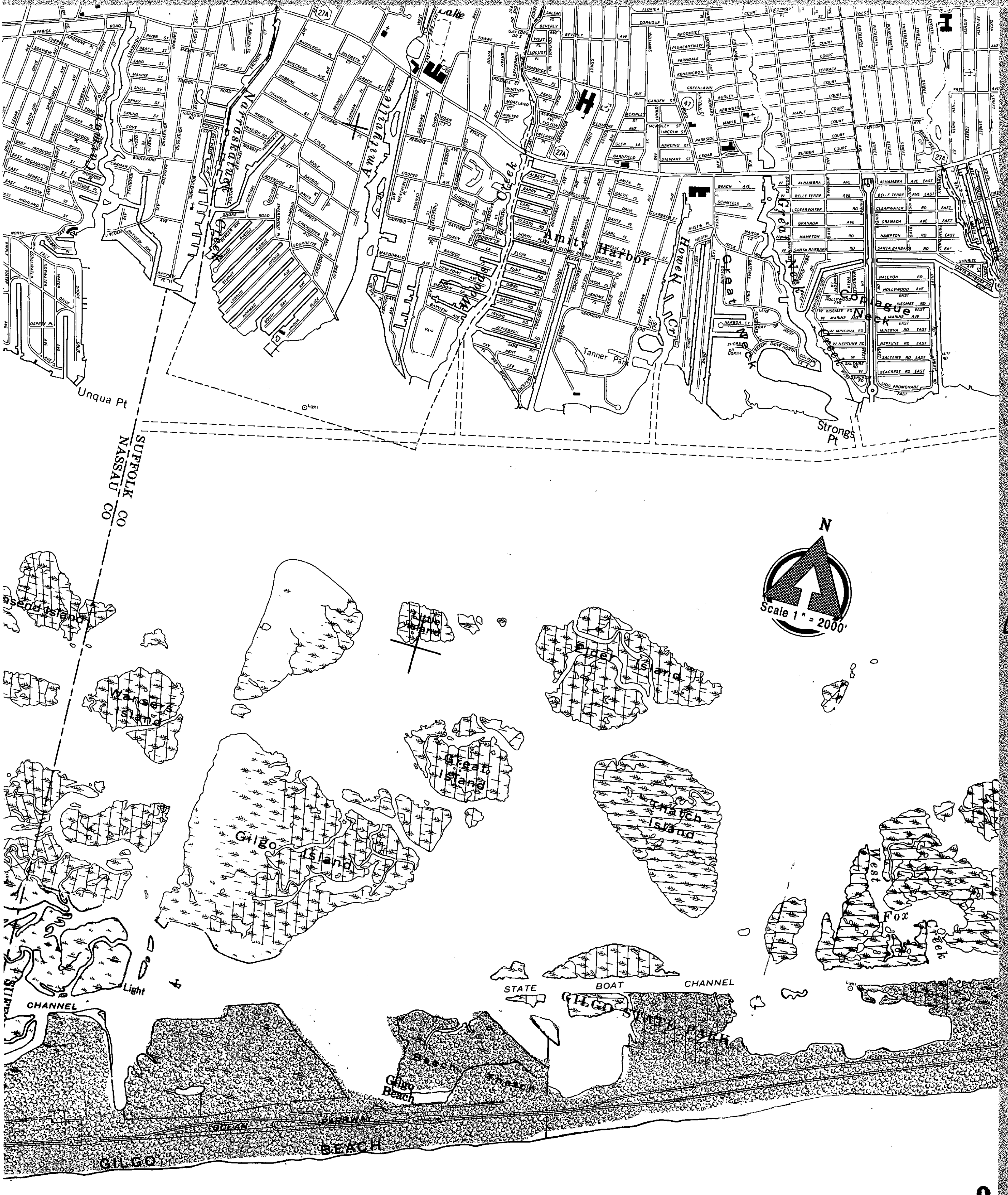
Hassock
Creek
Ramscat Channel
Hassock
Channel
Channel
South Green Sedge
Pearsalls
North Meadow
East Rockaway
West Meadow
Meadow
Substation
Powerplant
Lead
Charles Pt
Duck Pt
Green Sedge Pt
CHANNEL
Hassock
Channel
Barnums Channel
Sand Bar Pt
BROAD
Island
Island Park Harbor
Hog
Harbor Isle
ISLAND PARK
Black Banks
Shell Harbor
The Lagoon
Hassock
BM2
Creek
Shell
Garrett
Wreck
Lead
Channel
C H A N N E L
LONG BEACH
East
L O N G
B E A C H
CEAN


Parsonage Cove
BALDWIN PARK
Baldwin Harbor
Bay Colony
Freeport Bay
Waterfront Park
Randall Bay
WOODCLEFT CANAL
Hudson Bay
COUNTY
The Narrows
MIDDLE BAY
Baldwin Bay
Lead
Channel
Parsonage Island
East Channel Island
North Cinder Island
Cinder Creek
Cinder Island
North Channel
Tidal Flat
Sea Dog Island
Scow
Smith Meadow
Long Creek
Pine Marsh
High Meadow
Creek
Bay
North Meadow
Sea Dog Creek
Middle Island
Long Meadow Island
REYNOLDS
Alder Island
East Alder Island
Meadow
Tidal Flat
CHANNEL
Lido Beach
Lido Beach
Nassau Beach
Point Lookout
JONES INLET
West End
JONES BEACH
Short
N
Scale 1" = 2000'
1


Merrick Bay
Tidal Flat
Fighting Island
Mill Creek
Merrick Pt
Nicks Pt
Whaleneck Pt
White Pt
WANTAGH
COUNTY PARK
Treatment Plant
EAST BAY
Flat Creek
Semans Island
Tidal Flat
False Channel Meadow
W Neds Creek
Neds Meadow
Neds Creek
False Channel
Big Crow Island
Broad Creek
Cuba Island
Tidal Flat
East Island
Crooked Lead
Middle Island
Great Island
Low Island
Goose Cr
Fundy Channel
Crow Island
West Crow Island
of Fundy
Lead
Middle Crow Island
INTERCHANGE M10
Wife Lead
East Crow Island
Channel
Egg Island
Green Island
Swift Creek
Haunts Creek
Jones Island
Tidal Flat
Deep Creek Meadow
Snipe Island
Sloop Channel
SLOOP
CHANNEL
Long Meadow
Coast Guard
Zacks
STATE PARK
JONES BEACH
Beach

2

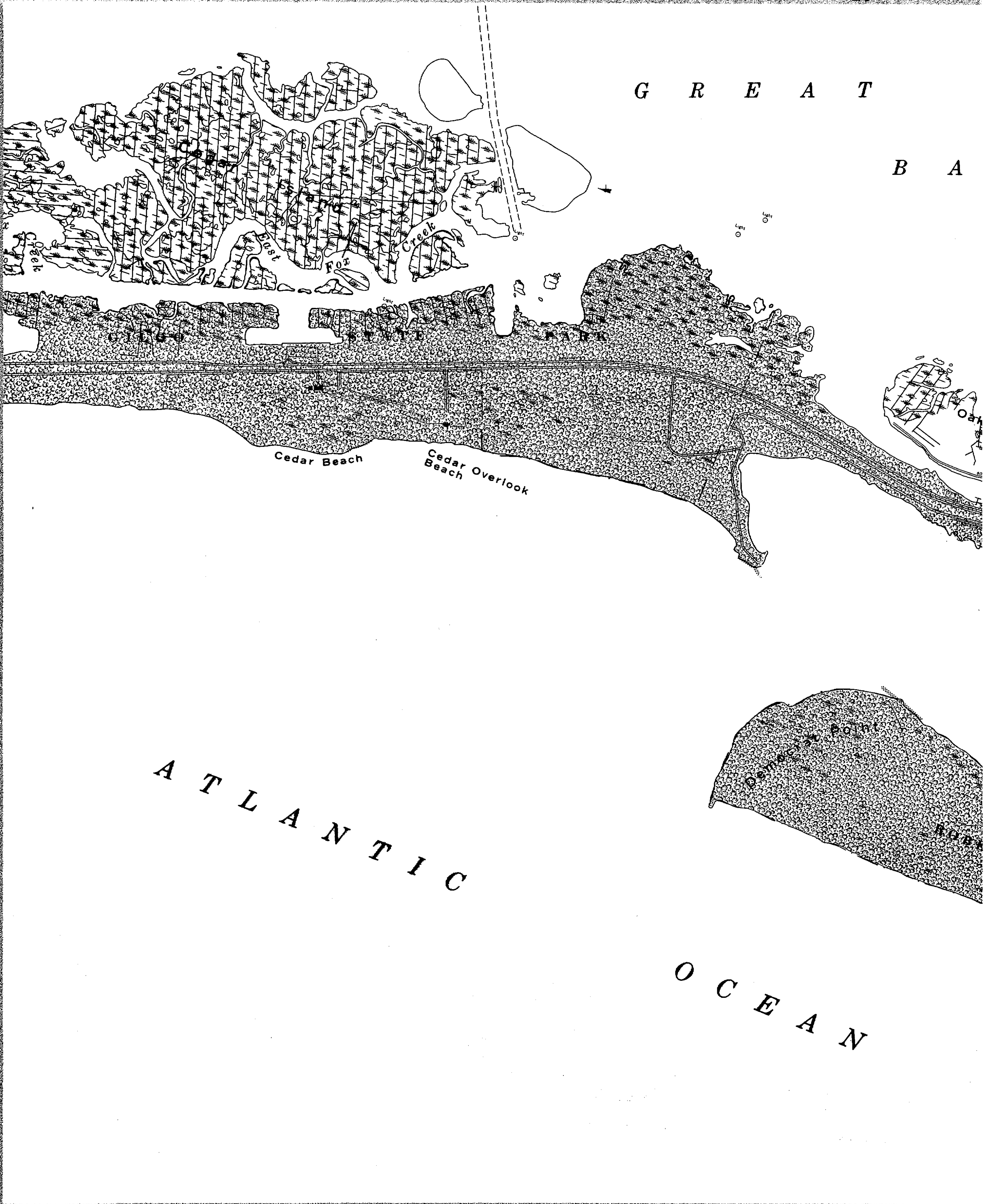
Seaford
Massapequa
Seamans Neck Park
Creek
Seamans Island
Goose Island Dr
Goose Island
Stone Creek
The Drain
North Line Island
Bulkhead Drain
Middle Line Island
South Line Island
Black Banks Island
Diamond
Shoals
Sanford Island
Light
Harbor Green
John J Burns Park
Jones Creek
OYSTER BAY
West Island
Squaw Island
Amity Channel
State
Boat
Tobay Beach Bird and Game Sanctuary
Salt Pond
Gilgo Heading
Beach
State Park
BEACH
TOBAY
BEACH
Nassau Co
Suffolk Co



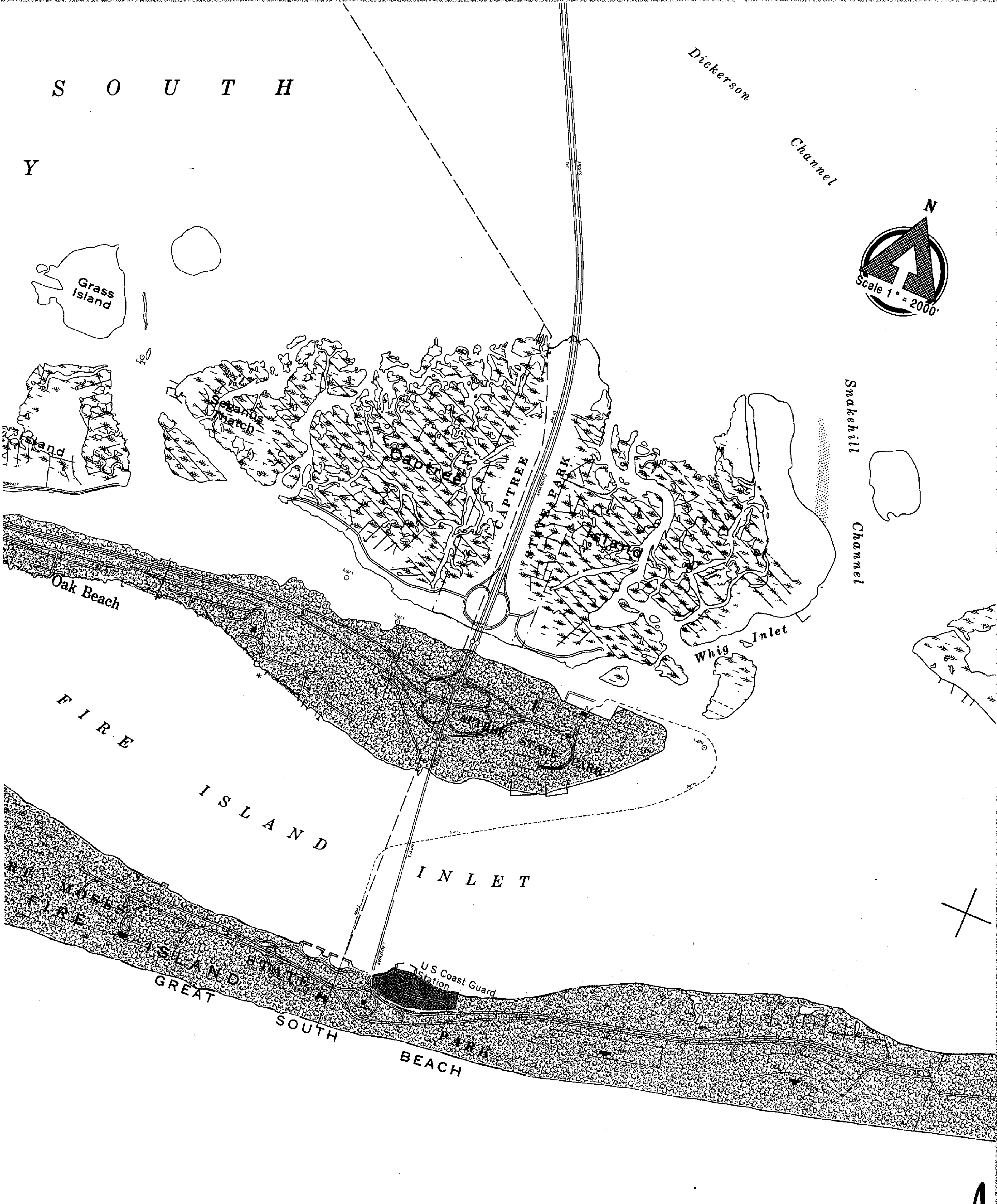
Narraskatuck Creek
Amityville Creek
Woods Creek
Amity Harbor
Howell Cr
Great Neck
Great Neck Creek
Copiague Neck
Carman Creek
Unqua Pt
Light
Tanner Park
Strongs Pt
SUFFOLK CO
NASSAU CO
N
Scale 1" = 2000'
Little Island
Elder Island
Wanser's Island
Great Island
Gilgo Island
Hatch Island
West Fox Creek
STATE BOAT CHANNEL
CHANNEL
GILGO STATE PARK
Gilgo Beach
OCEAN PARKWAY
GILGO BEACH

