U.S. DEPARTMENT OF COMMERCE
National Technical Information Service

PB-269 433

Primary Productivity and Basic Food Chain Relationships in Two Long Island Bays

New York State Dept of Environmental Conservation, Albany

Prepared for

National Marine Fisheries Service, Washington, D C

Mar 77

UNITED STATES
DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL MARINE FISHERIES SERVICE

COMMERCIAL FISHERIES RESEARCH AND DEVELOPMENT ACT

COMPLETION REPORT

STATE: New York

PROJECT NO.: 3-182-R

PROJECT TITLE: Primary Productivity and Basic Food Chain Relationships in two Long Island bays.

PERIOD COVERED: June 1, 1973 - March 31, 1976

PREPARED BY: R. E. Fox DATE: 3/8/77
Senior Aquatic Biologist (Marine)

APPROVED BY: [signature] DATE: 3/8/77
D[illegible]tor, Division of Marine
[illegible]d Coastal Resources

ABSTRACT

A three year study was undertaken to determine primary productivity and basic food chain relationships in two Long Island embayments.

The areas chosen were Moriches Bay and Shinnecock Bay, located on the southern shore of Long Island. Moriches Bay receives waste loadings from treated wastes and sludge deposits originating from past and present duck farms located on tributaries to the bay. Shinnecock Bay is connected via a coastal canal (Quantuck Canal) to Moriches but does not have any major sources of pollution located along its shoreline.

The study was designed to determine water quality in the two bays, sediment distribution, the effects of precipitation on water quality and phytoplankton populations.

Analyses of the data do not indicate any significant differences between the two bays on the basis of the parameters chosen. The average salinity of Moriches Bay was 1.6 parts per thousand (o/oo) lower than the average salinity of Shinnecock Bay (27.5 o/oo versus 29.1 o/oo).

INTRODUCTION

Geography:

Moriches and Shinnecock Bays are coastal embayments located along the southern shore of Suffolk County, Long Island, New York. The bays are protected from the Atlantic Ocean by a narrow barrier beach, although each is connected directly to the Atlantic Ocean by means of a shallow tidal inlet. Narrow Bay connects the western portion of Moriches Bay to Great South Bay; Moriches Bay and Shinnecock Bay are connected via the Quantuck and Quogue Canals while the northern portion of Shinnecock Bay is connected to Great Peconic Bay by Shinnecock Canal, (see Figure I).

Moriches Bay is approximately 8 miles in length and Shinnecock Bay is approximately 6 miles long. Both vary from one to three miles in width. Depths in each bay average about five feet and exceed ten feet in only a few areas such as the intercoastal channels.

History and Importance:

Moriches Bay has a history of problems related to water pollution. A storm caused closure of Moriches Inlet during 1951-53 reduced the mean tidal range from 0.6 feet to 0.2 feet and decreased the total volume exchange by about 65 percent.[1] During the time the Inlet was closed, a "bloom" of planktonic microorganisms (*Nannochloris atomus*) occurred throughout the bay, practically excluding the more normal estuarine plankton flora. These blooms of *Nannochloris* gave the water its characteristic green color and presumably caused the decline of shellfish populations by suffocation attributed to low dissolved oxygen levels. Such phytoplankton blooms were found to result from the chemical nature of the pollutants and the physical and chemical conditions in the bay waters associated with its reduced flushing rate.[2]

---

1 Nichols, M. M.
2 WHOI #58-57

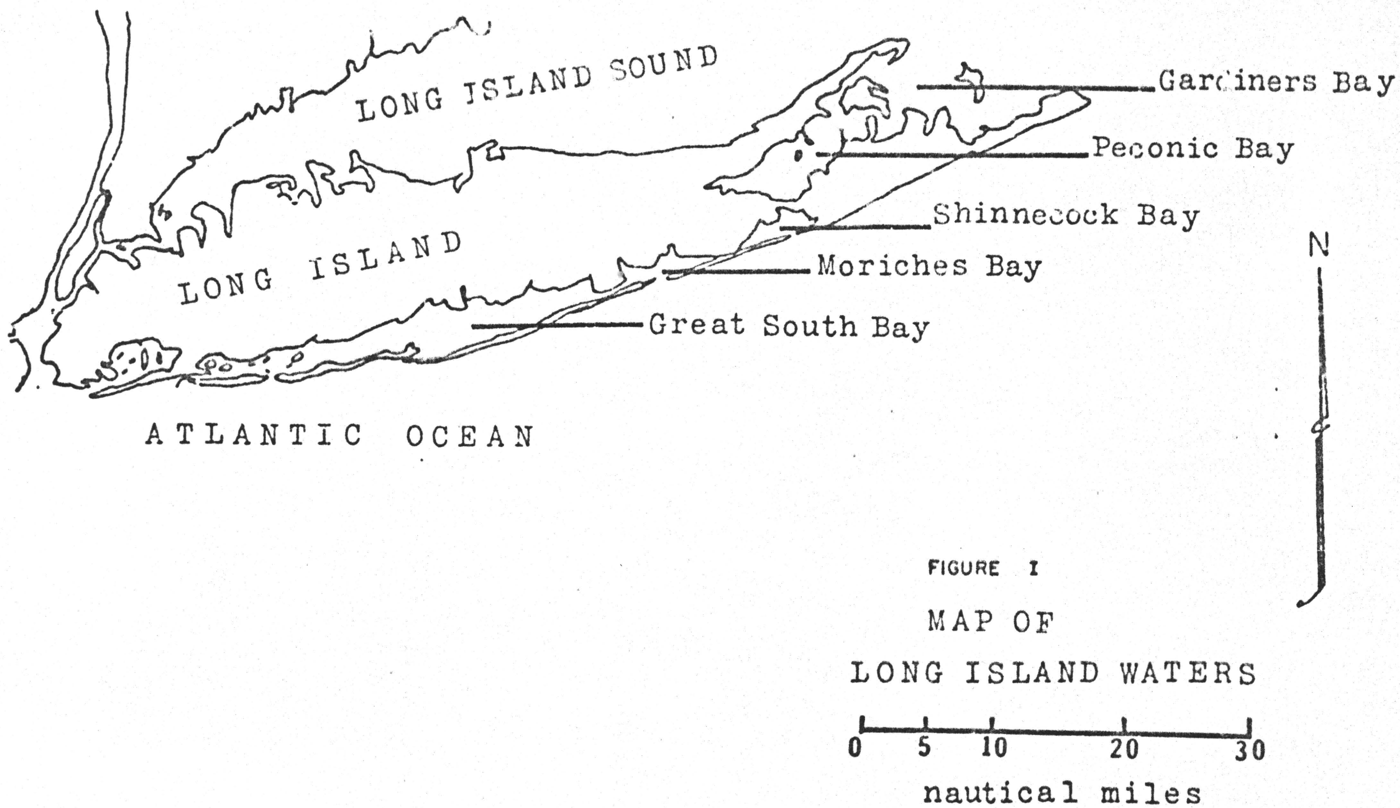


FIGURE I

MAP OF
LONG ISLAND WATERS

Moriches Bay receives drainage from many fresh water streams along its northern shoreline. A large duck farming and processing industry also flourished in this same area, discharging duck wastes directly into Moriches Bay through these estuarine tributaries. Although duck farming activities have been significantly reduced in recent years, leachates from decades of sludge buildup continue to affect the bay waters. More than half of the productive bay bottom is considered uncertified from a bacteriological standpoint by the State and is thus closed to the harvest of shellfish.

Shinnecock Bay is in a relatively pristine condition, receiving limited fresh water drainage of land pollutants. There is essentially no duck farming or any other industry affecting water quality. Compared with Moriches Bay, the human population along the shoreline is relatively sparse and natural beaches and marshlands abound. Virtually all of Shinnecock Bay is classified as certified by the State and thus open to the harvest of all species of shellfish.

Coastal lagoons such as Moriches and Shinnecock Bays are important because many fish of commercial value spend part of their lives within these areas. Some species spawn and the young mature within the protected confines of the lagoon. Concerning management of estuarine fisheries, J. L. McHugh stated, "Well over half of our domestic commercial fish catch is based on estuarine dependent species. Typical fishery resources of these estuaries are oysters, clams, crabs, shrimp and a variety of coastal and anadromous fishes which use the inshore estuary seasonally".[3]

Speaking of estuaries, Thomas R. Glenn, Jr. of the Interstate Sanitation Commission stated that "more applied biological research is urgently needed to provide engineers and planners with the necessary facts so that abatement programs can achieve water quality necessary for aquatic life".[4]

Although Moriches and Shinnecock Bays are similar in many respects, the duck farming activities located along the northern shoreline of Moriches Bay do result in a major nutrient loading to Moriches not found in Shinnecock Bay.

This study was designed to investigate the relationship between water quality and the primary producers in these environments. Primary productivity and basic food chain structures were also investigated for comparative purposes between the two Bays.

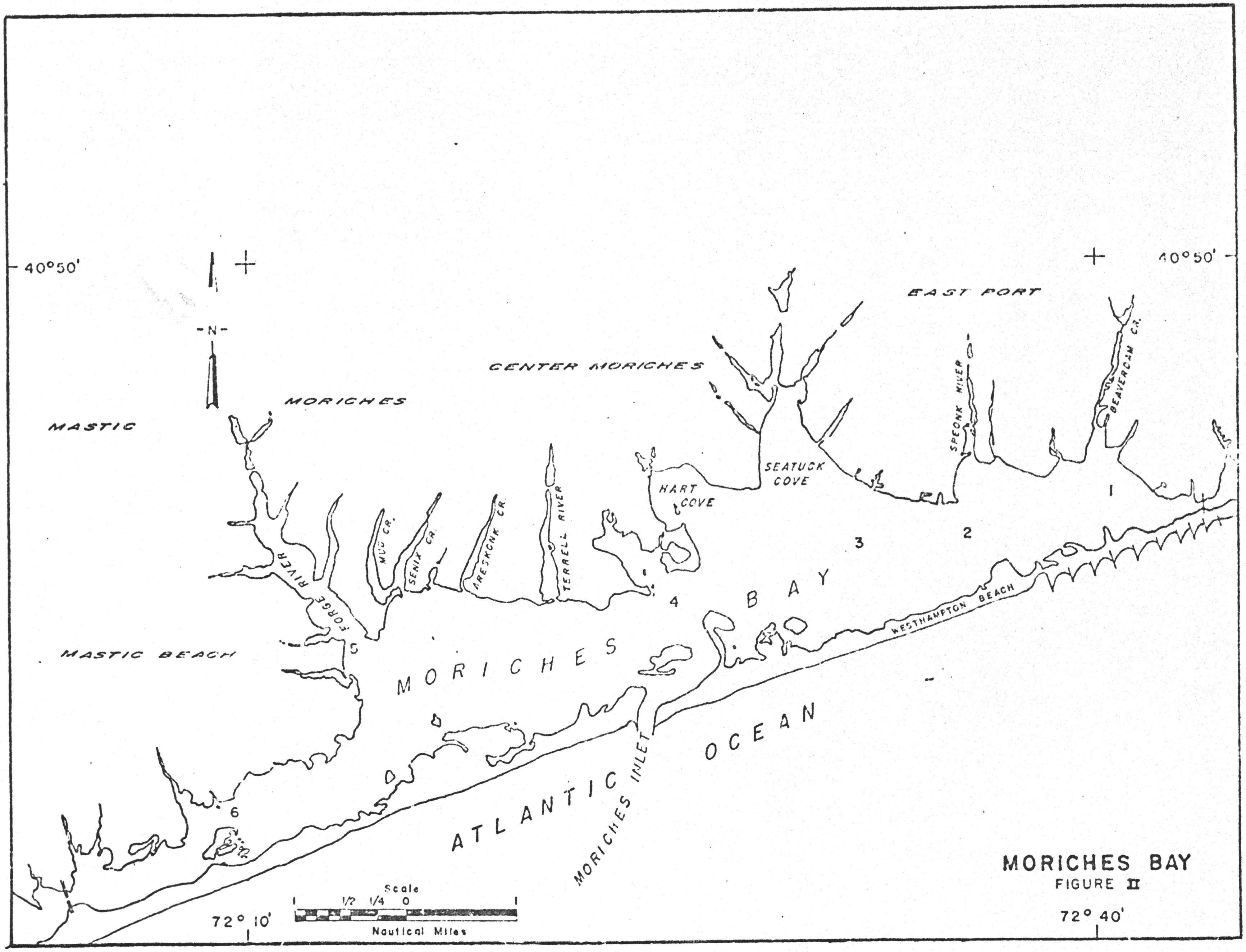
It is felt that a basic understanding leading to an intelligent usage of these environments can lead to continued productivity of these embayments as spawning and nursery grounds essential to the continuation of a viable fishing industry.

METHODS AND MATERIALS

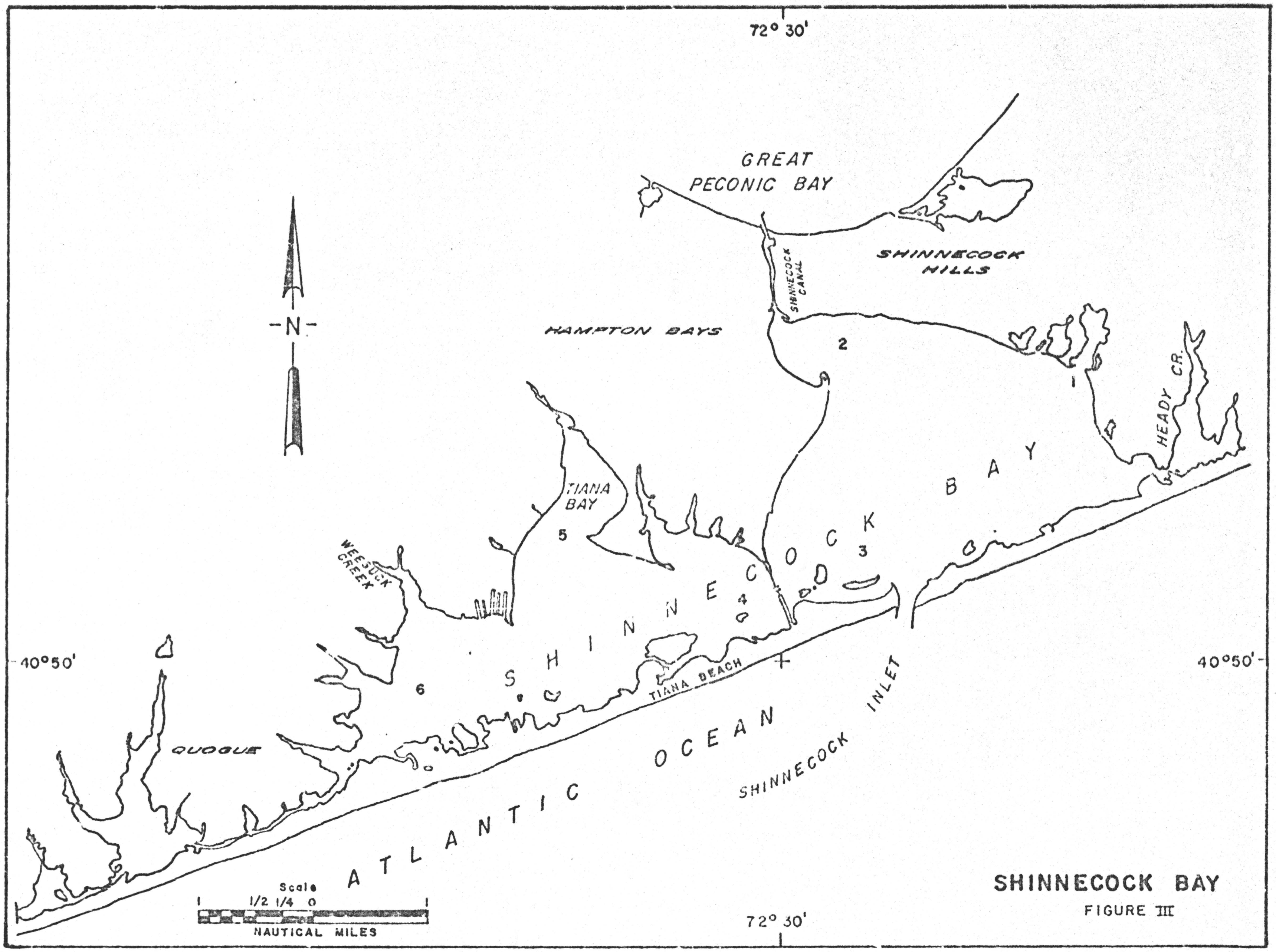
Job I) Determination of water quality: Six (6) primary stations were established in each bay. The location of each station is shown in Figure II for Moriches Bay and in Figure III for Shinnecock Bay. Measurements were recorded at each station for dissolved oxygen, salinity and temperature. Water samples were also collected at these stations throughout the duration of the project. These samples were returned to the laboratory and analyzed for suspended solids, nitrogen and phosphorus. Determinations were made in accordance with Standard