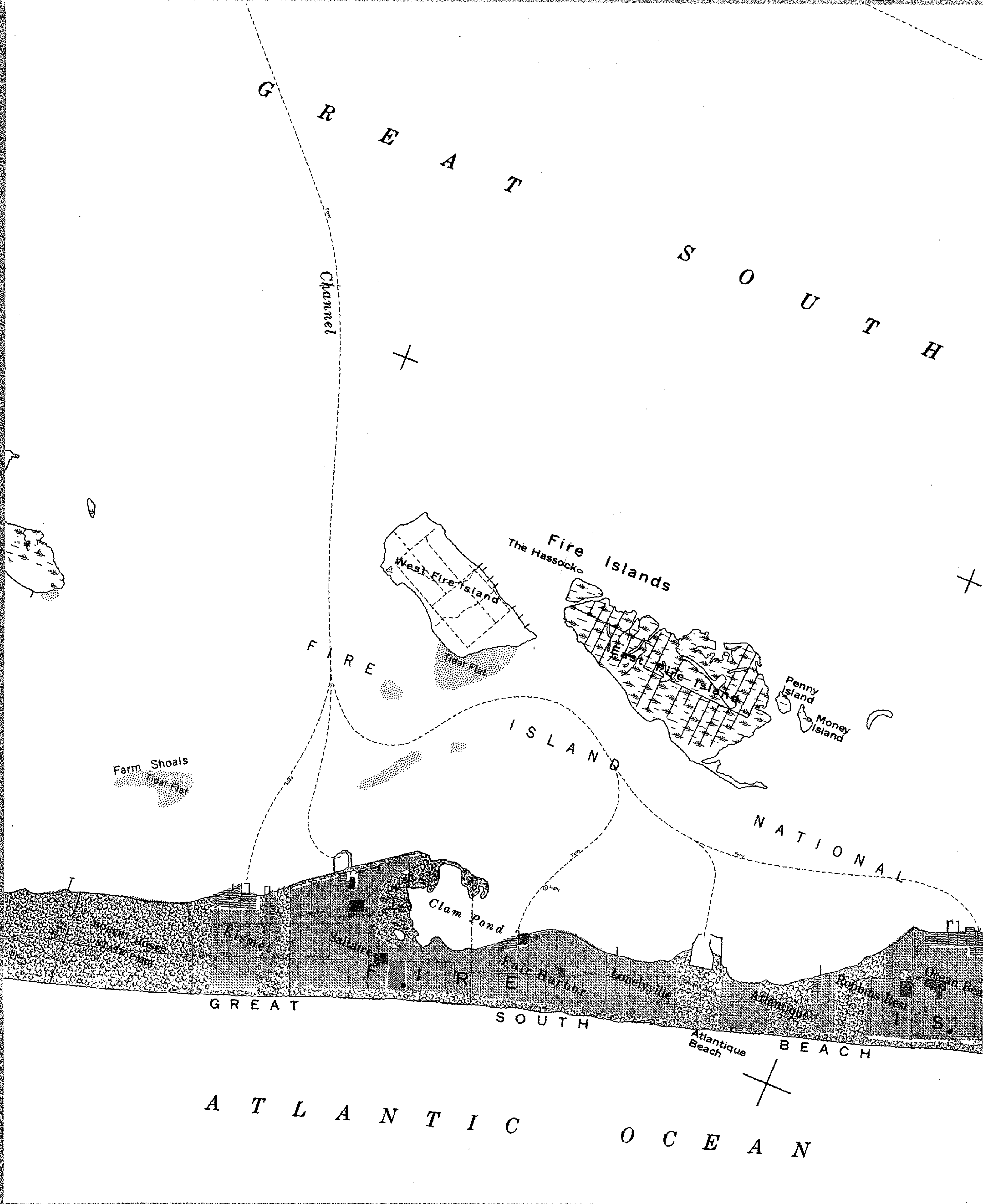
10

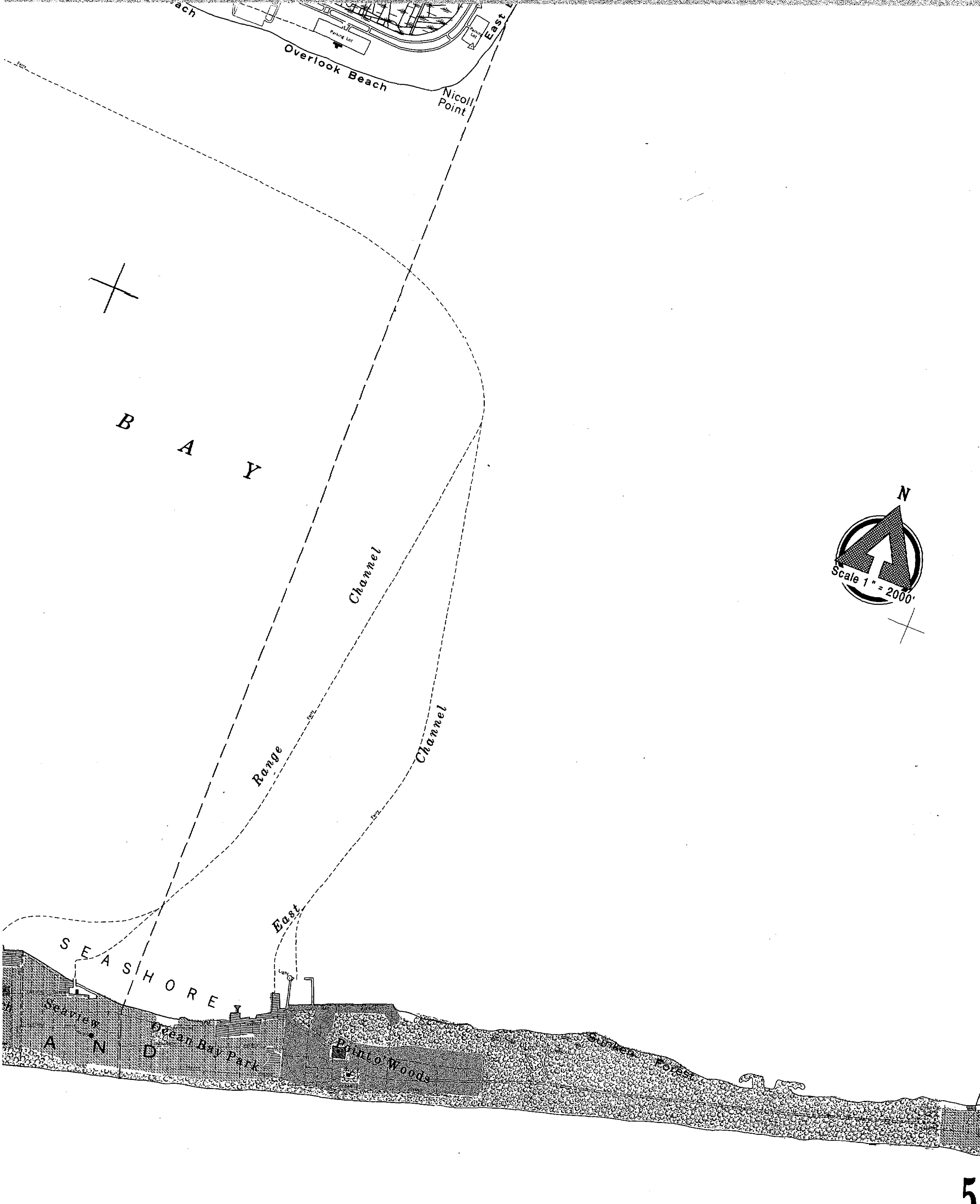
3

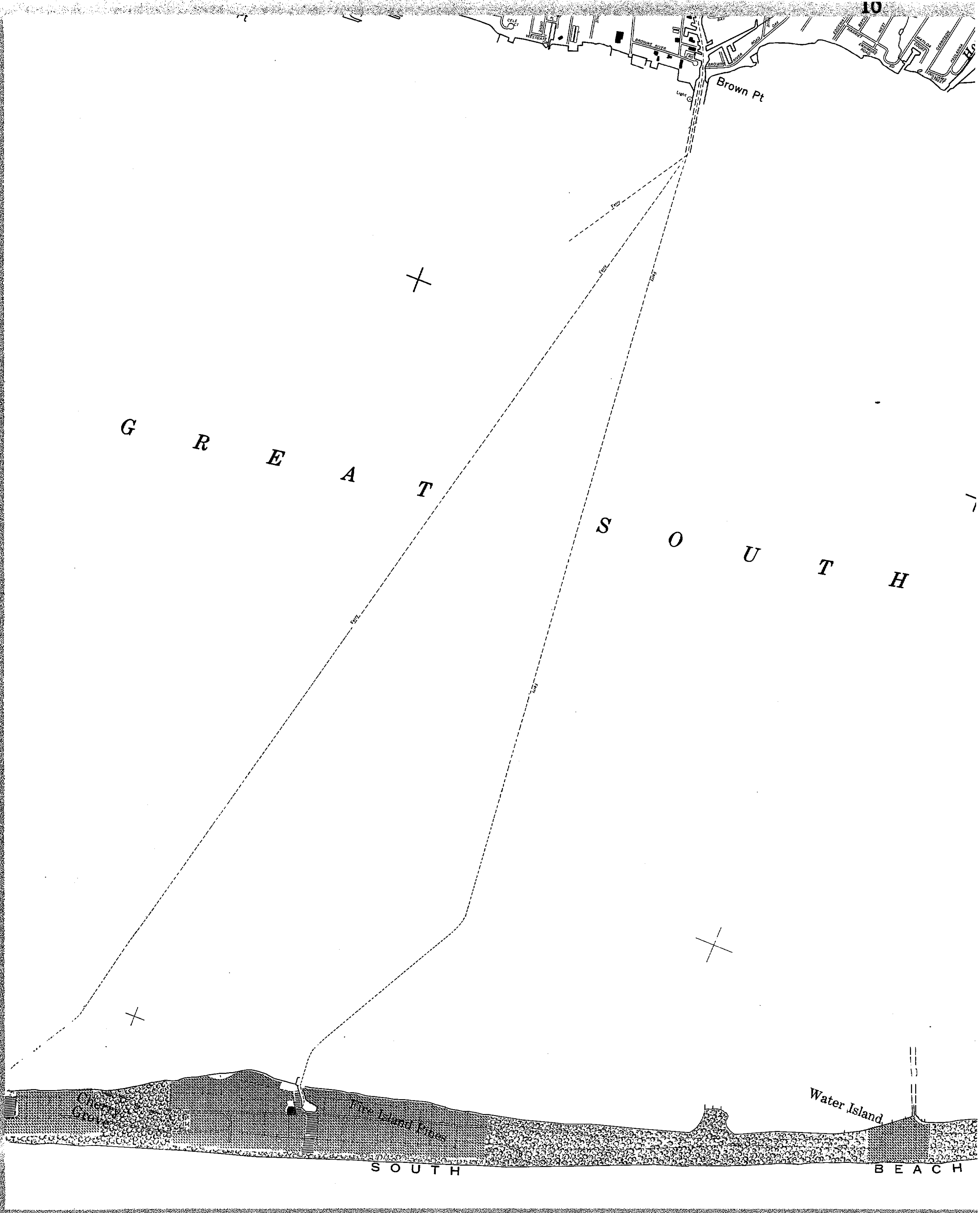


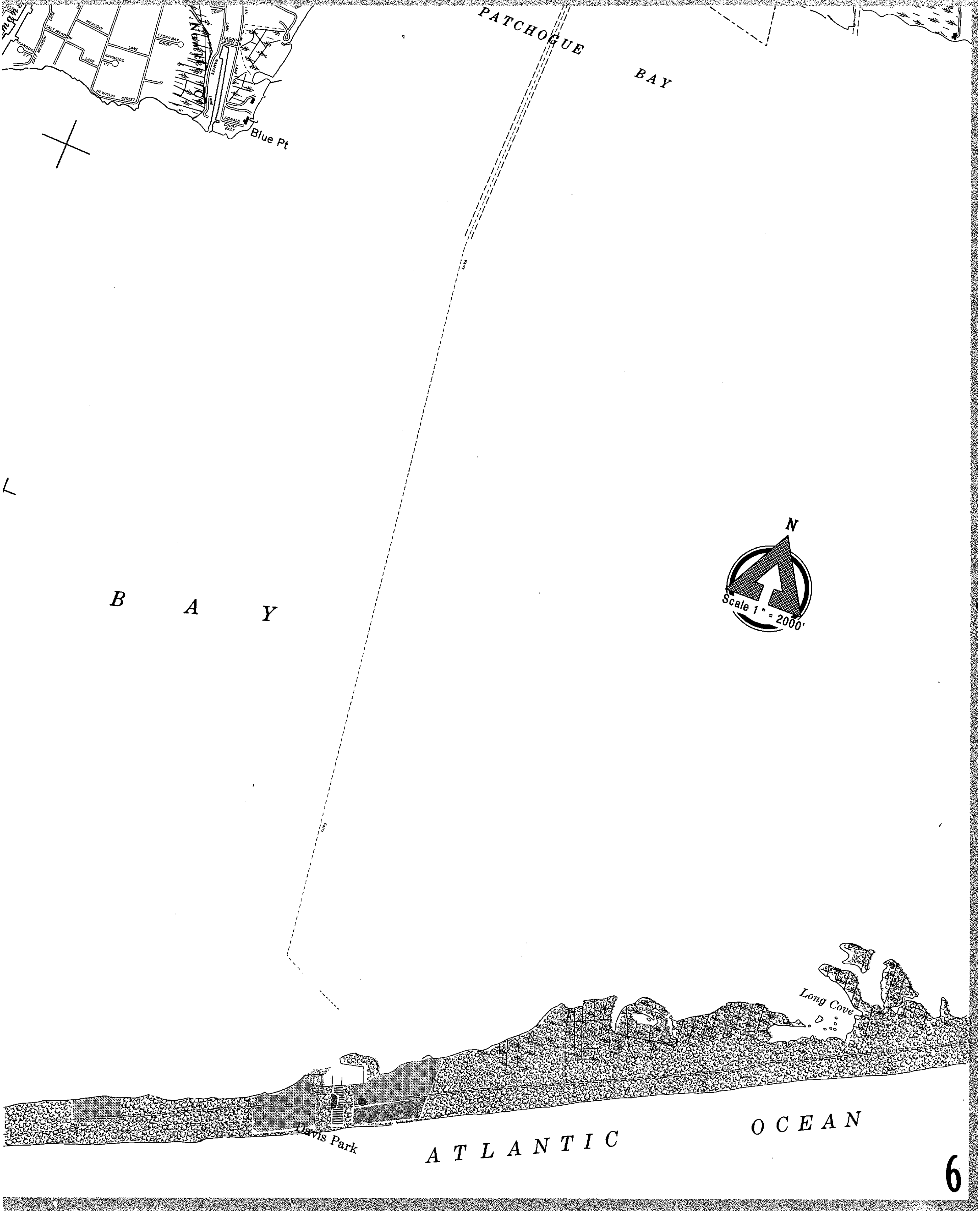
G R E A T
B A
Cedar Island
East Fox Creek
Creek
Light
GILGO STATE PARK
Cedar Beach
Cedar Overlook Beach
Democrat Point
A T L A N T I C
O C E A N

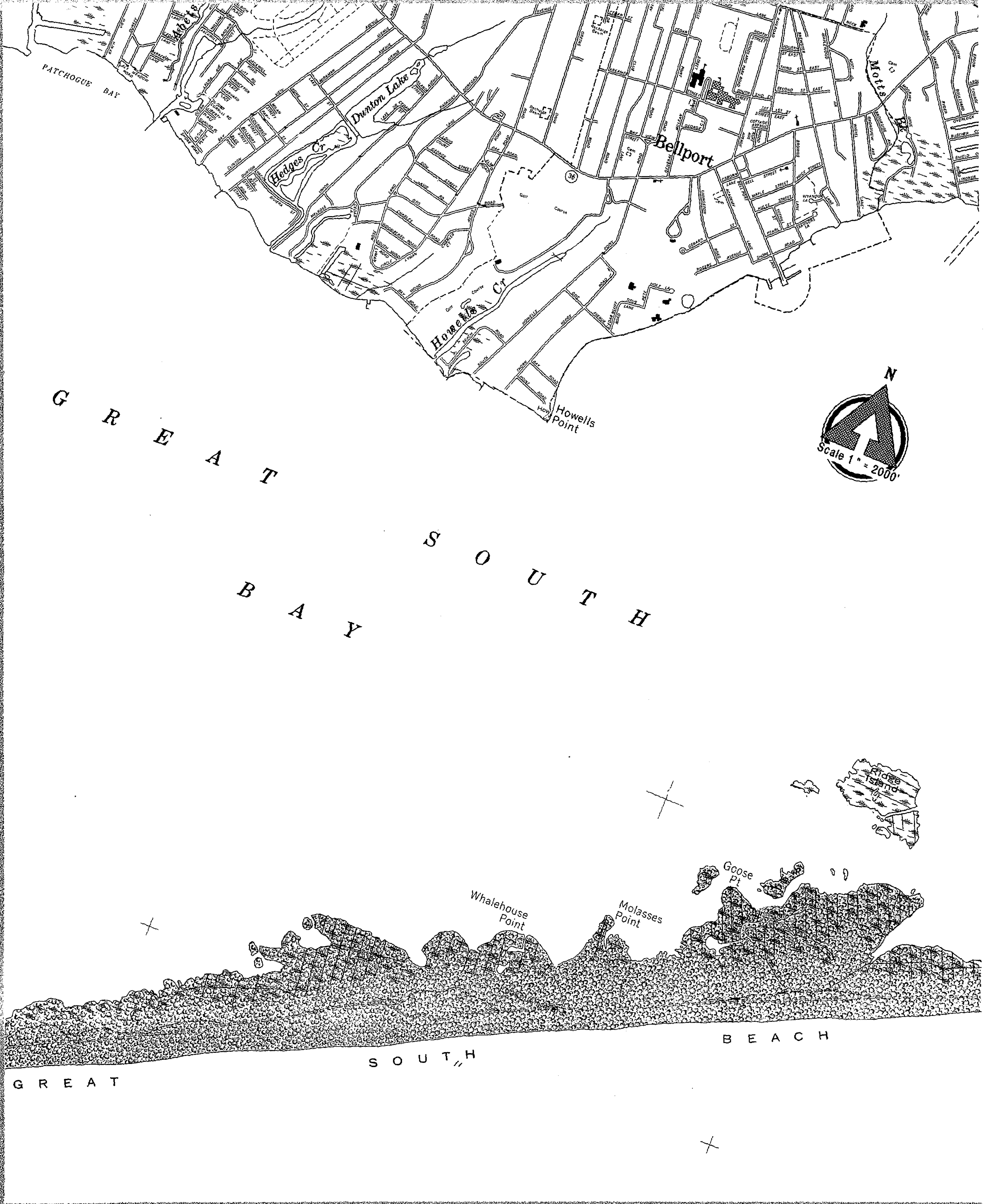

S O U T H
Y
Dickerson Channel
N
Scale 1" = 2000'
Grass Island
Seganus Thatch
Island
Captree
CAPTREE STATE PARK
Island
Snakehill Channel
Oak Beach
Whig Inlet
FIRE ISLAND INLET
U S Coast Guard Station
FIRE ISLAND STATE PARK
GREAT SOUTH BEACH


11
4
GREAT SOUTH
Channel
Fire Islands
The Hassock
West Fire Island
East Fire Island
Tidal Flat
Penny Island
Money Island
FIRE ISLAND NATIONAL
Farm Shoals
Tidal Flat
Clam Pond
Kismet
Saltaire
Fair Harbor
Lonelyville
Atlantique
Robbins Rest
FIRE IS.
GREAT SOUTH BEACH
Atlantique Beach
ATLANTIC OCEAN


ach
Parking Lot
Overlook Beach
Nicoll Point
East
B A Y
Channel
Range
Channel
East
SEASHORE
Seaview
Ocean Bay Park
Point o' Woods
Sunken Forest
A N D
N
Scale 1" = 2000'


10
5
Brown Pt
Light
Ferry
G R E A T
S O U T H
Cherry Grove
Fire Island Pines
Water Island
S O U T H
B E A C H


PATCHOGUE BAY
Blue Pt
B A Y
N
Scale 1" = 2000'
Long Cove
Davis Park
ATLANTIC OCEAN