---

3 A Symposium of Estuarine Fisheries, Amer.Fish.Soc.Special Pub., No. 3, 1966
4 A Symposium of Estuarine Fisheries, Amer.Fish.Soc.Special Pub., No. 3, 1966



MORICHES BAY
FIGURE II



SHINNECOCK BAY

FIGURE III

Methods for Analysis in Seawater.[5] Measurements for each sample date are averaged for each bay and presented graphically by Figures IV through IX.

Job 2) Determination of sediment distribution: Samples for sediment analysis were collected throughout each bay either by diving or by means of a grab sampler. Each sample was mechanically sorted and graded. Those samples which were comprised of a silt/clay fraction (grain size less than .063mm.) exceeding 15 percent were subjected to hydrometer measuring techniques to further differentiate these types.[6] Most samples were further analyzed to quantify organic content.

Sediment distribution maps showing sediment gradients were prepared for each bay (Figures X and XI).

Job 3) Determination of the effect of precipitation on nutrient levels in Moriches Bay: A major portion of the chemical nutrients were believed to enter Moriches Bay as a result of land runoff and duck sludge erosion following precipitation. Ten stations (Figure XII) along the northern shore of the bay were sampled during extended periods of dry weather and also following periods of recorded rainfall. A one liter sample was taken and analyzed for nitrogen and phosphorus concentrations.

Job 4) Determination of phytoplankton populations: Water samples were collected at the six primary stations (Figures II and III) for analysis of phytoplankton populations. Samples consisted of one liter of water which were preserved immediately following collection. Upon return to the laboratory, each sample was allowed to settle and was then decanted so that the total phytoplankton population of one liter was contained in 100ml. of sea water. The samples were stored in this condition until microscopic examinations were made.

In preparation for each analysis, a 10ml. portion of the 100ml. sample was further concentrated to 1.0ml. by centrifugation. A fraction of this 1ml. sample was then counted using a standard Palmer nannoplankton counting chamber with a Whipple disc in the microscope ocular. All counts were conducted at a magnification of approximately 440 X. Due to the magnification and concentrations involved, each organism counted represents 433 organisms per 1.0ml. of original sample.

The data obtained in the first, second and third segments of this project are presented in Tables I, II and III respectively. The Genus of organisms identified is listed in Column A. Column B indicates the percent of stations in each bay at which the organism was found at least once during the sample period. Column C indicates by percentage, the number of samples containing an organism compared to the total number of samples counted in each bay. Column D indicates the relative percent of each organism out of the total organisms counted for each bay.

RESULTS AND DISCUSSION

Job 1) Water quality: Determinations of salinity, temperature, dissolved oxygen, suspended solids, nitrogen and phosphorus were made on samples collected from six stations in each bay (Figures II and III) throughout the project.

---

5 Strickland and Parsons, 1968.
6 Shepard, Francis P., 1954.

The measurements for each sampling date are averaged for each bay and presented graphically in Figures IV through IX.

Measurements within each bay do change from one sample date to another, although average values for each bay indicate the seasonal variations. The higher values for nitrogen, phosphorus, suspended solids, temperature and dissolved oxygen alternate between the bays. Maximum, minimum and mean values for these parameters are presented in Table I. These values are obtained from measurements made at each primary sampling station (Figures II and III) during the project's three segments. No significant differences between Shinnecock and Moriches Bays are indicated for nitrogen, phosphorus, suspended solids, temperature and dissolved oxygen.

However, there is an observed salinity difference between Shinnecock and Moriches Bays. This difference, although slight, may be important. The average salinity for all stations in Moriches Bay for the three year period is 27.5 parts per thousand while the corresponding value for Shinnecock Bay is 29.1 parts per thousand. The average salinity for Moriches Bay is 1.6 parts per thousand lower than for Shinnecock Bay.

This salinity difference may be an important factor in the production of hard clams (Mercenaria mercenaria). Large concentrations of hard clams exist in many areas of Moriches Bay. Shinnecock Bay is much less productive for hard clams when compared with Moriches. If the hard clams in Moriches Bay are existing near the upper level of their salinity range, then an increase in average salinity of 1.6 parts per thousand in Shinnecock Bay may be significant with the higher levels proving detrimental to spawning, setting, growth or other biological functions necessary for successful hard clam production.

Job 2) Sediment distribution: Twenty-eight samples for sediment analysis were collected from Shinnecock Bay and forty-one from Moriches Bay. Sample sites were distributed throughout each bay.

Analyses of data indicated that three basic types of sediment were present. The general categories into which all samples fit are as follows:

1. Sand (comprising 95 percent or more sand).

2. Sandy silt (sand with up to 30 percent silt).

3. Sand-silt-clay (sand with up to 50 percent silt and up to 10 percent clay).

Shinnecock and Moriches Bays have similar amounts of sand calculated on a percentage basis of total samples. The percentage of sediment samples in the sand category is 46 percent for Shinnecock and 51 percent for Moriches Bay. However, a dissimilar relationship is observed for the sandy silt and sand-silt-clay categories. Sandy silt compositions were found in 14 percent of the Shinnecock samples and 27 percent of the Moriches samples. Similarly, the sand-silt-clay compositions were found in 40 percent of the Shinnecock samples and 22 percent of the Moriches Bay samples. Sediment distribution maps based on the 3 categories above are presented in Figures X and XI.

Job 3) Precipitation and nutrient levels: Nitrogen and phosphorus analyses were conducted at ten sampling sites along the northern portion of Moriches Bay (Figure XII). Samples were collected for this portion of the study from April through October 1975 on 21 occasions. The purpose of this study was to

Water samples collected from typical blooms have been found to contain 50,000 to 100,000 organisms per milliliter of water. It should be emphasized that these phenomena usually last a few days and cause no permanent alteration to the environment.

CONCLUSION

This project was designed to obtain and compare chemical and physical characteristics of two adjacent marine environments relative to primary production and basic food chain structures. The two bays chosen are similar in most respects, with the noted exception that extensive duck sludge deposits are still located in streams tributary to Moriches Bay. The study was undertaken to detect basic ecological differences, if any, between these two bays. An intensive investigation of the relationships between water quality, sedimentation and basic food chain organisms found in the two environments was undertaken.

No significant difference exists between bays based on measurements of suspended solids, dissolved oxygen, nitrogen, phosphorus or temperature. A small but possibly important difference exists for salinity measurements. Based on all measurements made during this project, the average salinity of Moriches Bay is 1.6 parts per thousand lower than that of Shinnecock Bay. This difference may be a major factor for the greater hard clam production from Moriches Bay as compared to Shinnecock Bay.

Analyses of sediment samples showed similar sand content of the sediments for both bays. A dissimilar relationship between bottom sediments exists for smaller grain size categories. The sand-silt content of Moriches Bay is twice that of Shinnecock while the sand-silt-clay content of Shinnecock is twice that of Moriches.

Phytoplankton populations were enumerated for each bay during each project segment. Data comparison indicate little difference between the two bays. This similarity of phytoplankton populations is attributed to the similarities in water quality determined for each environment.

In order to explore a possible relationship between storm water runoff and nutrient concentrations, samples were collected from Moriches Bay before and after rainfall and analyzed for nitrogen and phosphorus content. Although there are indications of higher levels following rainfall, not enough consistent data are available to warrant conclusions as to the effect of rainfall on nitrogen and phosphorus levels in Moriches Bay.

Data collected during the project did not indicate any major ecological differences between Shinnecock and Moriches Bay with the exception of the average salinity values. Salinity values in Shinnecock Bay were 1.6 parts per thousand higher than those in Moriches which could be a significant factor since salinities in both bays are near the upper salinity ranges for hard clam propagation. Reported landings for hard clams have been higher for Moriches compared to Shinnecock Bay.

The apparent nutrient loading of Moriches Bay is not reflected by measurements of physical and chemical parameters made during this project. Both bays appear to offer equal potential as spawning and nursery grounds for numerous species of finfish of commercial importance found in the marine waters surrounding New York.