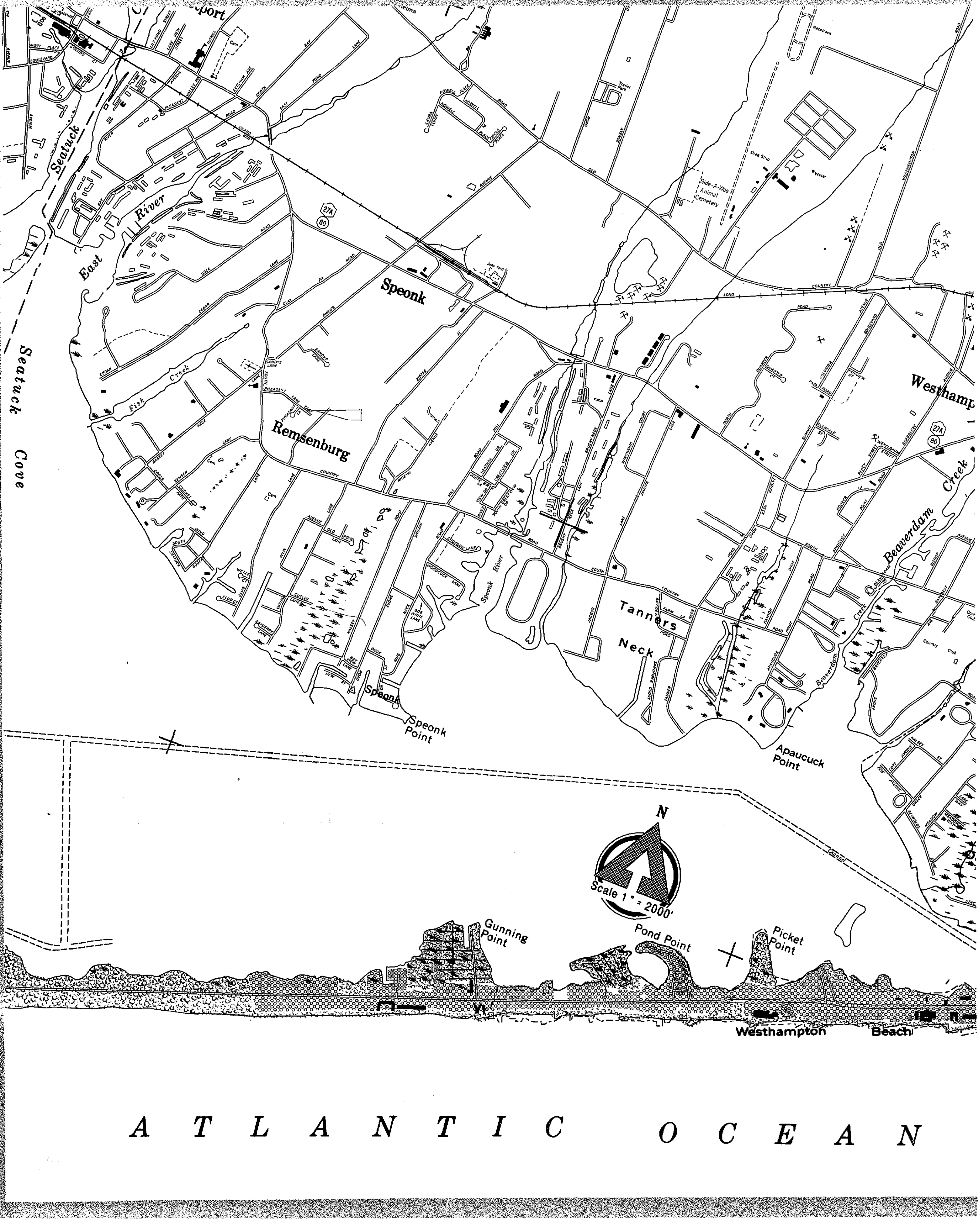

PATCHOGUE BAY
Dunton Lake
Hedges Cr
Bellport
Howells Cr
Golf Course
Howells Point
N
Scale 1" = 2000'
GREAT SOUTH BAY
Ridge Island
Goose Pt
Whalehouse Point
Molasses Point
GREAT SOUTH BEACH

6

Squassux Landing
Indian Landing
Woods Hole Pond
Straddle Point
Big Fish Cr Pond
Big Fish Creek
Fireplace Neck
West Cove
East Cove
Little Fish Cr Pond
Little Fish Cr
Sandy Point
Post Point
Long Point
BELLPORT BAY
Bay
Johns Neck
Johns Neck Cr
Hospital Island
Pelican Island
Smith Pt
Project Depth 6 feet
Mud
46
NARROW BAY
ATLANTIC OCEAN

46
Neck Cr
FORGE
RIVER
Channel
Island Point
Libby Point
Old Neck Creek
Mud Creek
Senix Creek
Areskonk Cr
Center
POOSPATUCK
INDIAN RESERVATION
Poospatuck Creek
Delafield Point
Long Creek
Smiths Point
Sands Point
Masury Point
Mastic Beach
Lawrence Creek
Home Creek
Forge Point
The Lagoon
Floyd Point
MORICHES
Pattersquash Island
New Made Island
FIRE ISLAND NATIONAL
SMITH POINT
7
A


Moriches
East Moriches
Mill Pond
Terrell River
Orchard Neck Cr
Little Seatuck Creek
Hills Creek
Bellview Beach
Davids Point
Tuthill Cove
Hart Cove
Haven Point
MORICHES COAST GUARD STA
N
Scale 1" = 2000'
Radio Point
Tuthill Point
BAY
Channel
Tidal Flat
SEASHORE
ISLAND
Moriches Inlet
COUNTY PARK
Cupsoque Beach
Swan Island
TLANTIC
OCEAN