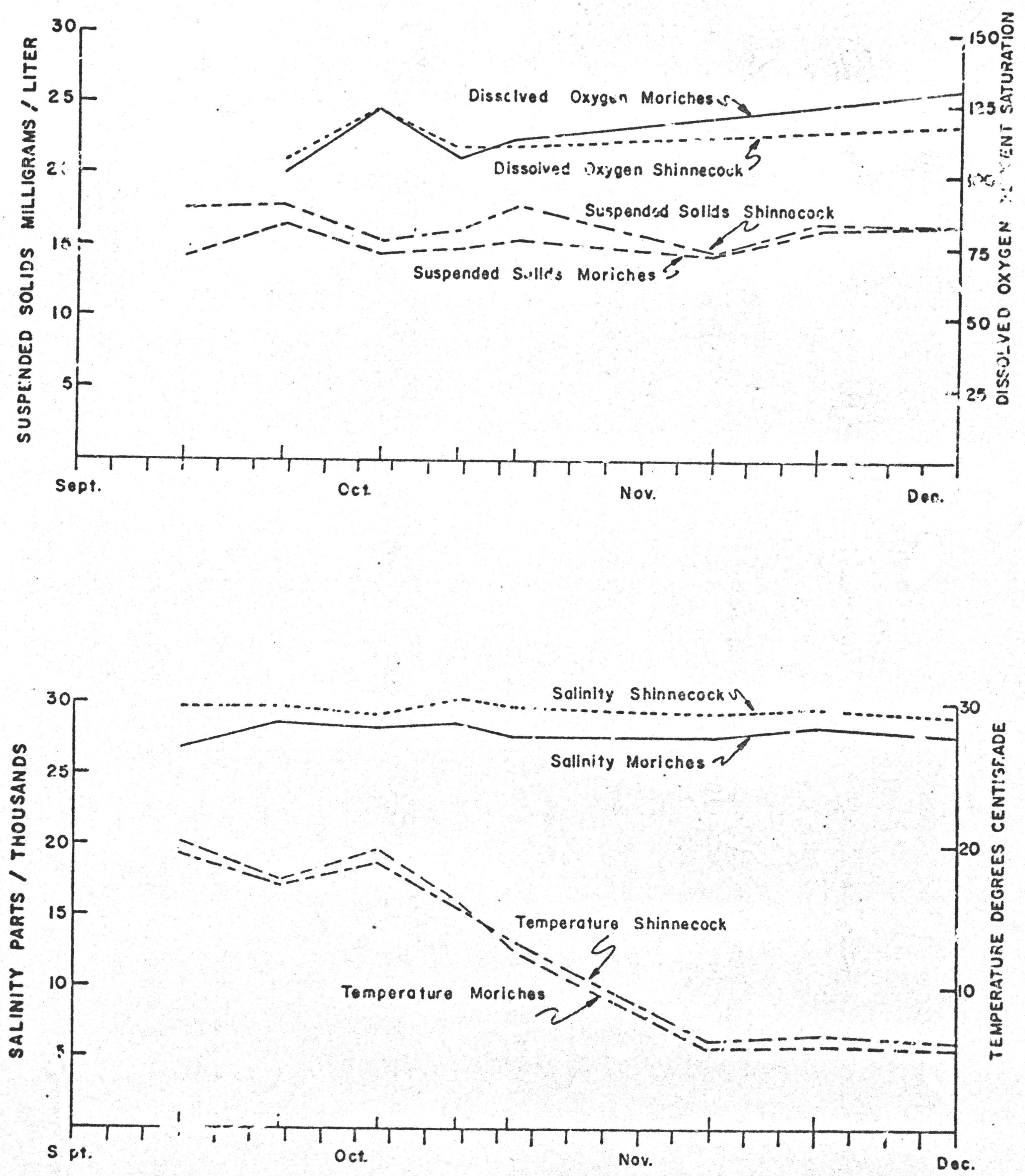


FIGURE IV

Segment I — 1973

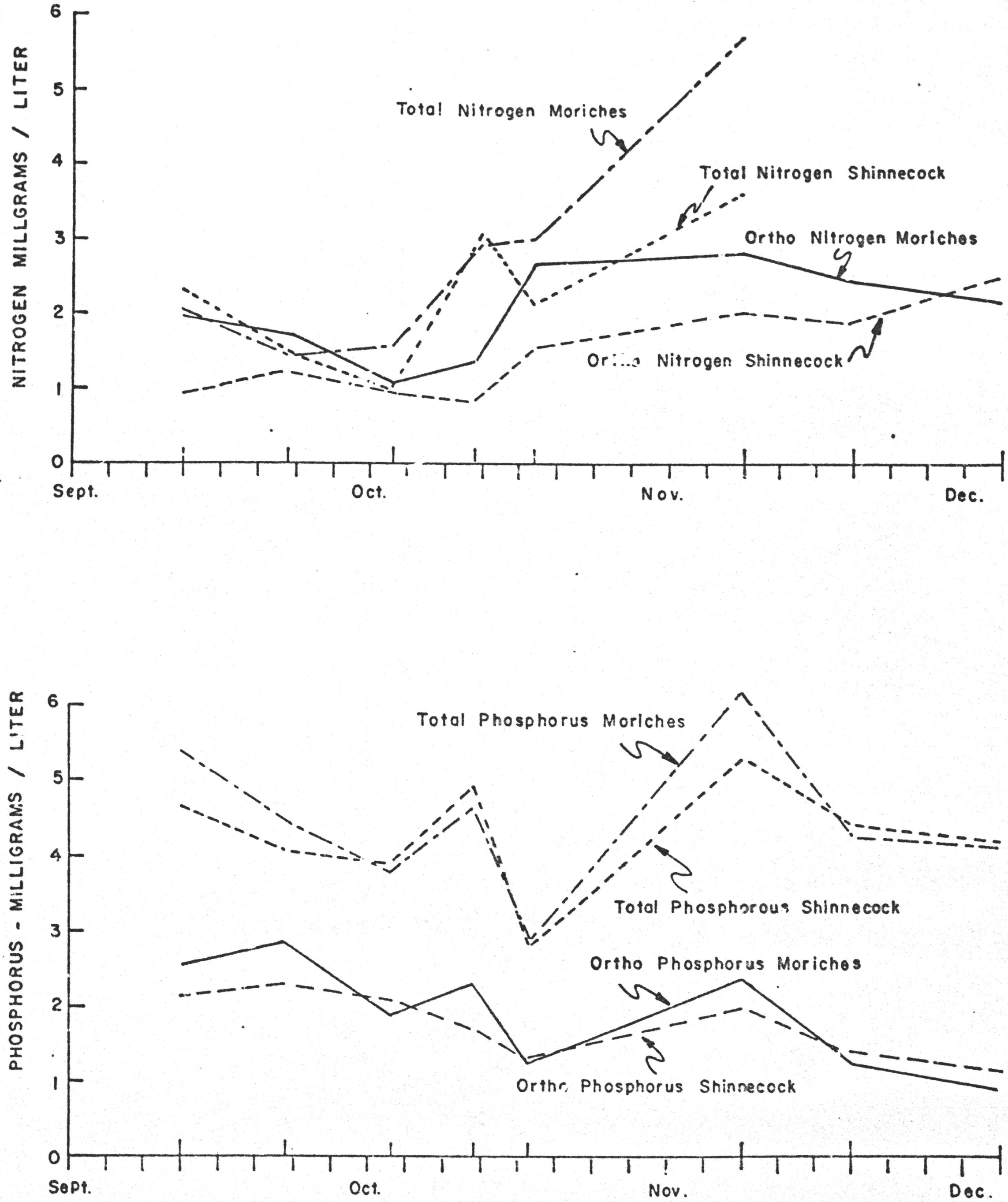
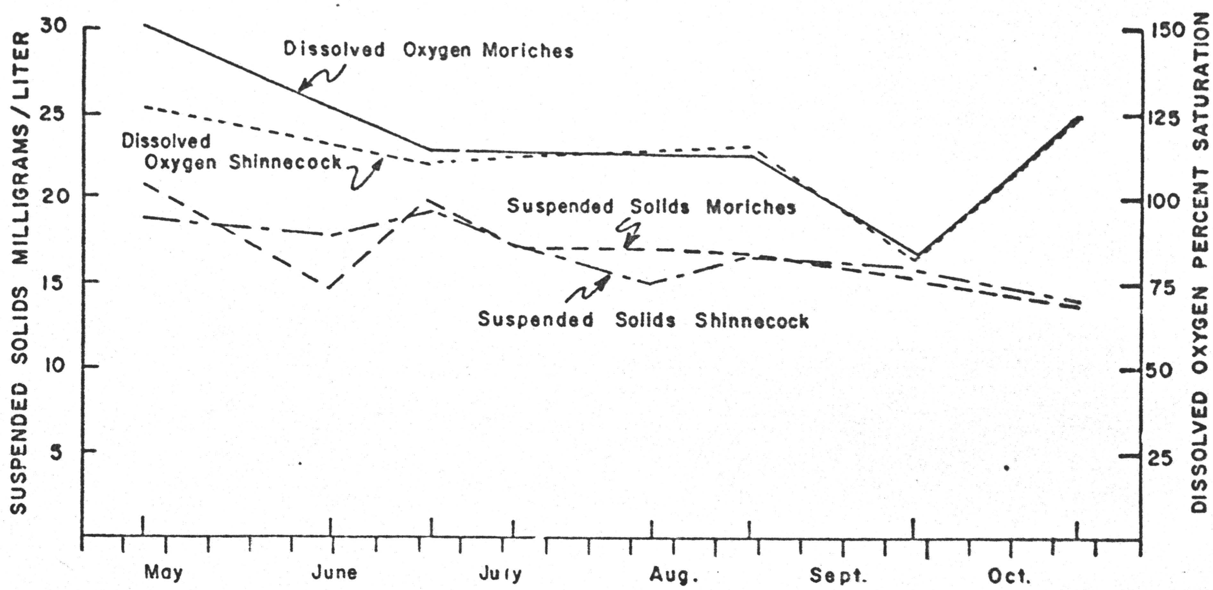


FIGURE V
Segment I — 1973



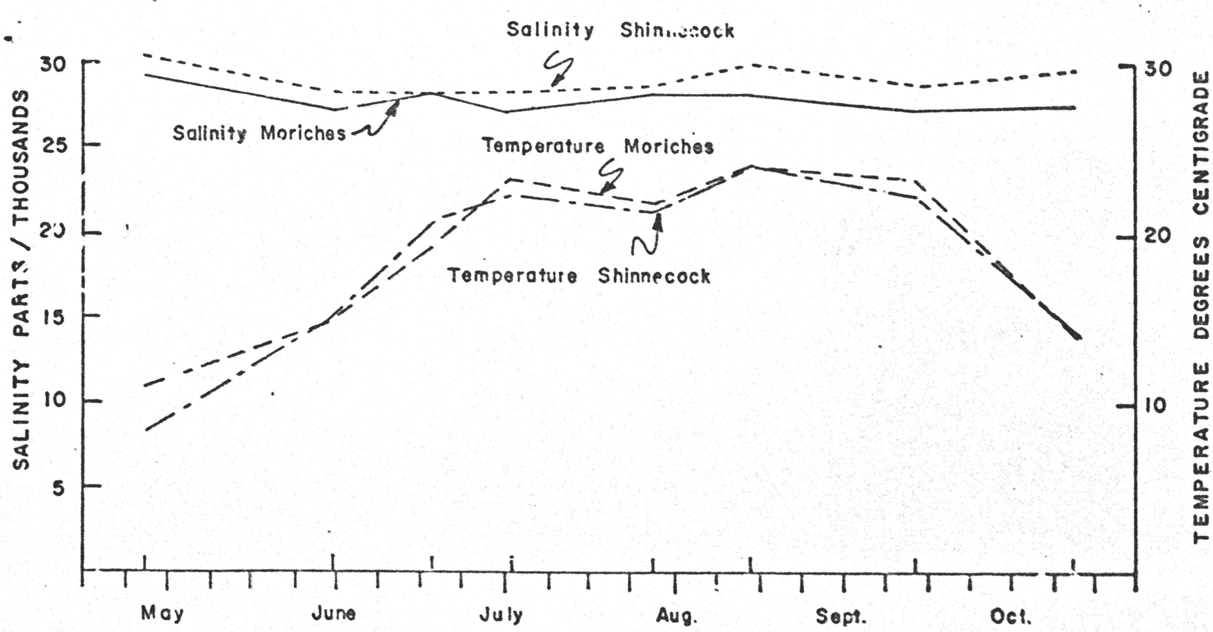


FIGURE VI
Segment 2 — 1974

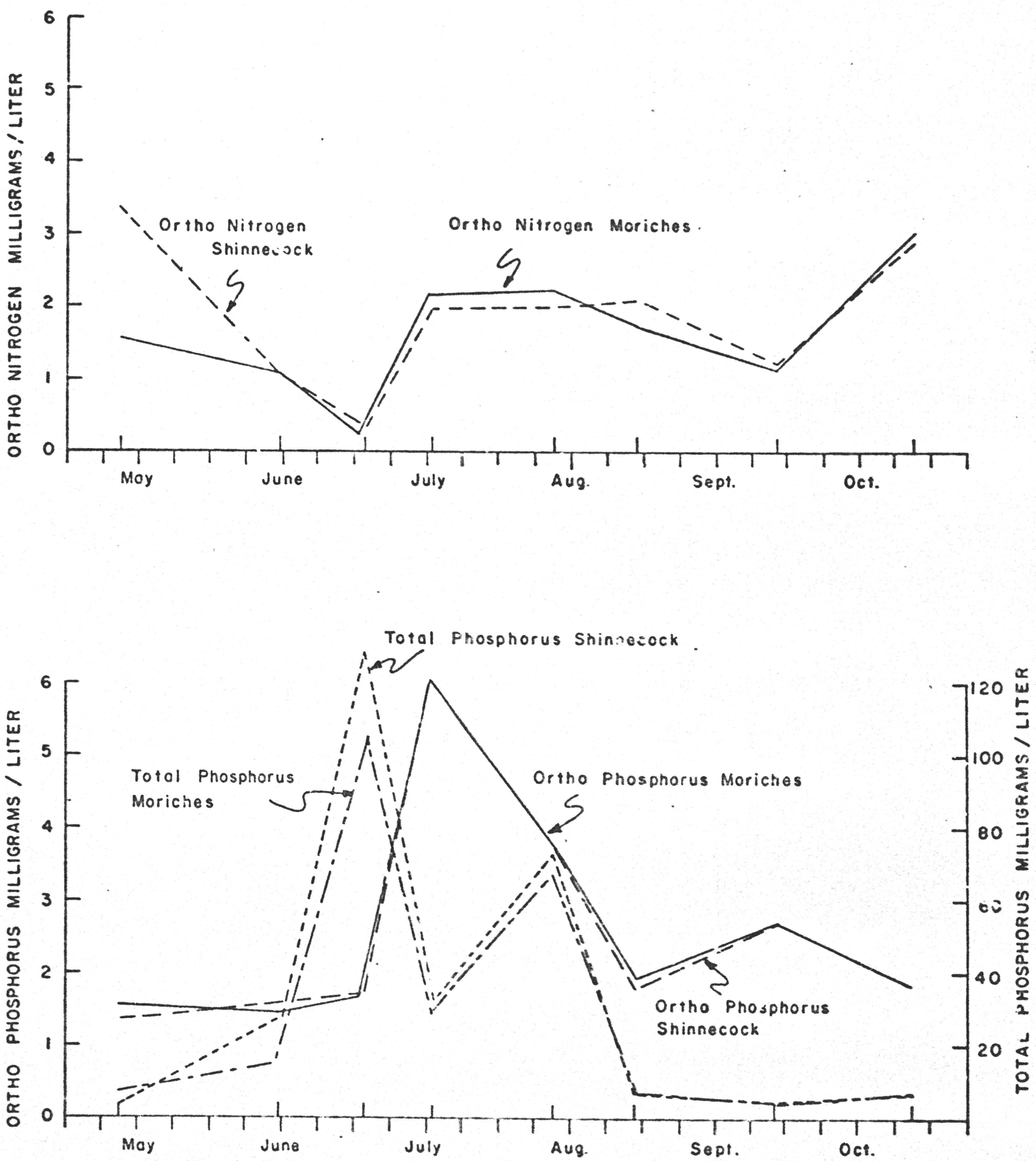
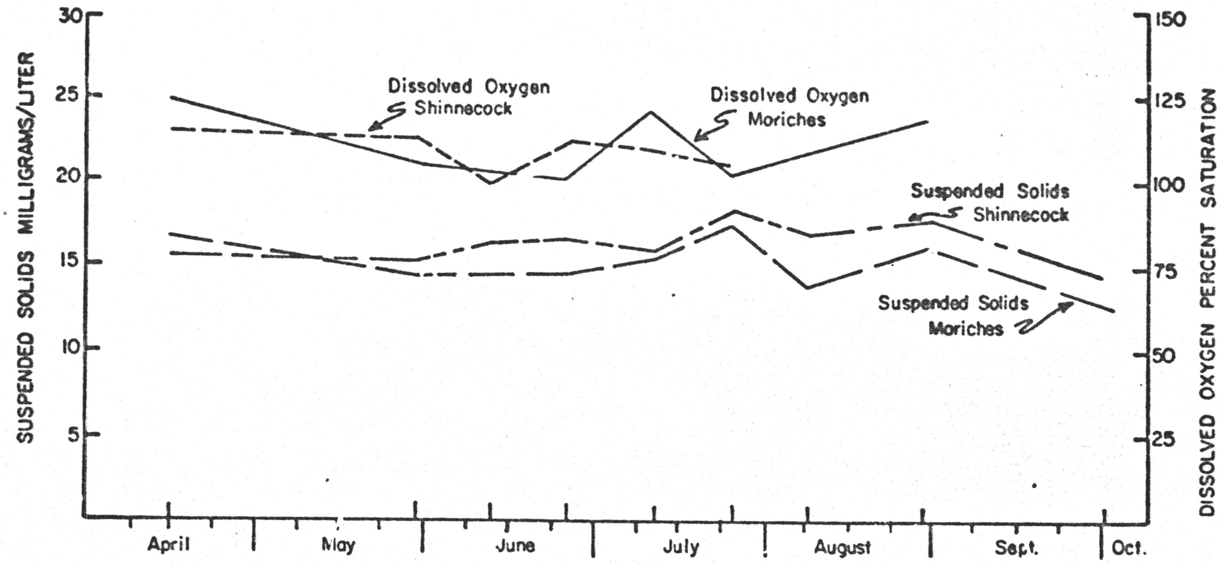