Seatuck
East River
Seatuck Cove
Fish Creek
Speonk
Remsenburg
Westhampton
Speonk River
Tanners Neck
Beaverdam Creek
Speonk Point
Apaucuck Point
Bide-A-Wee Animal Cemetery
Drag Strip
Racetrack
Trailer Park
Country Club
27A
80
N
Scale 1" = 2000'
Gunning Point
Pond Point
Picket Point
Westhampton Beach
ATLANTIC OCEAN

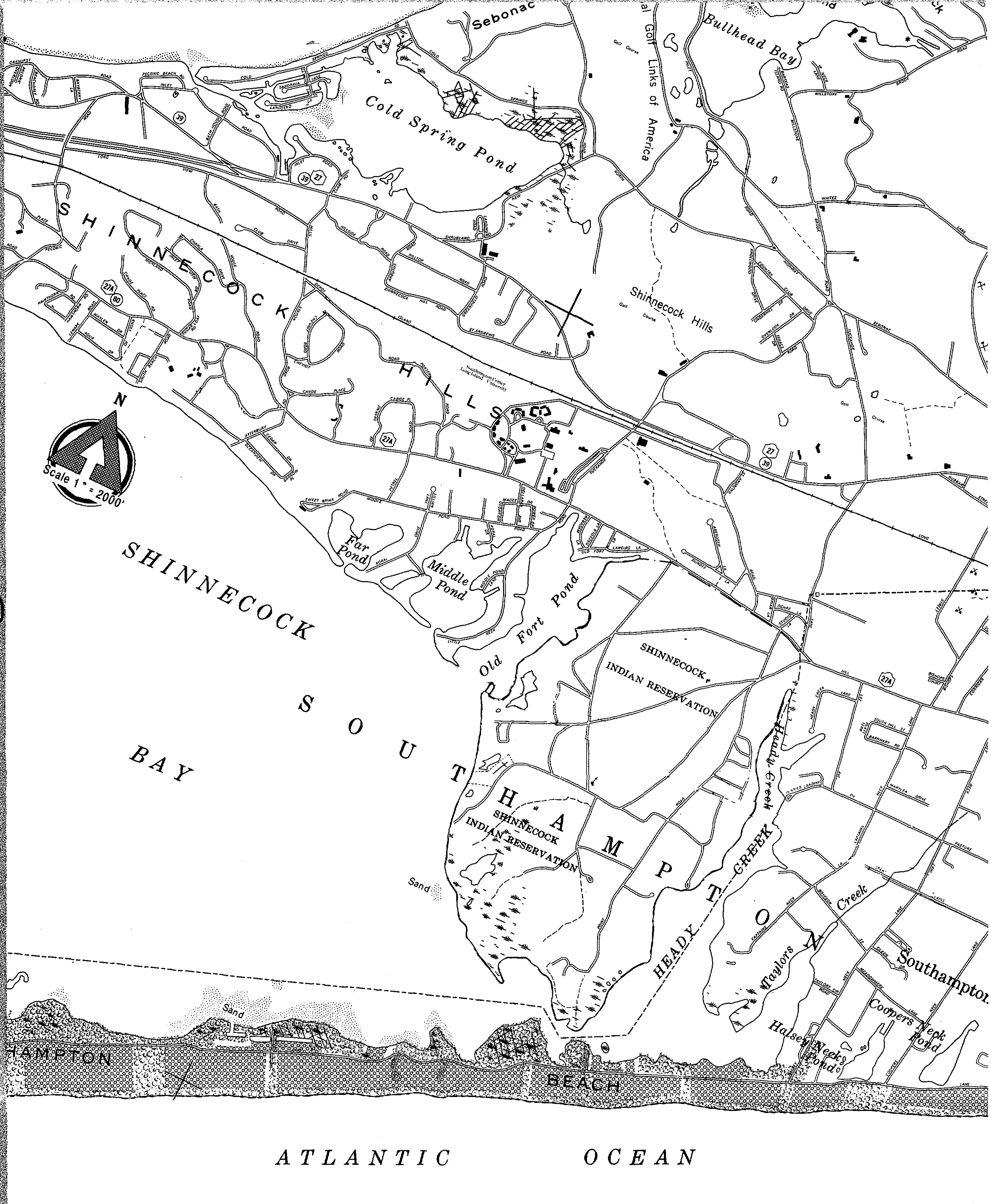
SUFFOLK COUNTY
AIRPORT
QUOGUE WATERFOWL REFUGE
North Pond
Beaverdam Pond
Aspatuck Creek
Quiogue
Quantuck Creek
Quogue
Westhampton Beach
Drain
Moneybogue Bay
Reedy Island
QUANTUCK BAY
Ogden Pond
CANAL
QUOGUE
Potunk Pt
Canal

9


Henrys Hollow
Tiana
Weesuck
Trailer Park
West Tiana
East Quogue
Alcotts Pond
Creek
Pine Neck
Phillips Cr
Stone Cr
Hampton Point
Phillips Point
Pine Neck Pt
West Point
Bay
Penniman Cove
Penniman Cr
Yacht Club
SHINNECOCK
Mud
TIANA
ATLANTIC

Tiana
Hampton Bays
Springville
Bennett Cove
Cormorant Pt
N
Scale 1" = 2000'
Smith Creek
Wells Cr
Penny Pd
Rampasture
Ponquogue
SHINNECOCK BAY
East Point
US COAST GUARD STA
Ponquogue Pt
BAY
Mud
Sand
Shinnecock Inlet
Tiana Park
Sand Beach
Rocks
BEACH
EAN
SOUTHAM

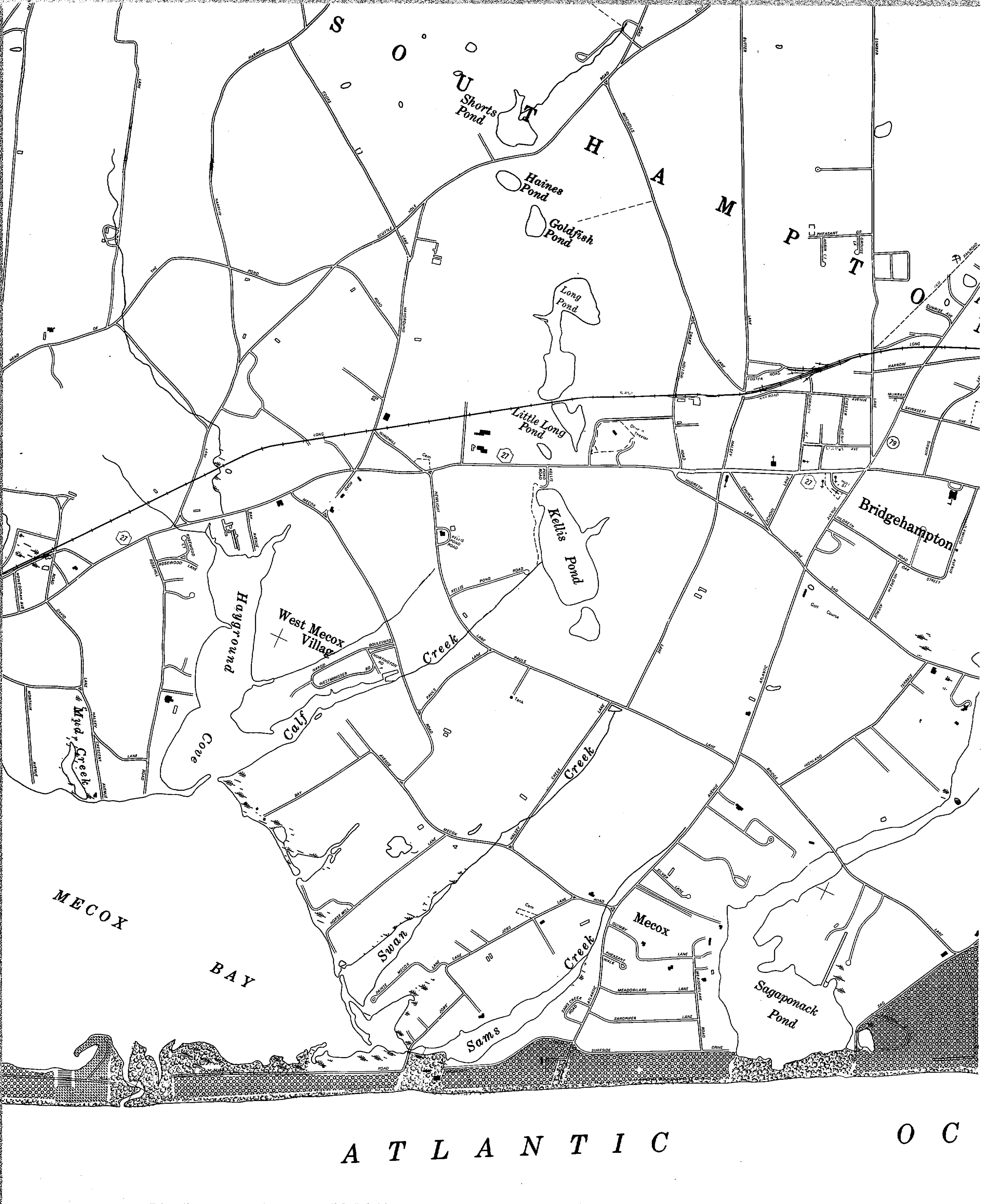
10



Sebonac
Bullhead Bay
Golf Links of America
Golf Course
Cold Spring Pond
SHINNECOCK HILLS
Shinnecock Hills
Golf Course
Southampton Center Long Island University
N
Scale 1" = 2000'
SHINNECOCK BAY
Far Pond
Middle Pond
Old Fort Pond
SHINNECOCK INDIAN RESERVATION
SOUTHAMPTON
Heady Creek
HEADY CREEK
Sand
Taylors Creek
Southampton
Coopers Neck Pond
Halsey Neck Pond
HAMPTON BEACH
ATLANTIC OCEAN

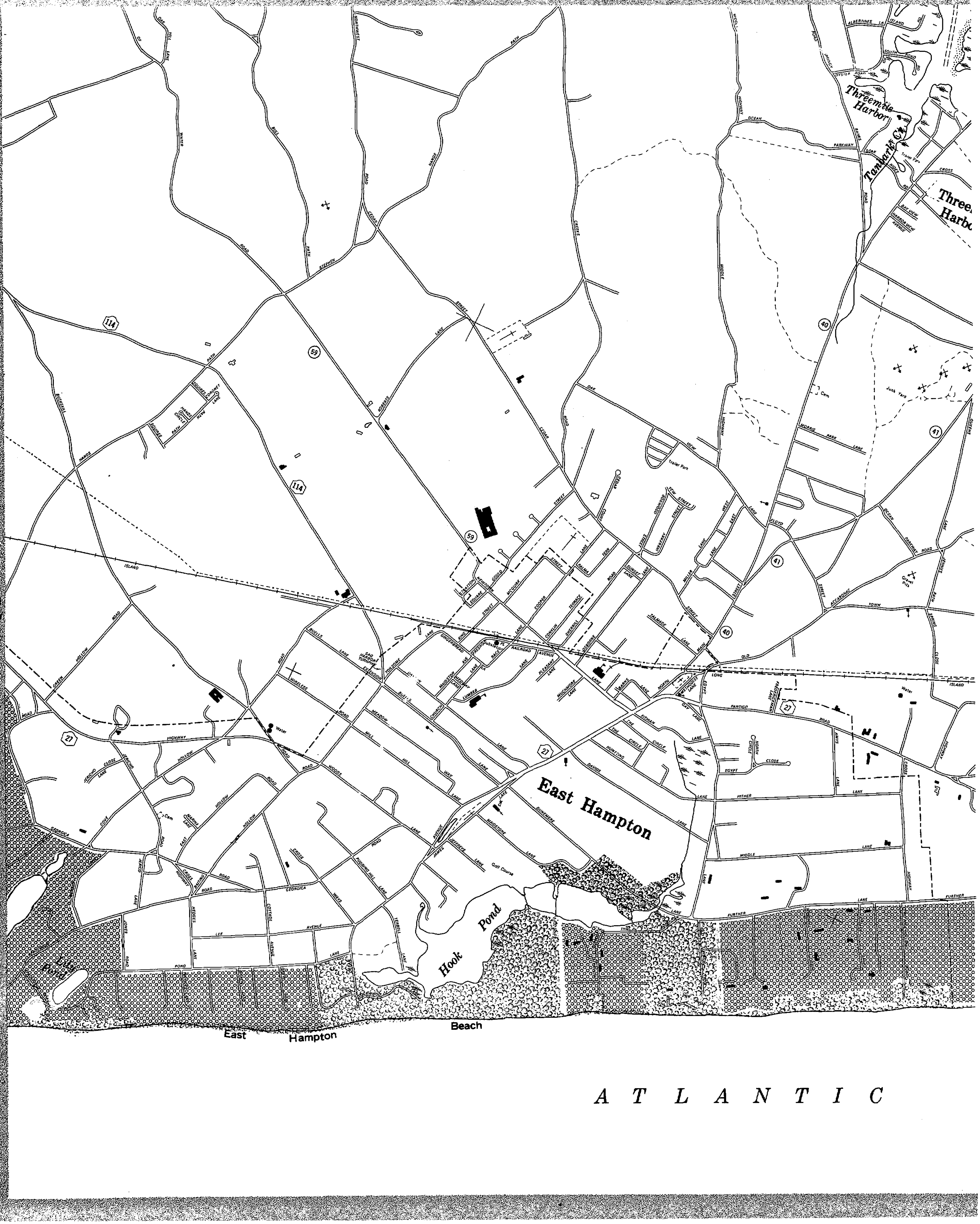

Big Fresh Pond
Little Fresh Pond
Tuckahoe
Cemetery
Cemetery
Southampton
Seven Ponds
Mill Pond
Water Mill
Mill Creek
Burnett Creek
Agawam Lake
Old Town Pond
Wickapogue Pond
Phillips Pond
Sayre Pond
Jule Pond
Channel Pond
Flying Point

11


S O U T H A M P T O N
Shorts Pond
Haines Pond
Goldfish Pond
Long Pond
Little Long Pond
Kellis Pond
Bridgehampton
West Mecox Village
Hayground Cove
Calf Creek
Mud Creek
Swan Creek
Sams Creek
Mecox
Sagaponack Pond
MECOX BAY
ATLANTIC
OC


Crooked Pond
Black Pond
Slate Pond
Little Poxabogue Pond
Poxabogue Pond
EAST HAMPTON AIRPORT
Golf Course
Gravel Pits
Sagaponack
Wainscott
Georgica Pond
Wainscott Pond
Peters Pond
Fairfield Pond
Wainscott Beach
E A N
N
Scale 1" = 2000'

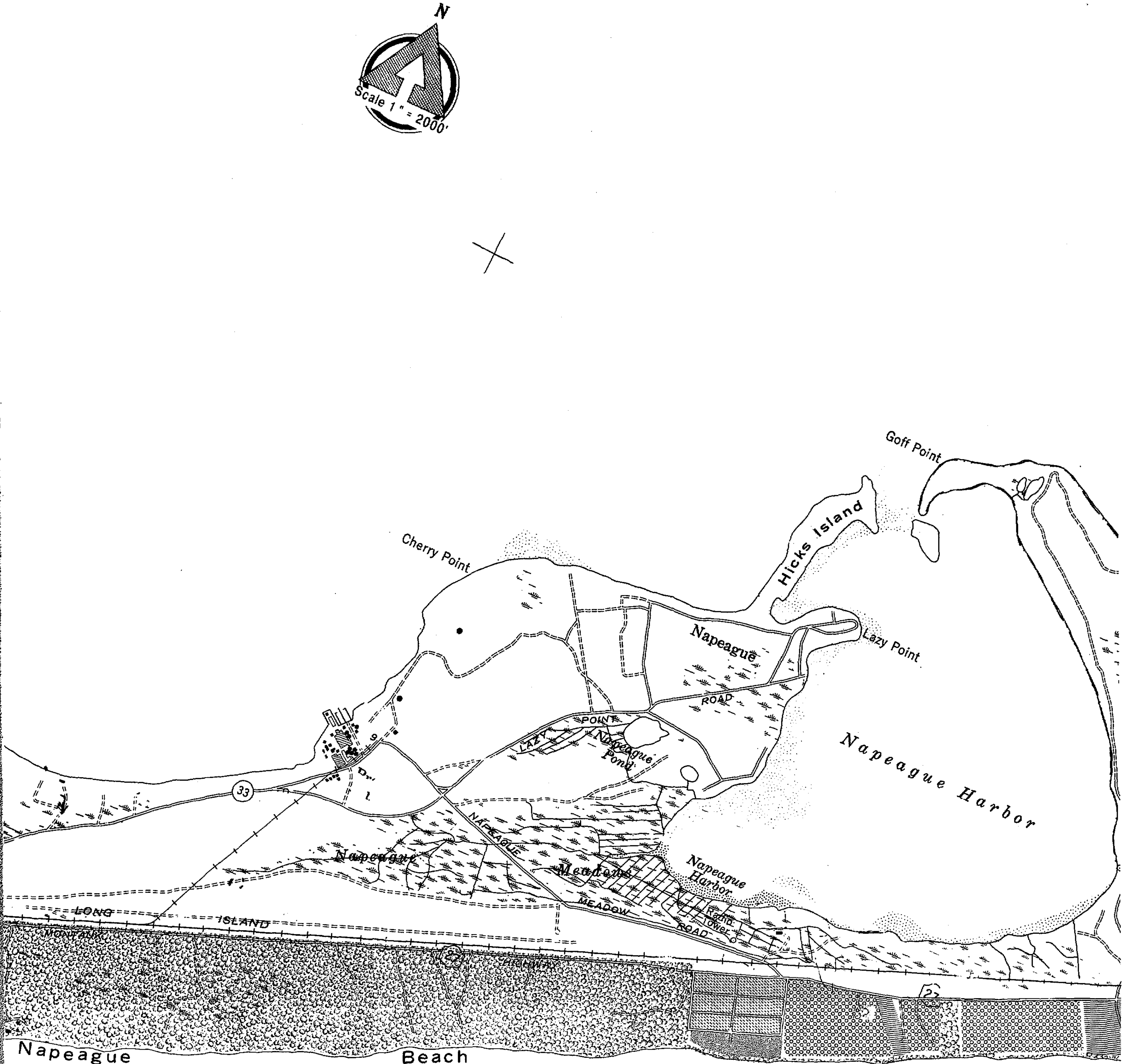
12

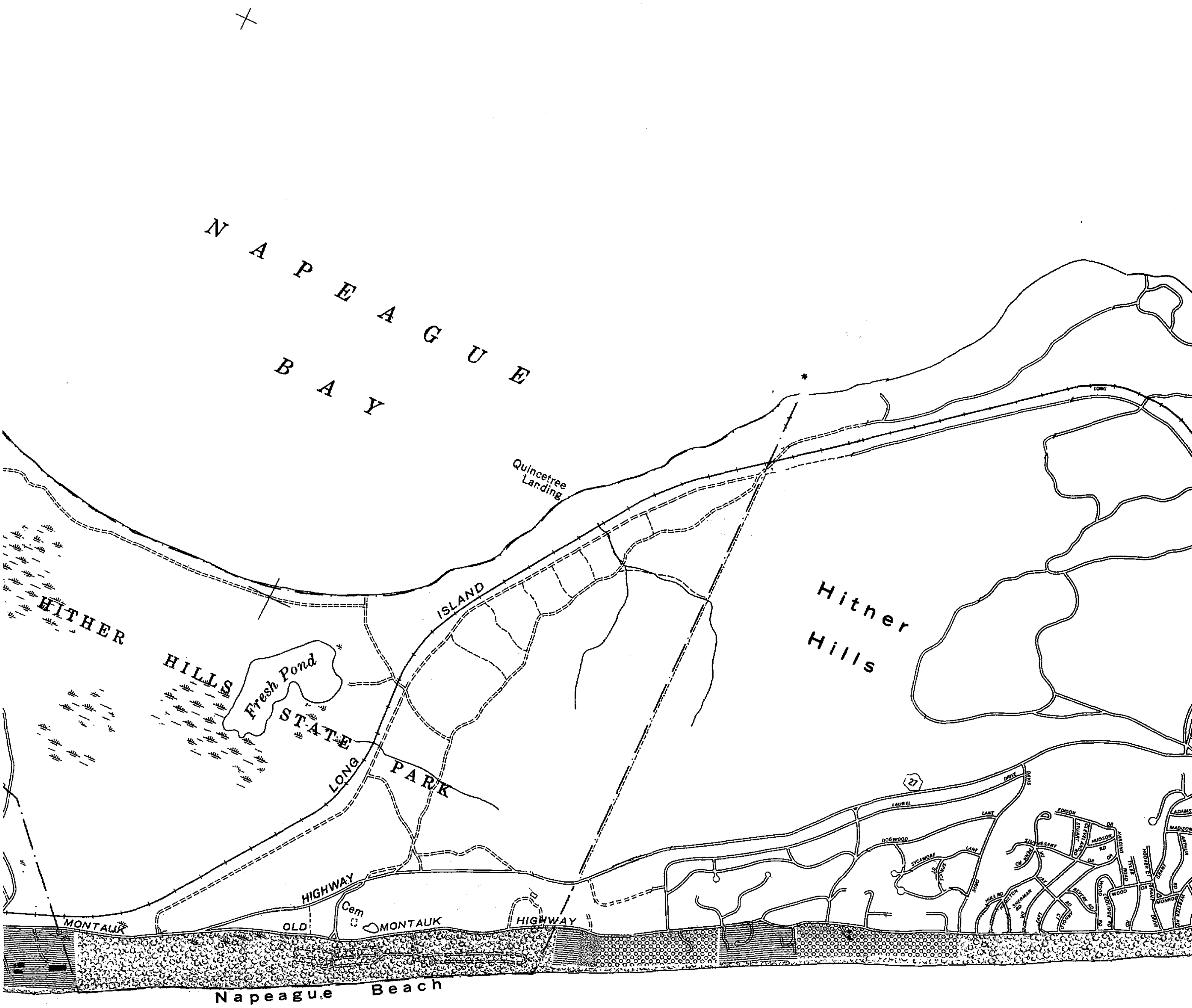


East Hampton
Hook Pond
Lily Pond
Threemile Harbor
Tanbark Ck.
Golf Course
Trailer Park
Junk Yard
Cem
Water
East Hampton Beach
A T L A N T I C


GARDINERS BAY
Accabonac Cliff
Louse Pt
East Harbor
Barnes Landing
Water
Alberts Landing
N
Scale 1" = 2000'
Fresh Pond
CROSS RD
Abrams Landing
OCEAN VIEW
CROSS ROAD
CRANBERRY
Amagansett
Water
Golf Course
NAVAL RES (RADIO STA)
OCEAN
41
40
27
33

13


N
Scale 1" = 2000'
Goff Point
Hicks Island
Cherry Point
Lazy Point
Napeague
ROAD
LAZY POINT
Napeague Pond
Napeague Harbor
33
Napeague Meadows
NAPEAGUE MEADOW ROAD
Napeague Harbor
Radio Tower
LONG ISLAND
MONTAUK
HIGHWAY
27
Napeague Beach


NAPEAGUE
BAY
Quincetree Landing
HITHER HILLS STATE PARK
Fresh Pond
LONG ISLAND
Hitner Hills
27
LAUREL
DRIVE
DAVIS
LANE
DOGWOOD
SYCAMORE
EDISON
HUDSON
MADISON
ADAMS
MONTAUK
HIGHWAY
OLD MONTAUK HIGHWAY
Cem
Napeague Beach


B
14
Culloden Point
FORT POND BAY
Rocky Point
U S COAST GUARD RESERVATION
Star Island
MONTAUK
E A S T H A M P
Golf Club
Fort Pond
Montauk
Ditch Plains
Montauk Beach
ATLANTIC OCEAN


LOCK ISLAND SOUND
N
Scale 1" = 2000'
SKY PORTEL AIRPORT
Little Reed Pond
Big Reed Pond
Shagwong Point
Blackfish Rock
Oyster Pond
Prospect Hill
MONTAUK POINT STATE PARK
False Point
Money Pond
Montauk Point

Chapter Four

IMPLEMENTATION NEEDS

4.0 Introduction

Long Island's south shore natural resources have an intrinsic value to society in their own right, in addition to the economic return associated with their use for recreational, commercial, and residential purposes. The barrier islands and spits provide buffers that protect the mainland from direct storm wave attack, and are also an integral part of the shallow lagoon system and associated fish and wildlife habitats. It is difficult to estimate the true dollar value of Long Island's south shore beaches and associated environments and their contribution to the quality of life in Nassau and Suffolk Counties, especially in light of the fact that comprehensive studies documenting usage characteristics, expenditures, etc., have not been conducted. It is axiomatic that the value is tremendous.

For comparative purposes, an economic analysis of saltwater beaches in Florida indicated that, in 1984, residents and tourists generated:

- direct and indirect beach-related sales of nearly $4.6 billion;
- beach-related business activity that provided $164 million in tax revenues to the state; and
- activity that resulted in the creation of jobs with an annual payroll of $1.1 billion(Bell and Leeworthy 1986).

While a similar study of the value of south shore beaches on Long Island is not available, the high level of visitation to public beaches here is indicative of their contribution to the economy. It has been estimated that an acute wash up of floatable pollution along New York beaches could result in a loss in total expenditures that ranges from $600 million to $1.8 billion, depending upon the multipliers used (Waste Management Institute 1989). One can only guess the magnitude of economic loss to the region if Long Island's south shore beaches were made inaccessible or unsuitable for recreational and other uses over the long-term as a result of management policies that fail to address the need for inlet management, regularly scheduled sand bypassing, restoration of longshore transport, and growth control measures.

The implementation of erosion control projects and non-structural measures will be essential to the continued use of this natural resource — use that is threatened by shoreline instability, the ravages of tropical cyclones and northeast storms and the potential increase in the rate of sea level rise. The costs associated with shoreline management activity are large, but so are the long-term benefits, especially if one considers that the beach is a common property resource. It should be pointed out that erosion control projects funded by public agencies provide benefits to the general public at large, as well as those who enjoy coastal occupancy in this area. However, the recommendations outlined in this report are targeted to provide only that level of protection required to attain long-range land use plan goals and to maintain the integrity of the barriers, as opposed to the short-term, more narrow benefits associated with private occupancy of the shoreline.

The data and information base pertaining to coastal processes must be improved to enable the development and selection of cost effective erosion management projects. The first section of this chapter outlines an erosion monitoring element that should be considered a priority component of the long-term management program for the south shore. The second section outlines recommended changes in selected government programs and activities. Changes in the National Flood Insurance Program are proposed that would reduce the public subsidy related to private shoreline occupancy in highly vulnerable and mobile barrier islands and spits. Suggestions are included with respect to the New York State Coastal Erosion Hazard Act to improve implementation of its associated regulatory program involving construction activities along the coast. The chapter concludes with recommendations pertaining to the State of New York and its role as coordinator of Federal, state and local activities over the long-term in the implementation of a hazard management program that reflects the consensus of the parties involved.