FIGURE VII
Segment 2 — 1974



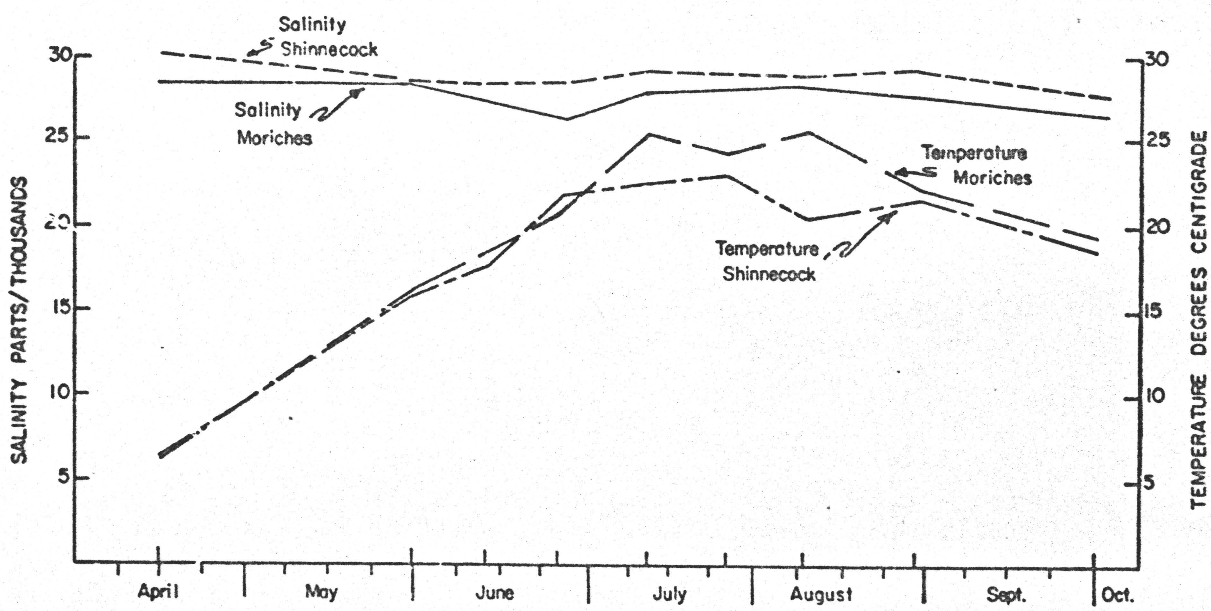
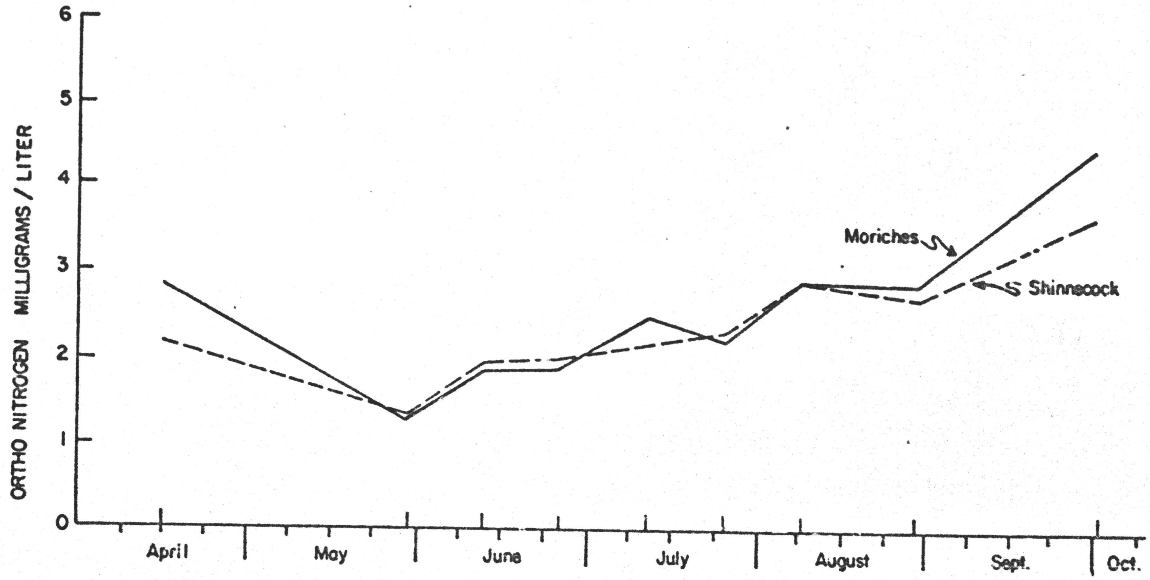


FIGURE VIII
Segment 3 — 1975



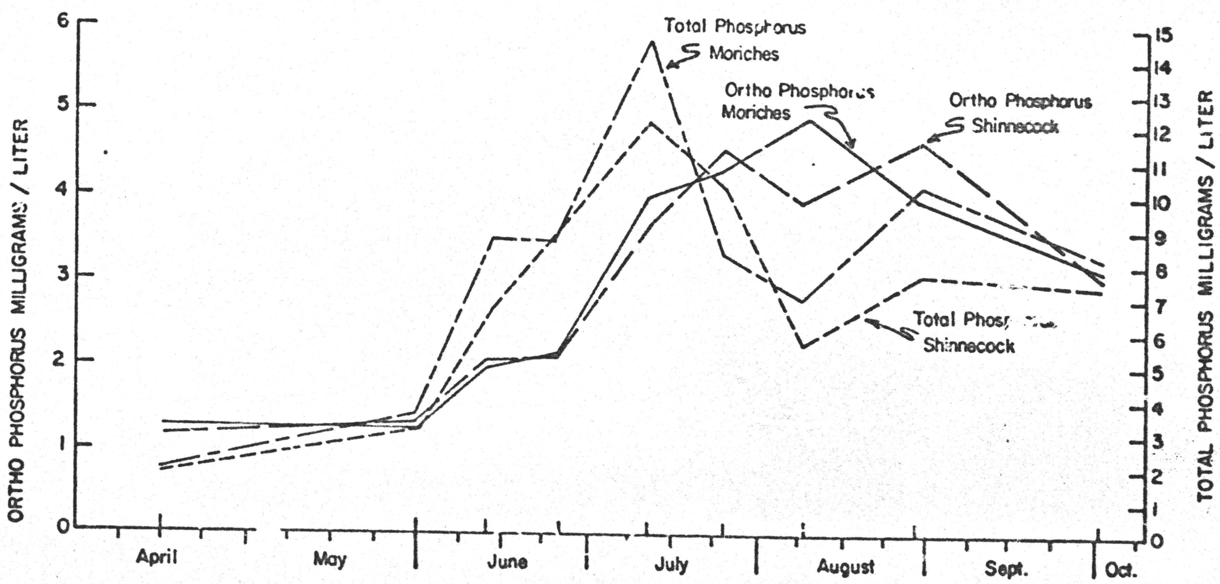
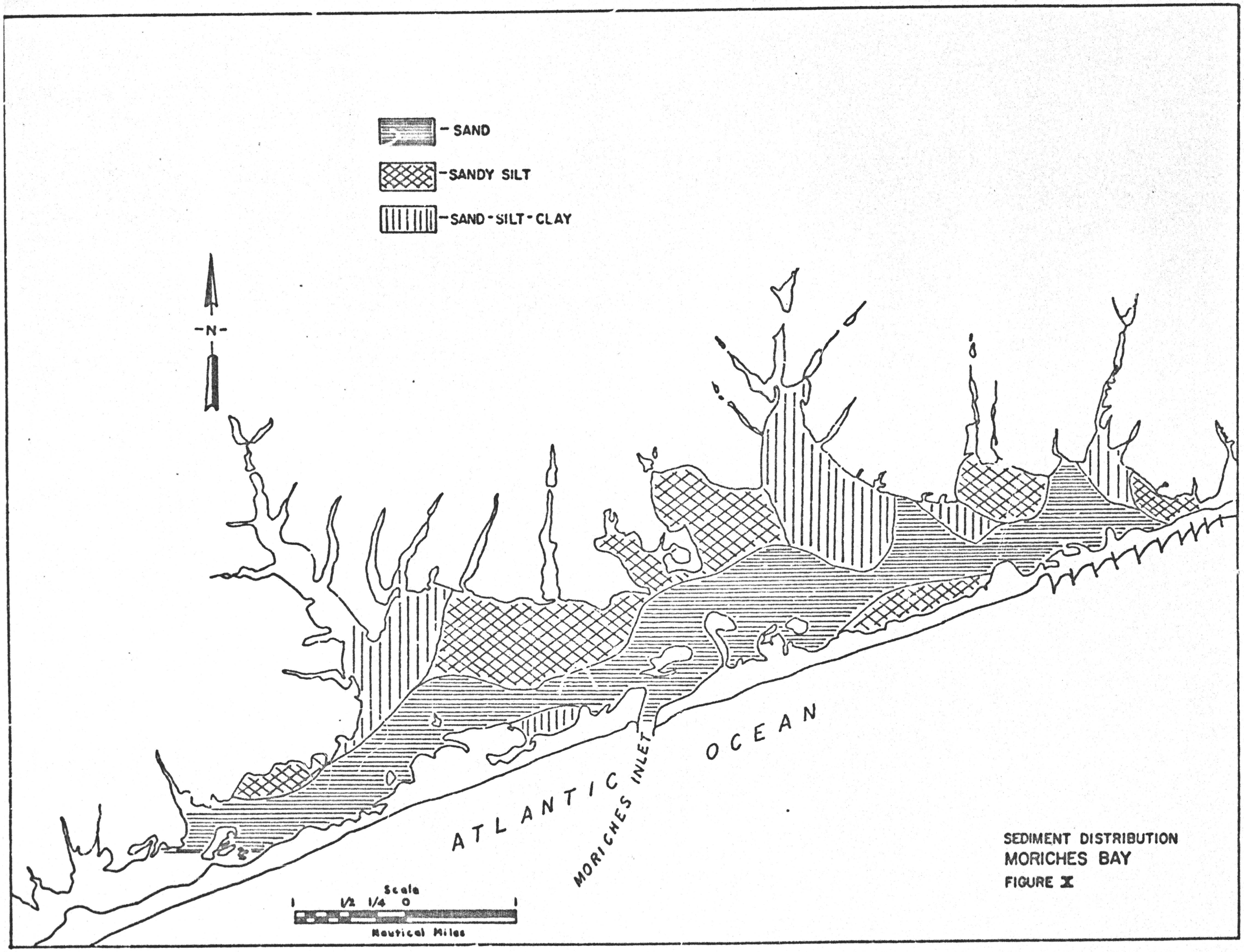
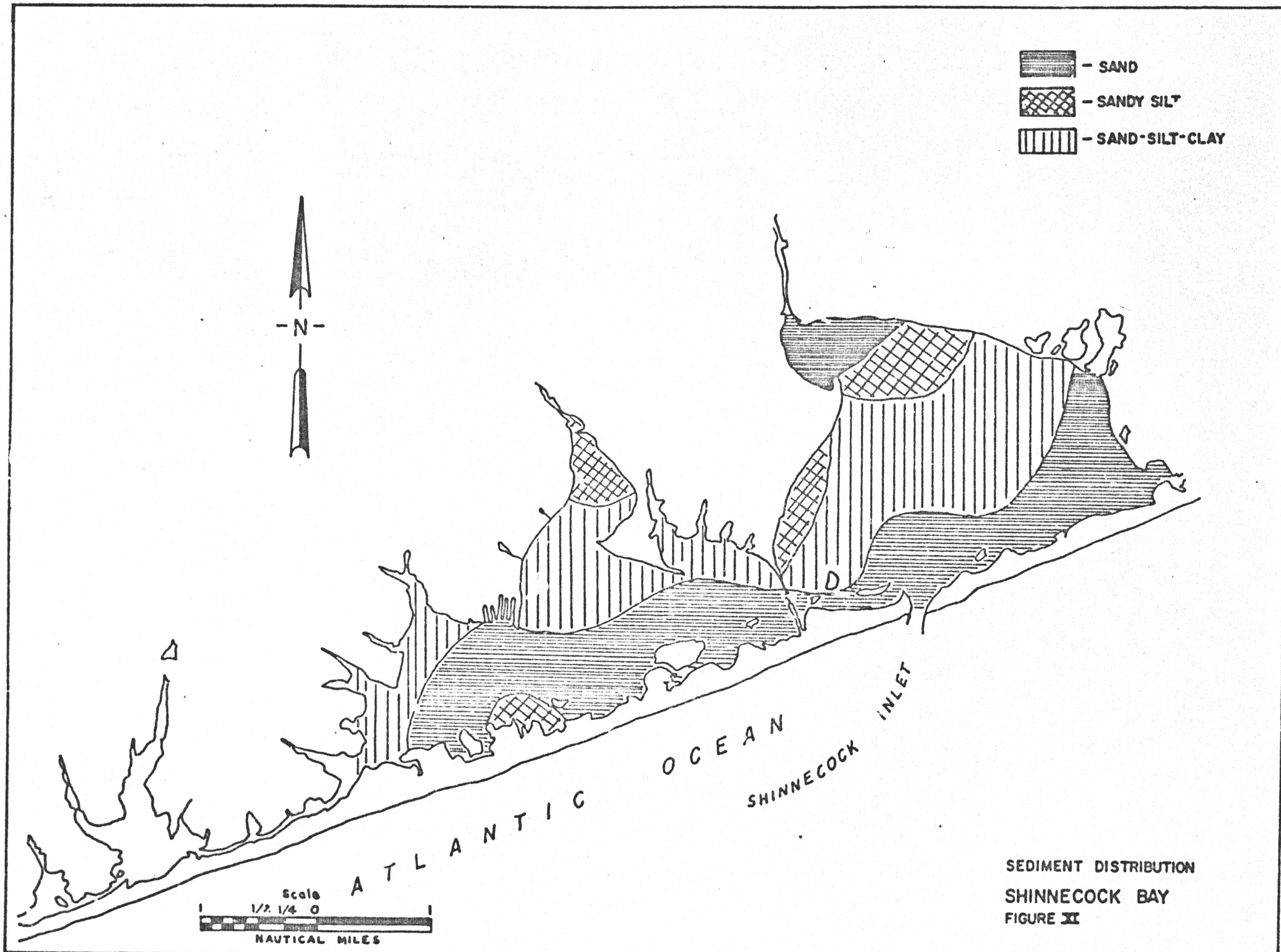