4.1 Erosion Monitoring Element

The teams of coastal geologists and engineers emphasized that the hazard management program for the south shore of Long Island must include an erosion monitoring element specifically designed to collect, maintain and continue the acquisition of certain data and information on the coastal system that would improve government's ability to make management and regulatory decisions. The monitoring element should be designed for the entire south shore system to provide information that will allow coastal managers to:

- *Further define and quantify the problem.* Development of effective management programs depends on having adequate information on the resource to be managed. For the south shore system, reliable estimates of such factors as the erosional risk, storm vulnerability and the expected degree of recovery after an erosional event are essential, if the effectiveness of the hazard management program is to be increased. This type of information can only be obtained by monitoring shoreline conditions and changes.

- *Evaluate the effectiveness and impacts of adopted and proposed strategies.* Any chosen strategy may fail to perform as anticipated, or conditions can change either naturally or because of human activity that alters the effectiveness of a previously chosen option. It will be important to recognize this situation in order to readjust the management program. Consequently, monitoring is required to provide the basis for changes. For the same reason, it is probably advantageous to begin with smaller scale projects rather than larger ones in order to develop experience in the integrated management of the coast.
- *Establish design criteria.* In many places, a variety of approaches with a range of designs will be possible. The final choice will depend largely on a cost/benefit analysis. A proper evaluation of both the estimated costs, predicted benefits and potential impacts will require specific designs of individual projects. While a monitoring element will probably not generate all the detailed information needs for site-specific designs, it can give the designer and manager invaluable information of a consistently high quality on the long-term local conditions and, therefore, greatly reduce the cost and time for feasibility studies of each proposed project.
- *Develop a better understanding of the causes and effects of observed shoreline behavior.* An adequate understanding of the coastal processes and shoreline responses on a systemic as well as site specific basis is essential:
  - —to estimate the effectiveness and potential impacts of any proposed solution, i.e., the probability of success;
  - —to calibrate and use models of shoreline behavior for assessing management decisions; and
  - —for addressing critical questions that affect the selection of management options in different areas.

The recommended monitoring element includes the following components:

- *Evaluation of available data.* As specific management-related questions arise, available data should be reanalyzed. Often an original data set was collected to address one set of questions, but can be applied to others. Historical data sources (maps, aerial photographs and National Ocean Survey T-sheets) should be utilized to document and quantify trends in shoreline position through time. A coastal data base should be developed to compile, maintain, and provide access to the data as well as information on coastal protective structures, dredging and beach nourishment activities, and other factors. Effort will be required to assemble and compile the available data in a format that is accessible and usable for management purposes, and to maintain the data base.
- *Monument system for beach profile surveys.* A monument system should be established and maintained along the coast from which periodic beach and near shore surveys should be done on a regular basis. Such data is indispensable in evaluating shoreline, beach and dune changes, developing reliable sand budgets and identifying multi-year trends which could indicate the adequacy of management strategies or changing conditions. The locations where profiles were surveyed by/for the Corps of Engineers in 1955 and 1979 east of Fire Island Inlet should be reoccupied and surveyed and additional lines, especially in the vicinity of structures and inlets, should be established. Profile measurements should extend from landward of the dune (or bluff crest) seaward to a point offshore equal to the closure depth (essentially, the depth at which profile changes are negligible), which was estimated to be at a depth of approximately 50 feet MLW on Long Island. A system of monuments west of Fire Island Inlet for locating beach profile surveys should be established at a maximum spacing of one mile along the coast (closer spacing may be required in dynamic areas, such as inlets or areas of particular interest). Arrangements should be made to ensure all surveys are done in as short of a time span as possible and, preferably, within a two-week period or less, i.e., as near synoptically as possible. Surveys should be done at least twice a year (near the time of the maximum summer beach and six months later or near the time of minimum beach widths) and after extreme storm events.

  Periodic aerial photography. Aerial photographs should be taken on a seasonal basis (i.e., winter and summer). The overflights should be scheduled for the mornings (before the sea breeze starts) at times between low and mid-tide and should, if possible, be coordinated with the surveys described above to provide ground truth measurements. Aerial photographs will assist in the determination of long-term recession rates based on changes in the high water line, vegetation line and/or dune position. Vertical aerial photographs taken on a regular basis can be used in conjunction with the survey data as a relatively inexpensive means of gathering important information on shoreline conditions, changes, and trends at relatively frequent intervals and over large areas. Photos should be rectified and key features, such as shoreline position, dune crest, landmarks, etc., should be digitized to facilitate the use of this information.
- *Directional wave gauges.* Coastal processes are driven by waves. There is a dearth of historical wave data to analyze the processes for this shoreline and no measurements are presently being made. At least two

directional wave gauges should be deployed for a two year period — one in the eastern end and one at the western end of the study area.

- *Application of models.* Many excellent models exist for forecasting coastal changes and the effects of human activity. They have been effectively used in other areas, but very few have been applied to the New York coast primarily due to the lack of reliable baseline data required to run the models. Information gained from an effective monitoring program would allow the use of available models to extrapolate and interpolate between measurement points, to assess the importance of observed changes, and to provide more reliable predictions of likely changes in the coastal system in response to prevailing and possible future conditions, and of the effectiveness and impacts of proposed activities.

The general erosion monitoring element recommended above would involve a commitment of personnel and resources. However, the benefits derived from such an effort would far exceed the cost, especially when one considers the value of the resources and development found along the south shore of Long Island, as well as the costs associated with implementing most erosion control alternatives. Monitoring element implementation would provide managers, planners and decision-makers with the information they need to identify, evaluate and develop technically sound and defensible erosion management strategies for a small fraction of the construction costs of most coastal projects.

The site specific details and other aspects of the proposed monitoring element remain to be developed. *It is recommended that the NYS Dept. of State convene a conference attended by representatives of interested Federal, state and local agencies and noted experts in the fields of coastal engineering and geology for the purpose of preparing the specifications for the tasks to be accomplished, parties assigned to accomplish same, sources of required funding, etc.* An attempt was made to provide preliminary, order of magnitude cost estimates for the various components of the shoreline monitoring element.

- Establish, maintain and operate coastal data base (annual cost) = $80,000 - $100,000
- Monument system and profile survey
  - — install 100 monuments and establish horizontal and vertical control - 100 monuments @ $300 - $500 = $30,000-$50,000
  - — conduct profile surveys and reduce field data 100 surveys @ $1,000-$2,000 per survey two times per year = $200,000-$400,000
- Aerial photography
  - — ± 400 9" X 9" photos at a scale of 1:6000 two times per year = $12,000
  - — digitize shoreline and analyze changes in shoreline position = $50,000
- Deploy and maintain 2 wave gauges per year for two years, and analyze field data = $240,000
- Shoreline response model application
  - — model set-up for south shore = $300,000
  - — model usage (annual cost) = $60,000
- Contingencies @ 10% of total cost

The range in total cost estimates for the five components of the erosion monitoring element over an initial two-year period including the 10% contingency is $1,003,200 to $1,267,200. (Significant cost savings could perhaps be realized by using photogrammetric techniques to prepare the sub-aerial portions of the profiles.) After this period, the range in annual cost is reduced to $561,000 to $583,000, including contingency.

It should be remembered that the monitoring element of the south shore hazard management program outlined above does not address the conduct of basic research on questions concerning coastal dynamics; it does involve the acquisition of data/information that will improve the technical basis for management and regulatory decisions subject to potential court challenge. However, the data collected in the monitoring element and the information generated through data analysis will assist the conduct of needed research that addresses priority scientific problems and ultimately improves public policy pertaining to erosion management.

4.1.1 Technical Data and Information Needs

The technical data and information required to develop and evaluate erosion management strategies can be grouped into two broad, interrelated categories: characterization of coastal features and changes, and physical forcings affecting coastal changes (i.e., waves, water levels, etc.). The specific information related to each of these categories is delineated in this section along with the types of data required to obtain the information.

4.1.1.1 Characterization of Coastal Features and Changes: An assessment and quantification of the physical characteristics and the changes occurring in a coastal area is essential in the development and evaluation of erosion control strategies. These changes include variations in the position and configuration of the shoreline and in the volumetric sediment budget in an area. The most basic level of information needed to begin developing an effective approach to erosion management is usually derived from direct measurements of the extent and magnitude of the effects of erosion on the coast.

The basic information required for characterizing coastal features and changes includes:

- long-term and short-term trends in shoreline migrations
- magnitude of shoreline changes caused by storms
- volumetric changes occurring along the shore
- volume of dune erosion and rate of dune rebuilding
- effects of existing structures.

The data needed to obtain the above information include:

- sequential shoreline positions through time
- sequential beach/dune/offshore profiles (to the closure depth)
- shoreline orientation
- description of the regional geologic setting including sediment grain size distributions
- historical dune volume changes
- volume of ebb and flood deltas at inlets
- overwash frequency and volume
- inventory of shoreline protective structures, i.e., location, size and orientation; porosity, permeability, and transmission characteristics; location, volume and schedule of beach fills, dredging and sand mining operations; and aerial photographs, plans and surveys associated with these projects.

The information on coastal changes is needed to:

- Define the erosion problem with respect to time and location and to make a preliminary assessment of the level and type of effort required to mitigate erosion trends. For example, in a particular area, a documented high chronic rate of shoreline recession over the long term would indicate that utilization of beach nourishment may not be cost effective, and that retreat or a structural response would be required to mitigate problems associated with erosion. Conversely, a low long-term recession rate could indicate the local sediment budget is only slightly out of balance and that beach renourishment may be an effective measure of erosion control.
- Forecast the range of expected shoreline changes at a site in order to establish appropriate setback requirements; properly select, design and locate structures; and calculate beach renourishment intervals.
- Identify the sources of sand feeding the longshore transport system and potential sources of beach fill material.
- Identify and improve the basic understanding of the cause and effect relationships associated with erosional problems.
- Model the impacts of storm events.

4.1.1.2 Physical Forcings Affecting Coastal Change: The information on coastal features and changes presented above defines and quantifies the effect of erosion along the coast. However, the causes of these changes are the waves, variations in water levels, and storms that impact the coast. Since these are the main physical processes driving sediment transport, which in turn determines the coastal response, information on these factors is also necessary to properly evaluate potential erosion management strategies.

The information needed on physical forcings includes:

- statistics on wave height, period, and direction
- measurements of the amount of land subsidence and an estimate of the rate of eustatic sea level rise
- storm surge heights and frequency.

Data requirements to obtain this information include:

- local wind (or atmospheric pressure) and nearshore bathymetry data for hindcasting wave climate
- wave gauge records
- tidal records
- long-term water level measurements
- leveling surveys to estimate land subsidence.

This information would be used to:

- calculate potential longshore sediment transport rates and directions, including frequency and persistence of transport
- estimate the magnitude, impacts and recurrence intervals of storms for cost/benefit and risk analysis
- calculate the perturbation of the sediment budget at inlets to determine sand bypassing requirements
- interpret the causes of shoreline changes in order to predict possible future conditions
- estimate time required for new inlets to close naturally
- develop design criteria for structural and nonstructural responses to erosion control, such as lifetime of beach fill projects, which is related to the wave height to the *minus-five-halves* power; height, length and spacing of groins; spacing, orientation and location of offshore breakwaters; and material strength requirements
- develop more accurate models to assess and predict impacts of various control alternatives.

4.2 Recommended Changes in Government Programs

4.2.1 The National Flood Insurance Program

Federally subsidized flood insurance has been available in the United States since 1968 under Title XIII of the Housing and Urban Development Act of 1968 (P.L. 90-448). The *National Flood Insurance Program* (NFIP) provided previously unavailable flood insurance protection to owners of structures in flood-prone areas. At that time, participation in the NFIP was voluntary. The Federal government offered low-cost flood insurance to individuals in those communities that adopted and enforced certain minimum floodplain management regulations.

The Act was amended in 1973 by the Flood Disaster Protection Act (P.L. 93-234), which required:

- designated communities to participate in the NFIP program or face restrictions of federal financial assistance; and
- property owners to purchase flood insurance to receive new or additional federal or federally related financial assistance for acquisition or construction purposes in identified special flood hazard areas.

To obtain federal disaster assistance for construction or reconstruction purposes, this Act also required property owners in participating communities to first purchase flood insurance.

The Housing and Community Development Act of 1977 removed the prohibition against conventional mortgage loans from federally regulated lenders in flood-prone communities not participating in the program, and added a notification procedure to alert prospective mortgagees that flood disaster relief would not be available for properties in those communities. The maximum insurance coverage presently available for a single family residence is $185,000 for the structure and $60,000 for contents. Coverage for other residential structures is $250,000. Contents are covered up to a maximum of $60,000. The NFIP is discussed in detail in the *Hurricane Damage Mitigation Plan for the South Shore Nassau and Suffolk Counties, N. Y.* (Long Island Regional Planning Board 1984).

Provisions of the Housing and Community Development Act of 1987 (Upton-Jones amendment), signed into law on 5 February 1988, expand coverage under the NFIP to include payment of the claims of owners of buildings that are subject to *imminent collapse or subsidence* due to erosion so that the building can be relocated or demolished, at the policyholder's option before the damage occurs. This provision applies to property bordering on the Great Lakes, the oceans, and other bodies of water including lakes, rivers and streams.

To qualify, buildings must be covered by flood insurance under the NFIP by 1 June 1988. After June 1, flood insurance must be in force for two years or the length of ownership of the building, whichever is less.

This amendment expands the NFIP's existing coverage, which previously paid claims on insured buildings that sustained physical damage as a result of storm-related erosion or were damaged as a result of erosion caused by water at higher-than-anticipated cyclical levels. The amendment specifies that a building subject to imminent collapse or subsidence from erosion would be eligible for a claim payment totalling up to 40 percent of value (or the cost of relocation, if less) when the building is to be relocated, or up to 100 percent of the building's value plus 10 percent (or the cost of demolition, if less than 10 percent), if it is to be demolished.