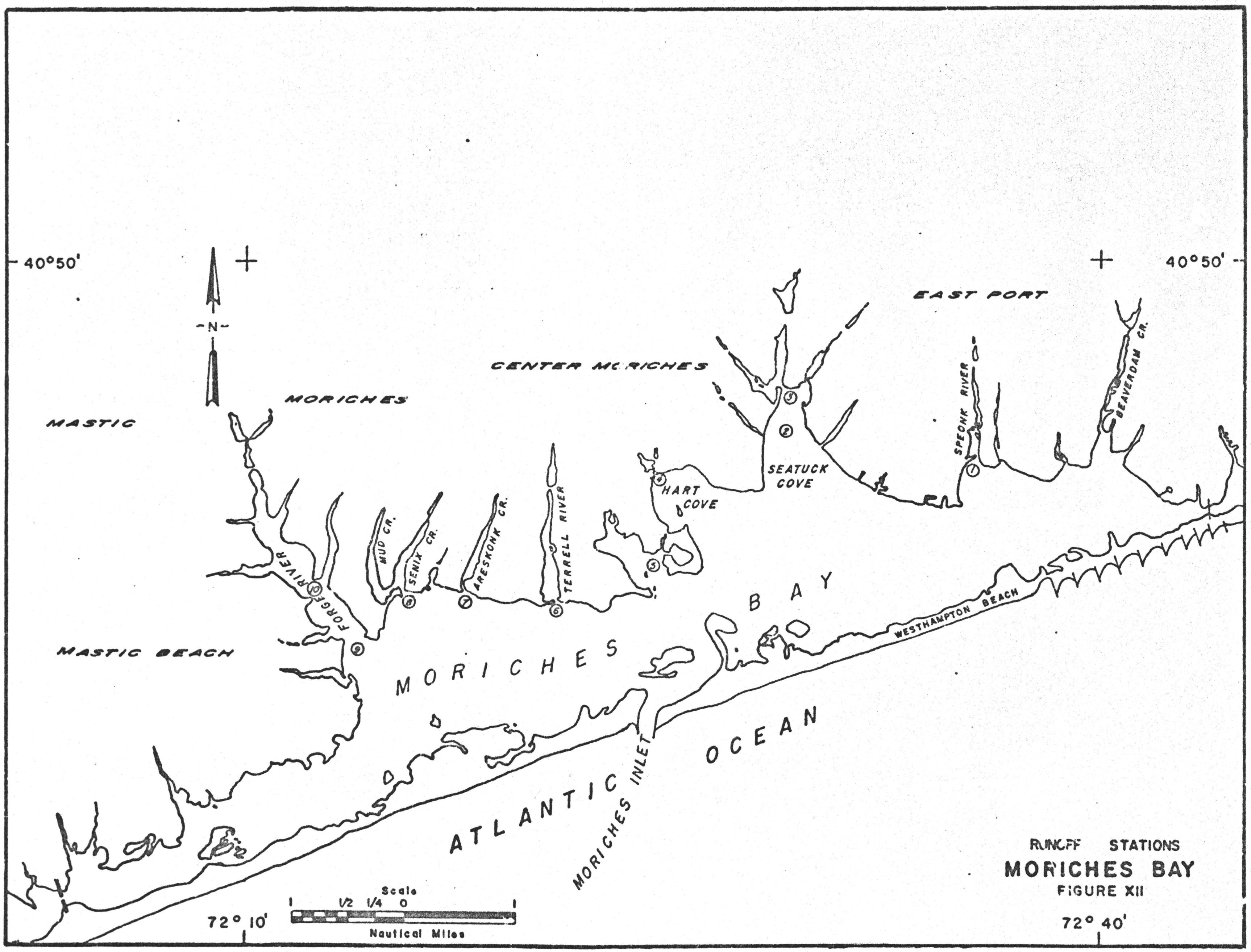
FIGURE IX
Segment 3 — 1975



SEDIMENT DISTRIBUTION
MORICHES BAY
FIGURE X



SEDIMENT DISTRIBUTION
SHINNECOCK BAY
FIGURE XI



RUNOFF STATIONS
MORICHES BAY
FIGURE XII

SUMMARY OF WATER QUALITY

TABLE I

	Shinnecock Bay			Moriches Bay		
	Max.	Min.	Mean	Max.	Min.	Mean
Sal. $^{o}/oo$	30.4	27.7	29.1	29.2	26.1	27.5
Temp. ^{o}C.	24.05	6.02	16.62	25.83	5.78	17.26
Nitrogen mg/l	3.68	0.32	2.41	3.20	0.25	2.14
Phos. mg/l	5.95	1.15	2.46	5.92	0.90	2.51
T.Phos. mg/l	126.14	1.75	15.30	105.66	1.92	14.35
Sus.sol.mg/l	18.77	14.0	16.56	20.67	13.0	16.29
D.O. % sat.	126	82	112.53	151	83	114.73

1973 PHYTOPLANKTON DATA

TABLE II

COLUMN A	COLUMN B		COLUMN C		COLUMN D	
DIATOMS	S	M	S	M	S	M
Achnanthes	33%	17%	3%	1%	0.2%	0.1%
Asterionella	50	0	7	0	1.7	0.0
Biddulphia	83	17	24	1	6.5	0.1
Campylodiscus	0	33	0	3	0.0	0.2
Ceratulina	17	17	1	1	0.3	0.5
Chaetoceros	33	0	4	0	0.4	0.0
Cocconeis	100	100	96	79	16.6	22.0
Coscinodiscus	100	100	49	26	9.4	2.9
Cymbella	83	100	18	34	2.0	3.5
Ditylum	0	33	0	3	0.0	0.2
Gyrosigma	50	67	4	12	0.5	0.9
Leptocylindricus	50	33	4	3	1.4	0.6
Licmorpha	33	17	3	3	0.3	0.2
Mastogloia	17	17	1	3	0.1	0.2
Navicula	50	83	6	12	0.5	1.2
Nitzschia	100	100	42	16	8.7	2.5
Opephora	100	100	42	49	6.1	9.8
Pinnularia	17	0	1	0	0.1	0.0
Pleurosigma	67	33	10	6	0.7	0.5
Rhizoselenia	33	17	3	1	0.2	0.1
Skeletonema	100	100	33	22	18.8	35.1
Striatella	33	17	3	1	0.2	0.1
Synedra	0	17	0	1	0.0	0.1
Thalassionema	100	100	18	13	4.3	1.6
Thalassiosira	87	100	13	13	4.9	2.5
Thalassiothrix	33	17	3	1	0.5	0.3
DINOFLAGELLATES						
Amphidinium	17	0	1	0	0.1	0.0
Ceratium	33	83	3	12	0.2	0.9
Exuviella	67	83	10	10	1.0	1.2
Goniaulax	67	100	13	18	2.1	2.3
Gymnodinium	100	100	39	43	7.1	8.8
Noctiluca	17	0	1	0	0.2	0.0
Peridinium	67	0	8	0	0.7	0.0
Prorocentrum	100	100	24	16	3.5	1.5

S = Shinnecock

M = Moriches

1974 PHYTOPLANKTON DATA

TABLE III

COLUMN A	COLUMN B		COLUMN C		COLUMN D	
	S	M	S	M	S	M
DIATOMS						
Bidulphia	33%	17%	1.21%	0.58%	1.07%	0.2%
Campylodiscus	17	17	0.61	0.58	0.21	0.2
Ceratium	17	0	0.61	0	0.42	0
Cocconeis	100	100	16.97	21.05	11.99	19.08
Coscinodiscus	100	100	17.58	14.04	12.85	10.84
Ditylum	17	0	0.61	0	0.21	0
Gyrosigma	33	17	1.82	0.58	0.64	0.2
Hemiaulus	17	0	0.61	0	0.21	0
Licmorpha	50	50	2.42	1.75	1.28	0.6
Mastogloia	0	17	0	0.58	0	0.2
Melosira	0	17	0	0.58	0	0.8
Navicula	83	100	6.67	7.60	2.57	3.41
Nitzschia	100	100	6.67	4.09	3.43	3.01
Opephora	100	100	15.76	18.71	11.56	11.85
Rhizoselenia	0	17	0	1.17	0	0.6
Skeletonoema	50	0	1.82	0	4.28	0
Synedra	17	0	0.61	0	0.21	0
Thalassionema	50	0	1.82	0	1.28	0
DINOFLAGELLATES						
Exuviella	83	83	4	5	13.28	9.44
Gymnodinium	100	100	10	8	4.93	6.63
Peridinium	0	67	0	2	0	0.8
Prorocentrum	100	100	10	15	29.55	32.13

S = Shinnecock

M = Moriches

1975 PHYTOPLANKTON DATA

TABLE IV

COLUMN A	COLUMN B		COLUMN C		COLUMN D	
DIATOMS	S	M	S	M	S	M
Asterionella	17%	0%	2%	0%	1%	0%
Bidulphia	50	17	12	2	1	/1
Campylodiscus	33	33	5	5	1	/1
Ceratium	17	17	2	2	/1	/1
Chaetoceros	50	33	7	5	3	/1
Cocconeis	100	100	43	60	9	6
Coscinodiscus	100	100	69	50	23	5
Gramatophora	17	0	2	0	/1	0
Gyrosigma	33	33	5	5	1	/1
Leptocylindricus	33	33	5	5	2	9
Licmorpha	17	33	2	5	/1	/1
Navicula	83	100	33	26	6	1
Nitzschia	100	100	29	17	4	1
Opephora	100	100	76	52	17	5
Rhizoselenia	100	50	14	7	5	/1
Skeletonema	33	17	7	2	2	/1
Synedra	17	0	2	0	/1	0
Thalassionema	33	0	5	0	1	0
Thalassiothrix	17	0	2	0	1	0
DINOFLAGELLATES						
Exuviella	100	100	33	29	26	9
Goniaulax	17	33	2	5	1	1
Gymnodinium	67	67	17	14	8	2
Peridinium	17	17	2	2	/1	/1
Prorocentrum	100	100	43	36	6	57

S = Shinnecock

M = Moriches

NOAA FORM 25-13
(2-73)

BIBLIOGRAPHIC DATA SHEET

U. S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

1. NOAA ACCESSION NUMBER NOAA-77060703	2.	3. RECIPIENT'S ACCESSION NUMBER

4. TITLE AND SUBTITLE Primary Productivity and Basic Food Chain Relationships in Two Long Island Bays	5. REPORT DATE March 1977
	6.
7. AUTHOR(S) R. E. Fox	8. REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS New York Division of Marine and Coastal Resources	10. PROJECT/TASK NO. Proj. 3-182-R
	11. CONTRACT/GRANT NO.
12. SPONSORING ORGANIZATION NAME AND ADDRESS NOAA National Marine Fisheries Service Washington, DC 20235	13. TYPE OF REPORT AND PERIOD COVERED Compl. Rept June 1973-March 1976
	14.

15. PUBLICATION REFERENCE New York Division of Marine and Coastal Resources Completion Report for Project No. 3-182-R, for the Period June 1, 1973 - March 31, 1976, March 1977. 23 p, 12 fig, 3 tab.

16. ABSTRACT
A three year study was undertaken to determine primary productivity and basic food chain relationships in two Long Island embayments. The areas chosen were Moriches Bay and Shinnecock Bay, located on the southern shore of Long Island. Moriches Bay receives waste loadings from treated wastes and sludge deposits originating from past and present duck farms located on tributaries to the bay. Shinnecock Bay is connected via a coastal canal (Quantuck Canal) to Moriches but does not have any major sources of pollution located along its shoreline. The study was designed to determine water quality in the two bays, sediment distribution, the effects of precipitation on water quality and phytoplankton populations. Analyses of the data do not indicate any significant differences between the two bays on the basis of the parameters chosen. The average salinity of Moriches Bay was 1.6 ppt (o/oo) lower than the average salinity of Shinnecock Bay (27.5 o/oo versus 29.1 o/oo). (Author)

17. KEY WORDS AND DOCUMENT ANALYSIS

17A. DESCRIPTORS

*Food chains, *Primary biological productivity, Water quality, Precipitation (Meteorology)

17B. IDENTIFIERS/OPEN-ENDED TERMS

Long Island Bays, Sediment distribution

17C. COSATI FIELD/GROUP

4B, 6F

18. AVAILABILITY STATEMENT Released for distribution: Elaine S. Downs	19. SECURITY CLASS (This report) UNCLASSIFIED	21. NO. OF PAGES 25
	20. SECURITY CLASS (This report) UNCLASSIFIED	22. PRICE PCA02/MFA01

NOAA FORM 25-13 (2-73) SUPERSEDES ALL PREVIOUS EDITIONS. ☆ U. S. GPO:1976-0-665-661/1159

[IN]VESTIGATION OF THE FEASIBILITY OF A REGIONAL GROUNDWATER MANAGEMENT INFORMATION SYSTEM FOR LONG ISLAND

LONG ISLAND REGIONAL PLANNING BOARD

208 PLAN IMPLEMENTATION

Task 4.A

JUNE 1983

Investigation of the Feasibility of a Regional Groundwater Management Information System for Long Island

Long Island Regional Planning Board

June 1983

Submitted in fulfillment of the requirements of Task 4.A of the Long Island 208 Waste Treatment Management Plan Implementation Study.

TECHNICAL ADVISORY COMMITTEE

Voting Members

Lee E. Koppelman
Project Director
Long Island Regional Planning Board

Theodore Burger*
Nassau County Department of Health

Donald Lister**
Nassau County Department of Planning

John D. Murray
Nassau County Department of Public Works

Aldo Andreoli
Suffolk County Department of Health Services

Vito Minei
Suffolk County Department of Health Services

August A. Guerrera
Suffolk County Water Authority

*replaced Thomas Maher 4/1/80
**replaced Irwin Kessman 10/27/80

Advisory Members

Philip Barbato
New York State Department
of Environmental Conservation

Nancy Papoulias*
United States Environmental
Protection Agency

George Neimeth
New York State Department of
Transportation

Henry F H Ku
United States Geological Survey

Thomas Doheny**
Town of Hempstead

Kevin Quinn
Town of North Hempstead

Jeremy Barth
Town of Oyster Bay

Michael White ***
Town of Hungtington

Dennis Lynch
Town of Babylon

James McClave
Town of Smithtown

Stuart Buckner
Town of Islip

Thomas Cramer****
Town of Brookhaven

Sarah Meyland
New York State Commission on
Water Resource Needs of
Long Island

George Prois*****
New York State Commission on
Water Resource Needs of
Long Island

*replaced John Ulshoefer
**replaced Harold Udell
***replaced Malcolm Hair
****replaced George Prois
*****replaced Edward Cantor

Administration and Report Preparation

Randall S. Davis
Edith Tanenbaum
Israel Wilenitz

Clerical Staff

Gail Calfa
Lucille Gardella
Theresa Kinkead
Penny Kohler
Edith Sherman
Jeanne Widmayer

ACKNOWLEDGEMENTS

This expanded project is really the progeny of a seminar on data management systems co-sponsored in March of 1982 by the L.I. Regional Planning Board and the N.Y. State Department of Environmental Conservation. In addition to demonstrating the kind of administrative and organizational effort achievable through inter-agency cooperation and communication, the seminar provided an effective forum for the exchange and sharing of ideas by agency personnel and other people from varied and diverse backgrounds. In this regard, the seminar achieved a remarkable degree of success in stimulating the imaginations of the participants, a fact that is apparent in the quality and depth of the resultant proceedings.

Although the seminar participants are too numerous to mention individually, several persons deserve special mention for the time and involvement they expended guiding the author through the intricacies of Long Island data management and computer technologies. Mr. William Flipse of the U.S. Geological Survey, Mr. Ron Green of the Suffolk County Department of Health Services, and Mr. Frank Wolzein of the N.Y. State Department of Environmental Conservation all gave freely of their time and were generous with their comments and advice. To the extent that this project successfully describes and analyzes Long Island's groundwater data management situation, the credit is largely theirs.

Phil Barbato of the New York State Department of Environmental Conservation, August Guerrera, formerly of the Suffolk County Water

Authority, and the late Dr. Edward Cantor of the N.Y. State Legislative Commission on Water Resource Needs of Long Island provided much inspiration and insight into the potential of computers as applied to Long Island groundwater data.

Finally, Dr. Israel Wilenitz, friend and colleague, provided both enthusiasm and encouragement, and Dr. Edith Tanenbaum helped to convert some of the technical jargon into concise english.

TABLE OF CONTENTS

=================

* * EXECUTIVE SUMMARY * *

=================

The presence of numerous, serious groundwater quality and quantity problems on Long Island has been well documented and has engendered substantial institutional involvement in the areas of groundwater protection and management. One result has been the development of extensive and varied agency data holdings. The management of that data, however, has evolved in a fragmented and piecemeal way, and the associated data overload has prevented full utilization of the data by agencies reluctant to expend money and manpower to keep track of each other's data. As a result, groundwater impacts from many activities (e.g., commercial/industrial development) have not been adequately considered by agencies in their land use planning, waste treatment and water supply management decisions.