Under the amendment, the value of the structure is the lowest of:

- the value of a comparable structure that is not subject to imminent collapse or subsidence;
- the price paid for the structure and any improvement to the structure, adjusted for inflation; or
- the value of the structure under the flood insurance contract.

The *Flood Insurance Administration* (FIA) has contracted with the *National Academy of Sciences* for recommendations regarding appropriate methodologies for developing erosion rate data required to implement this provision.

Until FIA has issued these regulations, claim payments under the policy will be made based on a determination by the Federal Insurance Administrator that the building:

- otherwise meets the requirements of the amendment, and
- has been condemned (or otherwise declared uninhabitable) by a state or local authority, and
- is subject to imminent collapse or subsidence as a result of erosion or undermining caused by waves or currents of water exceeding anticipated cyclical levels.

It is important to note that Section D of the amendment excludes coverage for *any structures located in the area west of the groin field on the barrier island from Moriches Inlet to Shinnecock Inlet* ***.....Thus, the amendment does not apply to the severely eroded portion of Westhampton Beach.***

Given these restrictions, it is obvious that this program is targeted to a limited number of structures,and is not designed to relocate *habitable* structures off of inherently vulnerable barrier islands. It is concluded that the NFIP in its current form does not go far enough to encourage relocation outside flood and/or erosion hazard zones, thereby ending federal subsidy and encouragement of a cycle of repeated losses. The extent of this federal subsidy has been documented in National Research Council (1989).

.....Thus the elimination of federal flood insurance coverage for structures located on barrier islands and spits must be considered.

Should Congress reauthorize the NFIP, it is recommended that:

- Incentives to relocate or require relocation of structures from hazard areas be strengthened by streamlining the section 1362 acquisition process, and by providing funds to the states to purchase heavily damaged structures.
- Publicly-subsidized flood insurance for new structures, or substantially rebuilt structures in hazard areas be eliminated.
- The Acquisition program, under section 1362 be sufficiently funded,and that relocation/demolition assistance under the Upton/Jones amendment be utilized to help end recurring damages. Currently, these programs are underfunded or underutilized, and are not being aggressively administered or administered strategically to end the recurring damage-repair-damage cycle. In the case of Upton-Jones, one of the most appropriate areas for application of its provisions, Westhampton Beach, is exempt. The Upton-Jones amendment should be amended so that it can be applied to the area west of the groin field in Westhampton Beach. Pursuant to the Upton-Jones amendment,

New York State should take steps to identify areas of *imminent collapse*. This would require implementation of an erosion monitoring program to determine erosion rates for various shoreline segments.

- Demolition/relocation assistance as provided under the Upton-Jones Amendment be part of an erosion management strategy which limits further development in erosion hazard areas.The Upton-Jones provision needs to be complemented with FEMA requirements to identify special erosion hazard areas, and require land use controls for the management of erosion hazard areas, as a precondition to a community's participation in the NFIP.
- New York State amend Article 36, Environmental Conservation Law (ECL), to give the State authority to pursue floodplain violations where there is no satisfactory local response.Regulation and management of floodprone areas currently rest with local government. Article 36 of the ECL requires local participation in the NFIP, and DEC has provided model regulations; however, implementation requires understanding and a responsible level of enforcement on the part of the local government. Sometimes, because of staffing inadequacies or lack of political support, floodplain regulations are not well enforced. There is currently no mechanism for any State agency to step in to assist a local government or to pursue floodplain violations. This short-coming weakens the overall intent of the program.
- The New York State Dept. of Environmental Conservation assign a sufficient number of personnel to Region I to ensure compliance with the NFIP.
- The NFIP be amended to prohibit alteration of dunes.

4.2.2 New York State Coastal Erosion Hazard Areas Act

New York State's Coastal Management Program (CMP) received Federal government approval in September 1982. In order to meet the requirements of the Coastal Zone Management Act of 1972 (P.L. 92-583), the State had to enact legislation addressing coastal erosion problems. Thus, in 1981 the State Legislature passed the Coastal Erosion Hazard Areas Act (Article 34 of the Environmental Conservation Law) as the principal law governing erosion and flood control along New York's coastline.

The purpose of Article 34 is to minimize or prevent damage and destruction to property and natural resources from flooding and erosion due to inappropriate actions of man. This coastal hazard mitigation policy is to be carried out through a regulatory program based on the control, through permits, of development and other land use activities in designated erosion hazard areas. Article 34 is intended to be implemented at the local level, except for State agency activities, which will require permits directly from the NYSDEC.Local implementation of State-approved coastal erosion ordinances is not required; however, should a town refuse or fail to adopt a satisfactory program which meets the standards and administrative and enforcementrequirements, regulatory authority will revert to the county and then to the State.

The NYSDEC has prepared erosion hazard area maps for the south shore coastal areas. Erosion hazard areas are defined in the regulations as natural protective feature areas or structural hazard areas. Most of the south shore falls into the first category, where natural protective features were used to determine the landward boundary of the hazard area. This boundary is defined in the regulations as a line set back 25 ft. from the landward edge of the dominant natural protective feature. Three types of natural protective features were used in delineating the boundary:

- the highest, most continuous dune formations
- bluffs, where existent
- the landward edge of the beach in areas with no dunes or bluffs.

This line was surveyed independent of political divisions, erosion rates (too variable in these areas) or existing structures.

Structural hazard areas have been designated along bluff shorelines with known annual recession rates of 1 ft. or more (e.g., the eastern portion of East Hampton). The width of the zone is defined as 40 times the average annual recession rate plus 25 ft.

Erosion hazard area permits must be obtained for development, new construction, erosion protection structures, public investment, and other land use activities within the designated coastal hazard area. The proposed regulated activity must meet the following general standards:

- It must be reasonable and necessary, relative to alternative sites and the necessity for a shoreline location.
- It must not aggravate erosion.
- It must prevent or minimize adverse effects on natural protective features, erosion protection structures or natural resources.

Furthermore, the regulations delineate restrictions on specific land use activities within both types of coastal hazard areas. For natural protective feature areas (Section 505.8), specific restrictions are delineated for activities in nearshore areas, beaches, bluffs, and primary and secondary dunes. Regulated activities include:

- dredging, excavating and mining
- construction, modification or restoration of docks, piers, wharves, groins, jetties, seawalls, bulkheads, breakwaters and revetments
- beach nourishment
- vehicular traffic
- the creation of pedestrian passages.

Activities not requiring a permit include planting, sand fencing, and the erection of private elevated walkways.

A permit is required for the construction, modification, or restoration of erosion protection structures, with the following conditions: proper design, minimum 30 year life, long-term maintenance program, and the use of appropriate materials. The structures cannot aggravate erosion at the site or adjacent sites and must minimize/prevent adverse effects to natural protective features (Section 505.9).

Any permit applicants wishing to obtain a variance must prove that compliance with the restrictions would cause unnecessary hardship or result in practical difficulties. They also must show that no reasonable alternative site exists, that responsible means and measures have been incorporated into the project design at the developer's expense, and that the structure(s) will be reasonably safe from flood and erosion damage (Section 505.13).

Article 34 imposes an additional responsibility on NYSDEC and local communities with no additional funding to administer a coastal erosion program. As a result, many local governments on Long Island are electing not to participate in the program. Adequate NYSDEC staff resources need to be made available to assist localities develop regulations, monitor enforcement of locally adopted regulations and, where necessary, administer programs in localities choosing not to participate.

If a locality elects to participate in the coastal erosion program, issuance of permits for construction, modification or restoration of erosion protection structures will become the responsibility of local Article 34 administrators. These administrators, primarily building inspectors at the village and town level, will be responsible for assessing whether erosion protection structures are properly designed and constructed of appropriate materials; if the structures will be capable of withstanding 30 years of use; if they will be adequately maintained over the long-term and will not aggravate erosion of adjacent sites; and if they will minimize adverse impacts to natural protective features. Local administrators will not necessarily have the technical background to answer the above questions. *NYSDEC personnel with coastal erosion control expertise should be added to the staff of Region I to assist local administrators of Article 34.*

4.2.3 Coordination of Erosion Management Activities

The NYSDOS should further the Proposed South South Hazard Management Program by incorporating its recommendations into the New York Coastal Management Program. As a result, through the consistency provisions of the State and Federal Coastal Acts, navigation and beach erosion control projects will be evaluated for compatibility with the South Shore Hazard Management Program. Funding for navigation projects should remain primarily a Federal government responsibility.

With regard to the non-structural measures, the land use plan policies as outlined in this program should be used as the basis for NYSDOS action in its coordinating role, and in the determinations of consistency under the NYS Coastal Management Program. On this point, the land use plan provides a frame of reference regardless of whether or not local governments along the south shore actively participate in coastal management and develop approved Local Waterfront Revitalization Programs.

Maintenance of the littoral drift must be considered as an integral part of inlet navigation projects. Federal, State and local governments must make every effort to ensure that sand obtained from by-passing projects performed by the COE at ocean inlets not be disposed of offshore, but rather be utilized as beach nourishment for downdrift beaches. The movement and placement of sand associated with COE inlet navigation projects and beach nourishment projects should be coordinated to eliminate offshore disposal of sand and minimize overall public expense.

It is COE policy to use the least cost alternative for maintenance dredging of navigation projects. This COE policy gives no consideration to sand nourishment needs of downdrift beaches and is inconsistent with NYDOS policy. It is now cheaper for the COE to utilize offshore disposal of sand dredged from inlet navigation channels than to pump the sand downdrift of the inlet directly onto the beach as nourishment. The COE is willing to use the by-passed sand for beach nourishment provided the localities assume the cost differential between on-beach and offshore disposal.

The rapidly eroding Town of Hempstead beach at Point Lookout, located downdrift of Jones Inlet, was rendered useless as a bathing beach during the summer of 1989. The erosion problem at the beach came about largely because sand from the last maintenance dredging of the Inlet in 1987 was disposed of offshore, rather than on the beach as had been done in the past. No local matching funds were made available at that time, and as a result, the COE disposed of the dredged spoil offshore. It is anticipated that State funds will be available for dredging scheduled in 1990-1991.

4.2.4 Eliminate Casualty Loss Deductions

The State and Federal tax codes should be amended to remove deductions for casualty losses to non-water dependent uses resulting from flooding, erosion and wind on property in the Coastal High Risk Zone. Under the casualty loss provisions, property loss which is not reimbursed by insurance claims can be treated as a deduction on an individual's Federal and State tax return. This deduction, which can be applied to loss in coastal hazard areas, tends to encourage and not discourage the construction and reconstruction of structures in these areas. The casualty loss provision is a public subsidy of an essentially private use, one which often excludes the public from full enjoyment of a public resource. Removing the public subsidy would discourage the siting of non-water dependent structures in hazard areas.

4.2.5 Disclosure of Flooding and Erosion Hazards

The Real Estate Law should be amended to require disclosure of flooding and erosion hazards on all conveyances of coastal property or interest in coastal property. There is currently no requirement in the Real Estate Law for buyer notification of flooding and erosion hazards when property is conveyed. As a result, there is an absence of public notification and awareness of the risks and consequences of locating in a hazard area. The requirement for consumer notification of coastal hazard conditions would allow property owners to make fully informed decisions prior to purchase.

4.2.6 Federal and State Disaster Assistance

The State and Federal government should require a waiver of public disaster assistance when any permit is given to reconstruct in a Coastal High Risk Zone. A large percentage of public hazard area costs are attributable to recurring payments to the same properties over a number of different storm events. This cyclical problem continues because there is no incentive for private owners to relocate their structures, or to bear the responsibility for the personal decision to stay in a hazard area. The public becomes caught in a cycle of public disaster payments which reinforces reconstruction in coastal hazard areas.

4.2.7 Exclusion of Sensitive Areas in Local Setbacks

Amend 6NYCRR 505 to provide that local zoning setback requirements are to be computed from the setback established by the Coastal Erosion Hazard Areas Act and its implementing regulations. The CEHA reduces public risk and disaster liability by protecting natural protective features and by requiring new development to be located away from hazard areas. The setback established in the CEHA is the minimum that is acceptable and in addition to any yard setback required by the local government under its zoning law. Under zoning practice, the rear yard requirements are measured from the rear property line. Some local governments are protecting sensitive environmental areas by excluding these areas from calculation of minimum lot size or setback requirements. This practice recognizes that these sensitive areas are not suitable for development and should not be treated as part of the developable lot. Standardizing use of the sensitive area exclusion by tying it to CEHA setbacks would increase the protection offered by the CEHA setbacks. It has added benefit of recognizing that inherently hazardous areas (and areas which will become hazardous in the foreseeable future) are not suitable for development.

4.2.8 State Coastal Barrier Resources Act

New York State should adopt a Coastal Barrier Resources Act to protect barrier islands from inappropriate development. The Federal Coastal Barrier Resources Act (CBRA) provides for designation of undeveloped barrier islands where no Federal funds or projects will be undertaken which would promote development or intensive use of the island. The purpose of the law is to maintain the natural protective function of barrier islands by creating disincentives to private investment.

There is currently no mechanism at the State level to prohibit State projects or expenditures of State funds which promote private development or inappropriate public development on barrier islands.

Glossary

BATHYMETRY - The measurement of depths of water in oceans, seas, and lakes; also information derived from such measurements.

BREAKWATER - A structure protecting a shore area, harbor, anchorage, or basin from waves.

BYPASSING, SAND - Hydraulic or mechanical movement of sand from the accreting updrift side to the eroding downdrift side of an inlet or harbor entrance. The hydraulic movement may include natural as well as movement caused by man.

CURRENT, LONGSHORE - The littoral current in the breaker zone moving essentially parallel to the shore, usually generated by waves breaking at an angle to the shoreline.