Recent interest in the protection and management of key groundwater recharge areas and the importance of planning future land use waste treatment and water supply management activities underline the need to provide decision makers with the most complete and relevant data in the most easily interpretable, efficient and cost-effective manner. Further, since future land use decisions will be made at the Town and Village level, the data must be easily accessible and in a useful format for local officials. A management information system (MIS) is needed to expand agency data handling capabilities, integrate agency data bases into a coordinated system of data sharing, organization and dissemination, respond efficiently to requests for groundwater information and data, and facilitate data and technology transfer to interested federal, state and local agencies.

Major groundwater data bases include those of the U. S. Geological Survey, U.S.EPA, N.Y. State Conservation, Health and Transportation Departments, County Health and Public Works Departments, County and private water purveyors, and the L.I. Regional Planning Board. The key to future MIS development is the designation of agencies to carry out the functions of data librarian, conduit and coordinator in order to promote data computerization, sharing and use, to organize and maintain a catalog of existing data bases (paper files as well as computerized), and to disseminate information and educate potential users. In addition, the report proposes the establishment of a management committee, composed of agency personnel associated with data collection, laboratory, data management and planning activities, in order to provide a forum for communication, coordination and periodic review and evaluation of the system. Moreover, such a committee would act as a guide and interpreter for the data, preventing misuse and misinterpretation by non-scientists or others not familiar with the data. The committee would work with a number of technical groundwater consultants, including the U. S. Geological Survey and Brookhaven National Laboratory.

Data base management systems were analyzed in terms of their ability to provide for the ready availability, accuracy, and local control of the data and for their capacity to fulfill a number of operational specifications, including desired outputs and analytical, graphics, printing and report writing capabilities. It is suggested that the procedures of the Intel System 2000 data base management system, in operation at the State University of New York at Stony Brook, serve as the 'model' for the design of future data collection efforts and the basis for future MIS development. Reasons include the system's flexibility, its ability to provide local control over data input and operations, and because it currently serves as the groundwater data management system for the two County Health departments, Suffolk County Water Authority and New York State Department of Environmental Conservation Region I office.

Candidates for membership on the management committee include the U.S. Geological Survey (USGS), N.Y.S. Dept. of Environmental Conservation (NYSDEC), L.I. Regional Planning Board (LIRPB), Suffolk County Dept. of Health Services (SCDHS), Suffolk County Dept. of Public Works (SCDPW), Suffolk County Water Authority (SCWA), Nassau County Dept. of Health (NCDH), Nassau County Dept. of Public Works (NCDPW), New York City Departments of Health and Environmental Protection, Long Island Water Conference (LIWC) and Long Island Association of Certified Laboratories.

Candidates for the administrative agency and data librarian were analyzed in terms of their groundwater-related experience, knowledge and familiarity, their ability to adopt a regional perspective, and their coordinating, communications and promotional skills. Because of its extensive experience in coordinating activities and providing technical assistance to towns, localities, and private citizens, it is suggested that LIRPB fulfill the administrative and information dissemination functions required. Similarly, because of its commitment to regional groundwater management, evidenced by its sponsorship of an island wide groundwater management plan, and its development and ongoing maintenance of a computerized index of Long Island groundwater data management systems, it is suggested that NYSDEC, Region I undertake the duties of the data librarian.

I. Introduction

A. Long Island Groundwater Management

The presence of numerous and serious groundwater quality and quantity problems has been well documented in various studies that have been carried out in both Nassau and Suffolk Counties, including the Long Island Comprehensive Waste Treatment Management Plan, the Nassau and Suffolk County public water supply studies and the N.Y. State Groundwater Management study. Likewise, regulatory programs that address many of these problems have been developed by various agencies. Some programs are new, others have been in place for many years. According to NYSDEC's groundwater management study, at least 25 major regulatory programs are now administered by Federal, State, regional and local agencies.

It is apparent that groundwater protection and management has engendered substantial institutional involvement. In addition, there is an informal network of communication and cooperation among the professional personnel in the various management agencies.

Perhaps the most important aspect of this network has been the development, through the 208 program, of a "family" of water-related professionals. Participation in the many 208 work projects and committees has led to productive working relationships among a key group of water-related professionals. Some projects undertaken by individual agencies are subject to both formal and informal review by group members and are thus subsequently integrated into the substantial body of work that has already been undertaken on the Island. Much water-related knowledge is available and is gradually being expanded with a minimum of duplication.

The informal arrangment described above has worked well in the past; however, three major factors indicate the need for change. First, the amount of data now being collected has become unmanageable by non-computerized means (see Appendix, p. A3). As a result, its use in critical development and aquifer management decisions has diminished. This means that decisions crucial to the future of Long Island and its people are being made on a more-or-less piecemeal basis and without access to all the available information.

Second, as knowledgeable people in the system retire or move out of the region, much of their knowledge is lost. Their data is extant, but without their interpretation and "feel" for the quality and reliability of the data, its usefulness becomes limited and the potential for misuse and misinterpretation is increased. By participating in the development of a data management system, these knowledgeable officials can program much of their knowledge into the components of the system. For example, data selection criteria can be developed that detail how specific data should be collected and/or reported, used and interpreted. In addition, information can be added that provides details on the reliability of the data, and limitations on its use. A note of caution is in order, however. If, as a result of data computerization, direct access to the data is provided to all interested parties without proper guidance, the potential for misuse and misinterpretation, especially by non-scientists, is increased.

Third, virtually all of the groundwater-related studies that have been undertaken by federal, state and local agencies have pointed to the need to consider the regional nature of the groundwater resource when evaluating localized inputs and withdrawals and attempting to develop any kind of management framework. To understand regional water conditions, large quantities of data must be subjected to objective statistical analysis. The exclusive use of local water data may introduce biases into the resultant analysis. The formation of a broader data base through computerization of agency data permits a more objective interpretation of the data and provides a regional perspective. Furthermore, computerization, with associated graphics and statistical analysis software, can reduce the time and manpower otherwise required for mapping, plotting, compiling statistics, etc.

B. Long Island Groundwater Data Base Management

Given the network of relationships among Long Island water-related agencies, it might be expected that the same cooperation would exit in terms of data development and sharing. This is not the case. Data development has taken place on an agency-by-agency basis. Moreover, with the exception of USGS, each agency's data base was for the most part developed to meet regulatory needs. The distinctive missions and needs of the data collecting agencies and the absence of coordination among them has led to the present situation, with each data collecting agency managing its own data base. These data bases are often characterized by inconsistencies and overlaps with other agencies' data. Adding to the confusion is the fact that some agencies may utilize different field sampling protocols and different types of field sampling equipment, involving differing calibration techniques. Thus, data from the various agencies may not be comparable even if the data definition schemes are similar.

From a management standpoint, the existing network of groundwater data bases presents the following problems:

1) Information is incomplete from a management perspective because in the past agencies collected data only as necessary to fulfill the narrowest definitions of agencies' regulatory requirements (one notable

exception being USGS, whose mandate is to provide information to the public about the nation's water resources). For example, existing water supply and water quality data include only withdrawal and pollutant concentration information. Well construction and laboratory methodology information, which might permit a better evaluation of the data's accuracy and answer important resource management questions, are not included.

2) The fact that some agencies utilize different sampling techniques, equipment and methods of interpreting their data means that data is not necessarily comparable among agencies and may be subject to altogether different interpretations.

C. Existing Data Base Organization

(Note: Much of the information used in this section was obtained from a computerized catalog of Long Island groundwater-related data and agency computer hardware maintained by NYSDEC. The file, called MISCAT (Management Information System Catalog) was established by NYSDEC as part of its Long Island Groundwater Management Study.)

Among the existing groundwater data bases on Long Island, the County Health Departments, U. S. Geological Survey and Suffolk County Water Authority data holdings are the most extensive. The NYSDEC, Region I and U.S. EPA, Region II offices store and utilize substantial amounts of Long Island data as well, and NYSDEC has obtained a terminal and an account at Stony Brook computing center, which enables it to directly access and use the full range of software available at the University. The EPA STORET System is based in Alexandria, Va., but the Region II office in New York City has direct access to the system. The U.S.G.S. is developing a decentralized in-house computer network (See Appendix A). Long Island data will reside at the Syosset sub-district office on a powerful minicomputer designed for local use, and will be fed into the national data base housed in Reston, Va. The system has the potential to support non-USGS users, but there has been no decision on this possibility as yet.

A brief description of existing data bases, both computerized and in paper files, is as follows:

1) NYSDEC HQ (Albany). Data are collected on a statewide basis for the following categories: Industrial chemicals (Industrial Chemical Survey data), solid wastes (Division of Solid Waste Data Management files, Waste Transporter Data Retrieval System), spill data, well data, SPDES data and pesticides data.

2) NYSDEC, Region I. There are two major computerized data bases at Region I: a) water supply well permit information, including withdrawal information for public and community supply wells. At present, there are approximately 900 wells with reporting requirements. (b) a sortable mailing list containing the addresses of 1100 concerned citizens and citizens' groups and approximately 450 agencies. The Region I well permit data base with 10,000 Nassau and over 80,000 Suffolk permits, together with current pumpage data, is in the process of being loaded into a public file at Stony Brook's computing center.

Major non-computerized data include incident, spill and response data (historical data on 400 completed spill investigations, data from more than 50 ongoing spill recovery operations, and EPA priority pollutant analyses), SPDES discharge monitoring reports, and pesticides data (including more than 5,000 applicator certifications, both private and commercial, 1900 business registrations and 25,000 commercial permits for stores of restricted chemicals and product registrations).

NYSDEC, Region I has established a computerized index of significant Long Island data management systems at Stony Brook's computer center. The index describes, in summary fashion, significant features about the systems described in this section as well as others. Plans are underway to develop sortable catalogs of groundwater data and related literature (see section II.A.1 for futher information).

3) U.S.EPA, Region II. Region II has obtained an account within STORET, EPA's national, comprehensive inventory of surface and groundwater data, both to acess and contribute data to the existing system.

Groundwater data in STORET come from U.S.G.S. sampling, and most of the data are from Nassau and Suffolk Counties. Additional data to be (or in the process of being) added to STORET include contractor sampling undertaken in conjunction with the Superfund program, hazardous site groundwater monitoring, U.S.G.S. field offices' sampling efforts, and Region II's surveillance team sampling efforts (most located at landfills with known groundwater problems). Additional EPA data that cannot presently be accessed through STORET include that generated in compliance with the Hazardous Waste Management Manifest system and the Federal Reporting Data System. A special feature of STORET is the Environmental Mapping System, which is a program that yields a color-coded mapping of pollution sources, water supplies and monitoring stations by latitude/longitude.

4) U. S. Geological Survey. The National Water Data Storage and Retrieval System (WATSTORE) was established in November 1971 to modernize the Geological Survey's existing water data processing procedures and techniques and to provide for more effective and efficient management of its information dissemination activities. The system is essentially a large-scale computerized storage and retrieval system used by USGS to store and disseminate water data acquired through its many activities. Data are collected from stream-gaging stations, lakes and reservoirs,

surface water quality stations, water temperature stations, sediment stations, water-level observation wells and groundwater quality wells. Each year many water data collection sites are added and others are discontinued, thus large amounts of diversified data, both current and historical, are amassed. Groundwater data include chemical, physical, biological and radiological characteristics of groundwaters, and physical, hydrologic and geologic data on USGS' many test sites, which include wells, test holes, springs, tunnels, drains, ponds, excavations and outcroppings.

The Survey's Long Island data base, which is available on minicomputer at Syosset, is much more important than the national WATSTORE system in Reston from a local usage standpoint. National water quality data is stored in Reston and is retrieved as needed, while the Syosset office maintains a subset of L.I. data for its use as well as in-house files for water levels. Computations and sophisticated statistical analyses are performed in-house on the minicomputer. The system is essentially a combination of centralized/decentralized computing. The Syosset office is in the process of acquiring a new minicomputer and complete DBMS software package which will add multi-user capability and increase the power of its Long Island data base system. Cooperator data on the system include SCDHS, SCWA and NCDH water quality data, including organic and inorganic constituent data.

5) N.Y.S. Dept. of Health (NYSDOH). NYSDOH's SAFWATER system is an elaborate data base management system that is used to keep accurate and up-to-date information on public water supplies in the state. It includes files on the following: watershed rules and regulations, water supply service areas, enforcement actions, water quality, operator certifica-

tions, drainage basins, USGS information, annual inspection data, and annual reporting data.

6) N.Y.S. Dept. of Transportation (NYSDOT). Paper files include information on petroleum spill recovery sites and incident spill reports. Data applications include recovery operation and spill occurrence trend analysis, contaminant transfer modeling and prediction, and general ambient and discharge water quality monitoring.

7) N.Y.S Environmental Facilities Corporation (NYSEFC). NYSEFC is assembling a library of information on solid and industrial waste, waste recovery and recycling. Information is obtained from the New York State Library System. The following data bases will be searched on a regular basis: Chemical Abstracts Condensates, Compendex (index of international engineering journal articles, conference proceedings, books and reports since 1970), the Congressional Information Service, the U.S. Dept. of Energy data base, Enviroline (index of materials concerning toxic substances and areas of pollution since 1970), the GPO Monthly Catalog, Pollution Abstracts, NTIS, and various other legal, business, magazine and newspaper indices.

8) Nassau County Department of Health (NCDH). Paper data files include pumping and well construction data from NYSDEC permits, water level data from NCDPW, and distribution, water quality and treatment data. Computerized files include inorganic sample data from water supply and monitoring wells, and organics and U.S. EPA priority pollutants data from selected wells. The inorganic files are already on System 2000 at Stony Brook. The organic files are being put on the system.

9) Nassau County Dept. of Public Works (NCDPW). Paper data files include water level records from an observation well grid system, water supply source information, and rainfall data. USGS and NCDH duplicate these data for their own uses.

10) Suffolk County Dept. of Health Services (SCDHS). SCDHS has implemented a user-oriented, general purpose DBMS called System 2000 at the State University of New York at Stony Brook which stores and categorizes chemical analyses of water samples collected from public and private supply wells and the County's monitoring well network. The system is designed to provide the capability to perform sophisticated statistical analyses of the above-mentioned data in order to identify groundwater problems and causes.

11) Suffolk County Water Authority (SCWA). Paper files include historical public water supply well information. This information, from 1976 to the present, has been entered into the Stony Brook System 2000 DBMS.

12) Long Island Reginal Planning Board (LIRPB). The LIRPB, in cooperation with the U.S. Census Bureau, has been preparing a computerized geographic base file, with accompanying maps, of the locations of streets and addresses within Nassau and Suffolk Counties. The system provides a means of pinpointing any kind of location on Long Island, and can add detailed geographical identification information to any kind of data. Once this is done, the data can be aggregated by geographical division. Additional paper data include land use information, population and socio-economic data, and maps of environmentally sensitive areas.

13) The National Water Data Exchange (NAWDEX). The National Water Data Exchange has been established as a nationwide program directed at improving access to water and water-related data and disseminating information about the availability of these data throughout the entire wa-

ter-resources community. NAWDEX is composed of a confederation of water-oriented organizations working together to facilitate the exchange of data and to improve the technology of data handling and transfer. Their program of operation is directed at providing guidelines to assure that all member organizations participate equally and that a climate of cooperation and open communication be established.

II. Data Management Needs

NYSDEC's State groundwater management study has noted that a number of recent workshops and conferences have stressed the need for a groundwater information system, including the New York State Conference on Groundwater in May 1980, the New York State Workshop on Groundwater Management Information in November 1980, the Conference on Groundwater Use Management in the Northeastern States in June 1981, the workshops on key program areas held in December 1981 under the Long Island Groundwater Project, and a March 1982 Long Island Groundwater Management Information Seminar, co- sponsored by LIRPB and NYSDEC, Region I. It was pointed out at the latter that the Long Island groundwater contamination situation is so complex that a sophisticated information system providing analytical, communicative and graphical capability is needed to facilitate an accurate understanding of the groundwater resource and the impact of human activity on it. It was also pointed out that such a system should be accessible to all concerned agencies and should include a mechanism for providing groundwater information to elected officials and the general public. The following groups of people need an information system:

- Planners - to improve the quality of their short and long term planning with respect to groundwater.

- Elected Officials and Operating Agency Managers - to improve budgetary and manpower allocation decisions and to decide on critical funding requests.
- Agency Staff - to increase the effectiveness of existing programs that rely on, or utilize, groundwater information.
- The General Public - to increase knowledge and awareness of the groundwater resource and the impact of human activities upon it.

A. Data Needs

A major conclusion reached at the March, 1982 seminar was that available groundwater data are not used as much as they should be in the decision-making process; and, in general, are not used to their fullest extent, primarily because decisionmakers are unaware of their existence. A number of data needs identified at the seminar constitute the principal reasons for the pursuit of a groundwater management information system. They include the following:

1. More knowledge of the type of data that exist. Agencies have tended to rely on their own information, since until recently there was no formal inventory of groundwater-related programs for Long Island. In many cases one agency is not familiar with another agency's data. This leads to some data duplication. If data collection efforts were coordinated and used in an integrated fashion, data collection costs could be minimized on an island-wide basis and the scope of data collection might be expanded, obtaining more information at a lower cost. NYSDEC, Region I, as part of its State Groundwater Management Program, has begun to address this problem. It has established a public file at the State University of New York at Stony Brook computer center called MISCAT (Management Information System CATalog). The file is a current catalog of relevant Long Island groundwater data bases, both computerized and non-computerized. Agencies

maintaining data bases will be expected to update their own data descriptions if they wish to utilize the system for their own needs, and NYSDEC will update significant data bases that are not presently computerized.

MISCAT information for each agency is organized into the following components: paper data handling, computerized data handling, data applications, agency management information needs, computer resources (including time-sharing vendor remote hardware, costs and software), independent computing capability, management information personnel, and miscellaneous documentation.

NYSDEC plans to establish two additional public files, called LITCAT and DATCAT, which will become sortable lists of groundwater-related literature and data sources, respectively, and will include documentation of their applications to groundwater data management.

At present, the various agencies are just starting to use MISCAT. The level of information currently contained in each agency's file is summary and will eventually have to be expanded to include additional detail on agency geographical and chronological data coverage as well as specificity on sample types, sampling and analysis protocols, and other areas mentioned in this section.

2. <u>More knowledge involving the way groundwater data is collected, reported and analyzed</u>. Sample collection, handling and analysis protocols are not routinely listed in most existing data bases. Since failure to property adhere to protocols can affect the validity of the data, a quality control check on whether proper procedures have been followed becomes an important part of the data base.

In addition, more knowledge is needed on the sample handling and analysis protocols used by the laboratories. Most laboratories used to analyze Long Island groundwater data participate in the New York State Health Department's laboratory certification program which consists of a 2-step procedure that 1) utilizes on-site inspections to insure that laboratories are using approved procedures, and 2) statistically analyzes participating laboratory performance on proficiency tests to insure the accuracy, validity and consistency of their water quality analyses.

The State Certification Program, however, is principally concerned with drinking water testing and may not require some of the additional groundwater-related sampling requirements used by USGS in its laboratory certification program. For example, there have been analyses that have passed the state program that have failed to pass USGS Standard Reference Water Sample (SRWS) screening program. What is needed is to make available to all data users information on all certification programs used by the data generator's laboratory, and to identify the differences in focus and requirements of each. Ideally, a standard laboratory quality assurance program should be developed for all groundwater sample analyses by any agency.

USGS is currently investigating agency sampling procedures and protocols and, in conjunction with NCDH, is planning a seminar to address standardization of sampling and analysis protocols.

3. More knowledge about existing data bases. As pointed out earlier in the text, many of the existing data bases developed as a means of coping with data overloads. Such data bases tend to become data 'graveyards' or 'sinks', with much data going into the system but very little data usage coming out of the system. USGS' WATSTORE is the most notable exception. A characterization of the status of Long Island

groundwater data usage is needed. This should include but should not necessarily be limited to the following:

a. A clear undertanding of the extent to which the data collected by the various agencies is actually used in making groundwater management-related decisions. More knowledge is needed on what and how much data is being used, and how it is being used.

b. Up-to-date documentation regarding those agencies that have developed and utilized groundwater data bases, those that control their input and retrieval functions, and the purposes and objectives of those data bases. NYSDEC's MISCAT is the first step toward this goal. At present, use of the larger data bases like STORET and WATSTORE is limited because few people know exactly what data they contain or how to obtain access. An important point, and one that may be the biggest obstacle to the development of a regional data base, is that agencies are reluctant to expend money or manpower to keep track of other agencies' data or related activities. Familiarity with other agency data bases demands considerable research and requires knowledge of the extent of compatibility between data bases and the accessibility of those date bases, including who has access, who is allowed to have access and how to obtain access.

c. An evaluation of existing data with respect to its potential integration into a computerized DBMS. A characterization of the status of existing data must be made in terms of how much is worth integrating, how much is ready to be integrated in a DBMS now, how much needs to be changed (and the nature of those changes), and how much will not be amenable to computerization.

4. Education for Managers and Users. Education is needed for cur-

rent users and data base managers as well as potential data users. Publicity and educational outreach become important functions of any managing agency. Increased publicity increases the number of potential users of the system by making them aware of what is there and how they may obtain use of the system. Education of agency data management personnel is a vital coordinative function that can increase the use of the system and help to expand its scope. The system itself will be evolutionary and educational in nature, growing in usefulness, sophistication and coverage as new agencies add knowledge and data over time.

Current users and managers must be made aware of all of the data available for use and how to use them, how to interface with other agencies' data and systems, and, most important, how to correctly interpret the data they are using. Potential users must be taught how to access, interpret and use the data, and must be kept up-to-date on available information and data base developments. Such information will increase the "user-friendliness" of existing data bases.

5. Standardization and Quality Control of Monitoring Procedures. An important aspect of the needed educational effort relates to the agencies' data collection personnel and field sampling crews. At present, some agencies use differing sampling equipment and procedures, and collect different types of information. An effort is needed to standardize sampling and analysis protocols and even equipment selection so that in the future data collected by different agencies will be compatible with each other. Uniform training of field and laboratory personnel is essential so that everyone will be collecting, analyzing and interpreting data in the same way. USGS, in conjunction with the Nassau County Department of Health laboratory, has initiated efforts directed toward these goals.

6. There is also a need to review the history of groundwater data collection on Long Island, with emphasis on the classification of historical data with respect to its completeness, credibility and the identification of any sources of bias; and to evaluate the varying monitoring methodologies that have developed over time. The usefulness of historical groundwater data is limited, because many of the earlier monitoring programs were designed to fulfill specific regulatory needs and failed to collect additional information that is important from a groundwater management standpoint (e.g., information on well construction and depth, sampling protocols, type of laboratory analysis used, etc.). In addition, early measurement techniques were often crude and imprecise compared with the much more sophisticated laboratory technologies in use today. In many cases, the limited data that is available does not provide sufficient information about circumstances surrounding the sampling events to permit a critical assessment of the data's credibility. In such cases, the data need to be classified and restricted to very general usage. An index of groundwater data should contain indications of the level of reliability to be placed on specific sets of data.

7. There is a need for some type of data quality assurance procedure that will indicate how credible the data are, how the data should be interpreted and, conversely (and possibly of more importance), how the data should not be interpreted. The agencies that control data input are critical to quality assurance. Thus, there is a need for those agencies to meet and agree on a quality assurance procedure. USGS is the only agency that incorporates standardized quality assurance into its data handling procedures, and should be a key participant in the development of quality

assurance procedures.

8. There is a need on the part of data generating and utilizing agencies for quick and easy access to each others' data. An important point that bears repeating is that agencies are reluctant to expend money and manpower tracking the status of other agencies' data management efforts. Free access to and use of a pool of agency data could result in substantial savings in time, effort and money for all agencies concerned, as well as less duplication of effort. In addition, using data collected for very specific purposes (e.g., water quality data, population and land use information, industrial activity and waste disposal information) in conjunction with each other might yield much more information about the island's aquifer system and the impacts of man's activities on that system than using the data sets independently. Such information could have significant implications for future development decisions on Long Island, particularly in the critical recharge area in Eastern Suffolk known as the Pine Barrens.

B. Management Needs

1. Management Information System. The above discussion leads to the heart of the groundwater data management issue: the urgent need for a management information system that will make the diverse forms of groundwater data existing in the many involved agencies readily available to decision-makers (see Appendix, p. A2).

A review of agencies' monitoring methodologies and history is an important first step in the development of such a system. Beyond this task, some experts feel that the entire development of groundwater monitoring on Long Island should be carefully and critically evaluated. This will insure proper usage of historical data and the reevaluation and refinement of present methodologies to reflect current needs and developments.

An important aspect of a management information system that has not been adequately addressed elsewhere is the potential use of the system by Town agencies. Since future land use decisions are made at the Town or Village level, the data should be readily accessible and in a format that is useful to the Towns. Potential uses of centralized groundwater data at the Town level include the environmental assessment process, comprehensive planning, zoning and site plan review. Coordination with the Towns and Villages is essential because many of the polluting activities that must be controlled are amenable to control at the local level.

2. Management Committee. There is a need for personnel directly involved with all aspects of data management to meet, talk about their respective problems and explore ways in which they can make each other's tasks easier and ways in which they can add to each other's knowledge. The technical personnel directly involved in the collection of all types of basic groundwater data, including well construction data, water-level measurements, groundwater pumpage and sample collection and reporting can best provide realistic input concerning data collection problems and can suggest procedures for their elimination. A standing committee composed of data management and computer personnel, data collection personnel as described above, planners, managers and other groundwater data users from all of the agencies involved with groundwater data collection would represent a continuing forum where agencies could exchange ideas and information, learn more about each other's procedures and problems, and develop and agree on procedures that would minimize duplication in agency data collection efforts, coordinate agency sampling programs and begin to standardize protocols. Such a groundwater data management committee could

advise potential users and thus help prevent misinterpretation and misuse of groundwater data by less well informed persons.

Important functions that could perhaps be best performed by such a committee include the following:

a. Identification of data overlaps, shortfalls and inconsistencies. The committee might be aided by a technical consultant in performing evaluations of Long Island groundwater data and monitoring history.

b. Evaluation and, to the extent feasible, standardization of data gathering and analysis methods in an effort to improve and help coordinate and standardize future data collection activities. Brookhaven National Laboratory is currently involved in an attempt to develop statistical screening and evaluation procedures for groundwater data and a standardized, comprehensive groundwater-related data schema--work that might be extremely useful to a management committee.

c. Decisions on technical questions, data interpretation, formatting and, in general, any policies related to the maintenance, use and proliferation of the data.

d. Periodic evaluation and review of the data management system in light of emerging developments in computer technology that could be incorporated in order to upgrade the system. Advances in minicomputer and computer graphics technology are occuring so rapidly that continual monitoring is needed to take advantage of emerging technological opportunities and thus keep the system 'current'.

3. Regional Operations Agency (ROA)/Data Librarian. A full-time

staff working in conjunction with the Management Committee is needed to facilitate the implementation of committee decisions; gather needed information and background information for input to committee delibrations; maintain an up-to-date index of groundwater data and ongoing data base activity; and actively disseminate groundwater information to Town, Village and other local officials, legislators, private consultants involved in groundwater-related work, and citizen groups. In essence, the ROA would act as an information center for Long Island groundwater data and a data librarian to guide outside interests and even agencies within the system as to the location of data and its nature, scope and potential uses. Actual control of the data would reside with the agency that collects and manages it. A potential user wishing to access the data would have to arrange with the originating agency in order to actually obtain the data.

Specific functions that would be addressed by such an agency include:

a. Organization and maintenance of a catalog of existing data, including an index to provide an ongoing identification of data base activity, the current definition of each independent data base, the chronological and spatial boundaries of the data and up-to-date descriptions of agencies' software, graphics and output capabilities.

b. Provision of a mechanism for the exchange and sharing of software capabilities and data through reports or via direct transfer programming, as well as the handling of administrative details.

c. Dissemination of information to potential users, existing users and data base managers. This would involve seeking out decision-makers, actively promoting the use of the data, and acting as a liaison between the involved government agencies and the public.

d. A broad educational outreach effort, to include:

(1) Data collection and field personnel training programs, focusing on improvements in existing field and laboratory procedures.

(2) Data base manager information and training programs covering computer software capabilities in the region, other stores of data, possibilities for interfacing with other agencies' data and systems, transfer of knowledge, and improved methods of data storage, manipulation and analysis.

(3) The familiarization of legislators, elected officials, researchers and agency personnel with the types and amounts of groundwater-related information available, and how to use it.

e. Ongoing monitoring of advances in computer technology with respect to potential improvements to Long Island's data management system. The ROA would provide information to the Management Committee for its periodic system review and evaluation function. This task would include developing contacts with technical computer organizations such as URISA (The Urban & Regional Information Systems Association), reviewing journals and published papers, and attending seminars and workshops.

4. Technical Consultants. The scope of the tasks described in this report are of sufficient magnitude and complexity as to exceed the available manpower and technical capabilities of most local agencies. Thus, there is a considerable need for the retention of technical consulting assistance.

The USGS subdistrict office in Syosset cooperates with many local agencies and private consulting firms and is probably more knowlegeable about the Island's aquifer system than any other single agency or consultant. In addition, the Island has a highly regarded national research center in Brookhaven National Laboratory, which has been funded to develop a methodology for the statistical refinement, coordination and use of Long Island groundwater data from many diverse sources. This effort should be tied in with current and ongoing agency data management efforts. The Island also has a county water authority that maintains substantial laboratory analysis capabilities. The authority's former chief chemist now a private consultant, is considered one of the Island's most valuable and frequently consulted source of water quality and other groundwater information. Finally, Long Island and the nearby Metropolitan Area is the home of several nationally recognized hydrogeological consultants. Tasks which would be undertaken by technical consultants include the following:

a. Review and analyze past groundwater monitoring practices on Long Island.

b. Develop the statistical and data/modeling manipulation procedures necessary to provide management information.

c. Examine existing data and statistical/interpretative methodologies in order to integrate diverse data where appropriate and to insure data compatibility. This would include the elimination of redundancy in data collection, handling and analysis. In this way, existing data would be expected to yield the maximum possible information.

d. Provide additional technical support to the management committee as needed, including information on advances in computer technology for the committee's periodic review and evaluation of the data management system.