DOWNDRIFT - The direction of predominant movement of littoral materials.

EOLIAN SANDS - (or BLOWN SANDS) - Sediments of sand size or smaller which have been transported by winds. They may be recognized in marine deposits off desert coasts by the greater angularity of the grains compared with waterborne particles.

FEEDER BEACH - An artificially widened beach serving to nourish downdrift beaches by natural littoral currents or forces.

GROIN - A shore protection structure built (usually perpendicular to the shoreline) to trap littoral drift or retard erosion of the shore.

HINDCASTING, WAVE - The use of historic synoptic wind charts to calculate wave characteristics that probably occurred at some past time.

JETTY - On open seacoasts, a structure extending into a body of water, and designed to prevent shoaling of a channel by littoral materials, and to direct and confine the stream or tidal flow. Jetties are built at the mouth of a river or tidal inlet to help deepen and stabilize a channel.

LONGSHORE TRANSPORT RATE - Rate of transport of sedimentary material parallel to the shore. Usually expressed in cubic yards (meters) per year. Commonly used as synonymous with LITTORAL TRANSPORT RATE.

MEAN SEA LEVEL - The average height of the surface of the sea for all stages of the tide over a 19-year period, usually determined from hourly height readings.

OUTFALL - A structure extending into a body of water for the purpose of dicharging sewage, storm runoff, or cooling water.

PERMEABLE GROIN - A groin with openings large enough to permit passage of appreciable quantities of littoral drift.

PILE, SHEET - A pile with a generally slender flat cross section to be driven into the ground or seabed and meshed or interlocked with like members to form a diaphragm, wall, or bulkhead.

PROFILE, BEACH - the intersection of the ground surface with a vertical plane; may extend from the top of the dune line to the seaward limit of sand movement.

RE-LOCATION - Movement of structure to a parcel located outside a high risk area.

RETREAT - Movement of structure to a less vulnerable location on the same parcel.

REVETMENT - A facing of stone, concrete, etc., built to protect a scarp, embankment, or shore structure against erosion by wave action or currents.

SCARP, BEACH - An almost verticial slope along the beach caused by erosion by wave action. It may vary in height from a few inches to several feet, depending on wave action and the nature and composition of the beach.

SEAWALL - A structure separating land and water areas, primarily designed to prevent erosion and other damage due to wave action.

STORM SURGE - A rise above normal water level on the open coast due to the action of wind stress on the water surface. Storm surge resulting from a hurricane also includes that rise in level due to atmospheric pressure reduction as well as that due to wind stress.

References

Allen, J. R. and N. P. Psuty. 1987.. *Morphodynamics of a single-barred beach with a rip channel, Fire Island, New York.* Coastal Sediments '87. American Society of Civil Engineers. (p. 1964-1975)

Bell, Frederick W. and Vernon R. Leeworthy. 1986. *An economic analysis of the importance of saltwater beaches in Florida.* SGR-82. Florida Sea Grant College. Gainesville, FL.

Berman, Ronald H. Nassau County Bureau of Real Estate, *Insurance and Workers' Compensation, Mineola, NY.* Personal letter 6 December 1989.

Bokuniewicz, H. J. et al. 1980. *Seasonal beach response at East Hampton, NY. Special Report No. 38.* Marine Sciences Research Center, State University of New York. Stony Brook, NY.

Bokuniewicz, H. J. 1986. *The condition of the beach at Fire Island Pines, NY: 1985-1986.* Report to the Fire Island National Seashore Advisory Board. Marine Sciences Research Center, State University of New York. Stony Brook, NY.

Campbell, Thomas J. et al. 1983. *Stage II study - Jones Inlet to Freeport, New York final report.* U. S. Army Corps of Engineers, New York District. New York, NY.

Creamer, Thomas M. U. S. Army Corps of Engineers, New York District, New York, NY. *Personal letter* 24 October 1989.

Davida, Edward. Suffolk County Dept. of Public Works, Hauppauge, NY. *Personal interview* 14 September 1989.

Day, Clifford G. U. S. Fish and Wildlife Service, Absecon, NJ. *Letter to George R. Stafford, Director, Division of Coastal Resources and Waterfront Revitalization,* State of New York Department of State, Albany, NY. 19 October 1988.

DeWall, A. E. 1979. *Beach changes at Westhampton Beach, New York, 1962-1973. Miscellaneous Report No. 79-5.* U. S. Army Corps of Engineers, Coastal Engineering Research Center. Fort Belvoir, VA.

Everts, C. H. 1973. *Beach profile changes on western Long Island. In: D. Coates ed. Coastal Geomorphology. Proceedings of the Third Annual Geomorphology Symposium.* State University of New York. Binghamton, NY. (p. 279-301)

Galvin, C. 1985. *Review of general design memorandum for project works at Fire Island Inlet.* Final report to the U. S. Army Corps of Engineers, New York District. New York, NY.

Hands, E. 1982. *Predicting adjustments in shore and offshore sand profiles on the Great Lakes. Coastal Engineering Technical Aid No. 81-4.* U. S. Army Corps of Engineers, Coastal Engineering Research Center. Fort Belvoir, VA.

Hyland, Francis. New York State Office of Parks, Recreation and Historic Preservation, Babylon, NY. *Personal interview* 5 September 1989.

Jensen, R. E. 1983. *Atlantic Coast hindcast, shallow-water, significant wave information. Wave Information Study Report 9.* U. S. Army Corps of Engineers, Coastal Engineering Research Center. Vicksburg, MS.

Kassner, J. and J. A. Black. 1982. *Efforts to stabilize a coastal inlet: a case study of Moriches Inlet, New York.* Shore and Beach 50(2):21-29.

Kassner, Jeffrey and J. A. Black. 1983. *Fire Island Inlet, New York - management of a complex inlet.* Shore and Beach 51(4):3-8.

Leatherman, S. P. and J. R. Allen. 1985. *Geomorphic analysis Fire Island Inlet to Montauk Point Long Island, New York.* Final report to the U. S. Army Corps of Engineers, New York District. New York, NY.

Lehman, Orin. Commissioner, New York State Parks, Recreation and Historic Preservation, Albany, NY. *Memorandum on Gilgo Beach erosion emergency to David Axelrod, Commissioner,* New York State Dept. of Health, 18 October 1988.

Long Island Regional Planning Board. 1979. *Long Island regional element New York State coastal management program.* Hauppauge, NY.

Long Island Regional Planning Board. 1984. *Hurricane damage mitigation plan for the south shore of Nassau and Suffolk Counties, New York.* Hauppauge, NY.

MacLean, David C. and Thomas S. Litwin. 1987. 1986 *Long Island colonial waterbird and piping plover survey. Cornell University Laboratory of Ornithology,* Seatuck Research Program in cooperation with the New York State Department of Environmental Conservation. Islip, NY.

Matthiessen, John. 1989. *Planning for sea level rise in southern New England.* The Sounds Conservancy, Inc. Essex, CT.

McCormick, C. L. and M. A. Toscano. 1980. *Origin of the barrier island system of Long Island, New York.* Geological Society of America Abstract with Program. Northeastern and Southeastern Combined Sections Meeting. Vol. 14, Nos. 1 and 2.

McCormick, C. L. 1973. *Probable cause of shoreline recession and advance on the south shore of Long Island.* In: D. Coates ed. Coastal Geomorphology. Proceedings of the Third Annual Geomorphology Symposium. State University of New York. Binghamton, NY. (p. 61-71)

Morton, R. W., et al. 1986. *Beach changes at Jones Beach, Long Island, NY 1962-74.* Miscellaneous Paper CERC-86-1. U. S. Army Corps of Engineers, Coastal Engineering Research Center. Washington, DC.

National Research Council. 1987. *Responding to changes in sea level: engineering implications.* National Academy Press. Washington, DC.

National Research Council. 1989. *Managing coastal erosion through the National Flood Insurance Program.* National Academy Press. Washington, D.C.

Nersesian, Gilbert. U. S. Army Corps of Engineers, New York District, New York, NY. *Telephone interview* 13 July 1989.

New York State Department of State. 1987. *New York State designated significant fish and wildlife habitat rating forms for Nassau and Suffolk Counties.* Albany, NY.

Niedoroda, A. W. et al. 1985. *Barrier island evolution, middle Atlantic shelf,* U. S. A. part II: Evidence from the shelf floor. In: G. F. Oertel and S. P. Leatherman eds. Marine Geology 63:363-396.

Panuzio, F. L. 1968. *The Atlantic Coast of Long Island.* Proceedings of the 11th Conference on Coastal Engineering. American Society of Civil Engineering. (p. 1222-1241)

Pritchard, D. W. and J. DiLorenzo. 1985. *Assessment of the effects of inlet geometry on currents in Moriches Inlet and on tidal ranges and storm surge elevations in Moriches Bay.* Final report to the County of Suffolk Dept. of Health Services. Marine Sciences Research Center, State University of New York. Stony Brook, NY.

Research Planning Institute, Inc. 1985. *Sediment budget analysis summary, Fire Island Inlet to Montauk Point reformulation study.* Final report to the U. S. Army Corps of Engineers, New York District. New York, NY.

Schmeltz, E. J. et al. 1982. *Beach/inlet interaction at Moriches Inlet.* Proceedings, Eighteenth Conference on Coastal Engineering. American Society of Civil Engineers. (p. 1062-1077)

Shipp, R. C. 1980. *Morphology and sedimentology of a single-barred nearshore system, eastern Long Island, New York.* Master's Thesis. University of South Carolina. Columbia, SC.

Suffolk County Planning Dept. 1985. *Analysis of dredging and spoil disposal activity conducted by Suffolk County.* Hauppauge, NY.

Taney, N. E. 1961. *Geomorphology of the south shore of Long Island, New York.* Beach Erosion Control Board Technical Memorandum No. 128. U. S. Army Corps of Engineers. Washington, DC.

Tanski, J. 1983. *Monthly beach changes at Ocean Beach, Fire Island, New York,* as measured by students of Bay Shore High School. Unpublished manuscript. Marine Sciences Research Center, State University of New York. Stony Brook, NY.

Tanski, J. and H. J. Bokuniewicz. 1988. *Westhampton Beach: options for the future.* New York Sea Grant Special Report 102. New York Sea Grant Institute. Stony Brook, NY.

Tanski, J. and H. J. Bokuniewicz. 1989a. *Identification and assessment of technical information requirements for developing coastal erosion management strategies.* Report to the Long Island Regional Planning Board. Hauppauge, NY.

Tanski, J. and H. J. Bokuniewicz. 1989b. *An overview and assessment of the coastal processes data base for the south shore of Long Island.* Report to the Long Island Regional Planning Board. Hauppauge, NY.

Tanski, J. and H. J. Bokuniewicz. 1989c. *A preliminary assessment of erosion management strategies for the south shore of Long Island. New York.* Report to the Long Island Regional Planning Board. Hauppauge, NY.

Titus, J. G. 1984. *Planning for sea level rise before and after a coastal disaster.* M. Barth and J. Titus eds. *Greenhouse effect and sea level rise: a challenge for this generation.* Van Nostrand, Reinhold. (p. 253-269)

Titus, J. G., T. R. Henderson and J. M. Teal. 1984. *Sea level rise and wetlands loss in the United States.* National Wetlands Newsletter 6(5):3-6.

Town of Babylon Dept. of Environmental Control. 1988. *Development potential of town of Babylon-owned vacant lots on the barrier beach and bay islands. Babylon, NY.*

Town of Babylon Dept. of Environmental Control. 1989. *Environmental assessment for the renewal of the Town of Babylon beach leases. Babylon, NY.*

U. S. Army Corps of Engineers. 1965. *Report on beach erosion control cooperative study Atlantic Coast of Long Island, New York, Fire Island Inlet and the shore westerly to Jones Inlet.* House Document No. 115. Eighty-ninth Congress, Washington, DC.

U. S. Army Corps of Engineers. 1966. *Beach erosion and interim hurricane study, Atlantic Coast of Long Island, New York, Jones Inlet to East Rockaway Inlet.* New York District. New York, NY.

U. S. Army Corps of Engineers. 1977. *Final environmental impact statement, Fire Island Inlet to Montauk Point, New York Beach Erosion and Hurricane Protection Project.* New York District. New York, NY.

U. S. Army Corps of Engineers. 1980. *Supplement no. 2 to general design memorandum no. 1: Moriches to Shinnecock reach. Fire Island Inlet to Montauk Point Long Island, New York,* Beach Erosion Control and Hurricane Protection Project. New York District. New York, NY.

U. S. Army Corps of Engineers. 1983. *General design memorandum Moriches Inlet project, Long Island, NY.* New York District. New York, NY.

U. S. Army Corps of Engineers. 1985. *Jones Inlet, New York Navigation project, modification of the existing project operation.* New York District. New York, NY.

U. S. Army Corps of Engineers. 1987. *General design memorandum Shinnecock Inlet project, Long Island, New York.* Final reformulation study and environmental impact statement. New York District. New York, NY.

Waste Management Institute. 1989. *Use impairments and ecosystem impacts of the New York Bight.* Dynamac Corp.. Rockville, MD.

Williams, S. J. and E. P. Meisburger. 1987. *Sand sources for the transgressive barrier coast of Long Island, New York:* Evidence for landward transport of shelf sediments. Coastal Sediments '87. American Society of Civil Engineers. (p. 1517-1532)

Wolff, M. P. 1982. *Evidence for onshore sand transfer along the south shore of Long Island, New York and its implication against the "Bruun Rule."* Northeastern Geology 4(1):10-16.

Wolff, Fred, Dennis Radcliffe and Charles Merguerian. 1987. *The impact of sea level rise on Long Island, N. Y.* Geology Dept., Hofstra University. Hempstead, NY.