III. Data Management Alternatives

A. Evaluation Criteria

The management alternatives considered were judged on the basis of their ability to satisfy the needs and shortfalls identified in Part II. Evaluation criteria were developed with respect to the following areas: Data Availability, Data Accuracy, Data Placement, System Performance and Output Capabilities. The following paragraphs explain each in more detail

SC-1: Data Availability.

Data on the system should be comparable with each other, and should be directly available to all parties in the system. Multi-user capability is required to avoid data 'bottlenecks.' System hardware should be locally accessible to speed up analysis and outputs. There should be a way to coordinate data and information requests to provide up-to-date information on the extent and status of data within the system as well as information on member agencies and to monitor data base activity outside of the system for items that might affect or relate to Long Island groundwater information.

SC-2: Data Accuracy.

Some method of quality assurance with respect to data added to the system is required. In addition, there should be a way to evaluate historical data within the system in terms of its accuracy and to characterize it in terms of its compatibility with other data. Reliable data collection, coding, input, analytical and laboratory procedures are required. Automated data editing and screening procedures are desirable.

SC-3: Data Placement.

Data should be under the control of the individual agency that generates them, but should be tied together in a management system that will facilitate public access to the data as well as manipulate and organize the data so they can be looked at collectively. This does not necessarily mean that the data need reside at the same location, but does require the data to be linked to each other by some kind of communication and transmission network to form an integrated body of data. Input of data should be restricted to system users who are familiar with data formats and organization.

SC-4: <u>System Performance and Output Capabilities.</u>

1. The system should be flexible enough to be modified and upgraded as time goes by and as better equipment becomes available to improve its efficiency and increase its cost-effectiveness.

2. An easy-to-understand, user-oriented retrieval language structure combined with user training is highly desirable, in order to foster widespread use of the system. At the same time, technical and analytical sophistication should not be sacrificed for general utility.

3. Data used in the system should be transferable among agencies and should be available for use, after appropriate conversion programming, by different agency software programs.

4. It should be possible to summarize information in a brief but comprehensive manner in order to give potential users a clear picture of what data exist. The system should thus contain substantial graphics, printing and report-writing capabilities, so that outputs are clear, easy to understand and immediately usable.

5. The system's geographic coverage and spatial analysis capabilities should permit both micro- and macro-scale analyses; for example, a coordinate grid system within which it is possible to examine

point locations, specific grid cells, groupings of grid cells within the system or the entire grid system. The system should be able to segregate data by municipal and other political boundaries. The system should be based on a common geographical identifier, i.e., latitude-longitude, which is the basis of USGS water data and is probably the most common identifier used for water-related data.

6. Desirable outputs include tabular and graphic data summaries and plots. Additional graphic outputs that can clearly identify trends and small changes in values over time and various geographic areas are desireable (e.g., 3-dimensional plots, bar charts, scatter diagrams, etc.). In addition, the system should be able to output selected data in various formats so that they can be used directly as input to various groundwater models in use (e.g., Paige & Pinder, Prickett-Lohnquist).

B. System Alternatives

1. System Structure.

An organized data base management system can take many shapes, ranging from a totally centralized structure to a totally decentralized arrangement (see Appendix, P. A1). In reviewing altenatives for Long Island, it is advisable to consider the existing structure that has developed over the last 25 years. The fact that many different agencies collect groundwater data and each manage it in their own way suggests that, realistically, the centralized alternative is not feasible. At the same time, there is a certain amount of consolidation and sharing that has taken place, such as the combination of local agency and U.S.G.S. data in USGS' WATSTORE system, which, in turn, suggests that the total decentralization alternative is neither necessary nor appropriate.

The major holdings are USGS' WATSTORE system, EPA's STORET system and

SCDHS' Water Quality DBMS, on Intel's System 2000 at Stony Brook. In setting up an organized data management scheme, one of these three systems would logically have to serve as the foundation for future data base development and the development of a unified data collection procedure to be used on an Island-wide basis. The structure for future data base development on the Island is thus envisioned as a linked and tightly coordinated network of interconnected data bases, with the design of future data collection and analysis efforts by the collecting agencies based on compatibility with the procedures of one of the major data stores described above.

The advantages of networking in this fashion are many, including the following:

(a) The data can be used almost immediately, since individual agency data procedures, forms and formats will not undergo the kind of wholesale reworking and transformation needed to convert to the standardized format required by a centralized system. The individual custom designs and formats of the agencies' existing data bases will essentially be retained, so agencies will not have to adopt totally new formats and methods for processing data. Instead, and only where possible, formats would probably be modified so that each agency's data would be compatible with that of the others and, hence, could be used conjunctively. This is probably the strongest argument in favor of System 2000 (Stony Brook), since three of the major groundwater data collecting agencies are using the system as their DBMS (SCDHS, NCDH and SCWA) and two more are tying in or are tied-in to the system as users (NYSDEC and LIRPB). In addition, USGS uses a version of System 2000 to manage a portion of its groundwater DBMS at the central WATSTORE office in Reston, Va.

(b) An integrated network of agency data bases takes advantage of the independent data base development that has taken place on an agency-by-agency basis. At this point in time, local and regional agencies are realizing the need for computerized data management and are really at the beginning of this type of development. At the same time, agencies like EPA and USGS, who already have well-developed stores of data, are taking advantage of the recent revolution in computer graphics and mini-computer technology to reorganize their holdings and procedures. Finally, NYSDEC is entering the computer age with the purchase of equipment and accounts with System 2000 at Stony Brook and at EPA's National Computing Center, where the STORET System is housed. A network of these independent systems would effectively utilize all of the effort that has gone into their development.

It is important to guide the development of these individual systems into a coordinated and cooperative framework to manage the information before the independent development of systems proceeds too far and the opportunity for early and timely coordination is lost. With many agencies in the initial stages of data computerization and others planning to follow suit, an immediate push for the development of a comprehensive management information system is essential.

(c) Networking is the most flexible, least costly and operationally the most efficient option. Individual variations in customized data base design are allowed, and the major costs are those of coordination. There are fewer capital expenditures needed for hardware, and a network of small DBMS' benefits from its portability, which allows for easier transfer of files and programs between systems. What is needed is a way of locating and gaining access to the many stores of data within the system and a guide to explain how the various pieces of data relate to each other.

2. System Analysis

The following systems were analyzed in terms of the criteria set up in Section A: USGS' WATSTORE, EPA's STORET, System 2000 (Stony Brook) and BNL's CDC System. In addition, each was analyzed on the basis of its ability to satisfy the needs and shortfalls identified in Part IV. The following paragraphs summarize the analysis.

(a) USGS' WATSTORE

SC-1: Data Availability.

Data in WATSTORE are compatible with each other and available to all users of the system. They are tied together by a common header file.

WATSTORE's Station Header file is an index of all sites for which water data are stored. It contains information pertinent to the identification, location and physical description of over 100,000 sites, including wells, test holes, springs, tunnels, drains, ponds, and excavations and outcroppings. USGS data has been widely used, so its schema and data formats are widely accepted. Its monitoring station network is extensive and located near problem areas. Hardware is locally accessible at the Syosset office. The acquisition of a new minicomputer is expected to enable the Syosset office to support more than 60 users. The office serves as an information/coordination center.

SC-2: Data Accuracy.

Because USGS collects data not to fulfill regulatory requirements but rather to increase its knowledge of United States waters and water-bearing strata, it is considered to be one of the most valuable sources of groundwater data. Its data coding and entry procedures have been carefully developed over a long period of time and are considered reliable. All data input to the system are automatically checked for water quality standard violations and against logical chemical and hydrogeologic principles. Printed messages alert the user to data that do not meet the criteria of the edit procedure. It is up to the user to make any necessary corrections. The Syosset office has developed an in-house routine that compares new data with historical data taken at the same site. Data from other agencies are input into the system, but only if those agencies participate in the USGS quality assurance program. WATSTORE is now being modified to include much more parameter and analysis level information, such as quality assurance codes, laboratories and laboratory analysis methodologies used, precision of measurements, more detailed sample type descriptions, etc.

SC-3: Data Placement.

All data input to WATSTORE is controlled by USGS. Water quality data is input directly by the central laboratory and stored in the central WATSTORE facility in Reston, Virginia. The Syosset office inputs cooperating agencies' data and can retrieve any or all data as needed. All cooperator data must undergo strict USGS quality assurance procedures before being entered to the data base. Although the data base is managed in Reston, the Syosset office maintains a subset of Long Island data for its use. There are provisions for outside agencies to become WATSTORE users, which allows them direct access to the system, though USGS work needs take priority over outside user needs. Though the new mini-computers being purchased by the Syosset office will be capable of supporting more than 60 users, the amount of hardware currently available will severely limit this number. At present, there are only two outside ports available, and USGS has no plans to expand this capability.

SCDHS, SCWA and NCDH regularly transmit water quality data to USGS for input to WATSTORE. USGS has written a translation program to convert the data into WATSTORE-acceptable format, and is working, in conjunction with SCDHS, on a translation program from WATSTORE to System 2000.

SC-4: System Performance and Output Capabilities.

In addition to its data processing, storage and retrieval capabilities, WATSTORE can provide a variety of data products, ranging from the simple retrieval of data in tabular form to statistical analyses of data. Output is produced in printed or graphic format, and includes computer printed tables and graphs (e.g., stiff diagrams), statistical analyses, digital plots (including hydrographs, plots of concentration vs. time, contour and three-dimensional plots), and data in machine-readable form. Computations except for some tables and statistics, are performed at the Syosset office on the sub-district's minicomputer. The data reside on tape. Both national and regional water data summaries are published on an annual basis by USGS and are used extensively by the Survey, other agencies and the public.

The system is interfaced with the Statistical Analysis System (SAS), a powerful statistics software package. In addition, the Survey's groundwater data is managed in part by a version of System 2000.

Each year the Survey offers a one week WATSTORE training course for cooperating agencies in Denver, Colorado, at its National Training Center. Authorization to use WATSTORE must be obtained from the Chief Hydrologist at the USGS' National Center in Reston.

USGS is officially moving to a combination of centralized-decentralized computing. Reston will maintain the national data base and the regional or sub-district offices will maintain regional data bases on independent but linked mini-computers for their day-to-day use. The major advantages of the new system will be more increased in-house computational power, since the Syosset office will acquire a complete set of DBMS software for the new system, and multi-user capability, although that is limited at present by the lack of necessary hardware.

(b) EPA's STORET System

SC-1: Data Availability.

Groundwater data in STORET comes primarily from USGS' WATSTORE System. Of 3200 groundwater stations in the System, 2400 are from Long Island. Since STORET relies heavily on WATSTORE, the evaluation of data availability is essentially the same.

SC-2: Data Accuracy.

EPA has recently been adding new data to the system, including those for synthetic pollutants (organic chemicals and priority pollutants), for approximately 34,000 samples contracted under the Superfund program, and monitoring data from hazardous waste sites. Inputting organizations are primarily state and local agencies. The coding and entry procedures have been carefully developed to meet national needs, although EPA does not require data going into the system to meet stringent quality assurance requirements, as does USGS.

SC-3: Data Placement.

Data input is handled exclusively by EPA. The system itself is housed in North Carolina's Research Triangle. EPA, Region II, in

New York, can work directly with the system and, thus, can obtain outputs fairly quickly. At present, there are no provisions for direct local use on Long Island, and it is unlikely that there will be.

SC-4: System Performance and Output Capabilities.

As a national system, STORET lacks flexibility and the responsiveness to local use that is desired. In addition, it is not managed by a standard software package, so its use is not transferable between agencies, and its retrieval language structure is limited to use by EPA. Outputs are similar to USGS's, an exception being its environmental mapping system (EMS). The system can produce a map of a specified area that depicts water quality violations listed by State agencies as part of Safe Drinking Water Act reporting requirements, environmentally sensitive water and habitat areas, identified pollution sources, and monitoring well sites. In addition, trends of increasing or decreasing contamination can be identified. The system is not as yet transferable to other agencies, but can convert other agency data to produce similar maps.

(c) S.U.N.Y. At Stony Brook - Intel System 2000

SC-1: Data Availability.

Data in the system include physical, chemical and organic water quality information from both public and private supply wells and County monitoring wells. Terminals are located in the SCDHS offices in Hauppauge, the NCDH offices in Mineola, the SCWA offices in Oakdale, the NYSDEC offices in Stony Brook and the LIRPB offices in Hauppauge. The same basic data schema that was developed by SCDHS is also being used by NCDH, SCWA, NYSDEC and BNL. SCDHS initially aided NCDH and SCWA with data input, but those agencies are now directly inputting their own data from their respective terminals. NYSDEC and BNL will eventually do the same. There are no plans at present for adding LIRPB data to the system, although the capability is there.

SC-2: Data Accuracy.

At present, all of the data in the system are physical and chemical analyses of water quality. The County laboratories, which participate in the New York State Health Dept. laboratory certification program, are used for most analysis, which insures the reliability of the data. Any private laboratories used are certified by NYSDOH and EPA. Historical data, some of which has already been entered, is suspect because of a lack of knowledge of past sampling procedures, laboratory equipment and analytical methods. As various other types of data are added to the system, care will have to be taken to insure their proper use and representation within the system. There is no automated editing or screening of data, and, within the system, and no distinction is made between total (unfiltered) and dissolved (filtered) constituents. This will lead to problems coordinating data with the USGS system, which does make the distinction.

SC-3: Data Placement.

At present, data input is performed locally by SCDHS, SCWA and NCDH. It can be expanded to involve agencies joining the system. Agencies' data are controlled by the individual agencies. The main data files are located at Stony Brook in the State University of New York's Computing Center, so access is quick and inexpensive. The system is being integrated with major local groundwater-associated agencies (SCDHS, SCWA, NCDH, NYSDEC, LIRPB and BNL). At present, the agencies can look at each other's data by obtaining each other's passwords and file names. In addition, through the use of the FORTRAN PLEX programming (See SC-4) agency data can be combined on a single file and collectively analyzed.

SC-4: System Performance and Output Capabilities.

System 2000 is flexible enough to be modified and/or upgraded at any stage in its existence. SCDHS recently purchased an output software package called Report Writer that will provide additional features such as the computation of totals, subtotals and grand totals, breakpoint analysis and the specification of detailed report formats. At present, available outputs include tallies of wells exceeding water quality standards, basic report and data summaries. The system has the capability to work interactively with various software packages (e.g., DISPLA, an extremely powerful graphics package recently acquired by Stony Brook, Minitab, P-STAT and SPSS, which are statistical packages available at Stony Brook), and will understand programs written in Standard FORTRAN, through a capability called FORTRAN Procedural Language Extension (PLEX). FORTRAN programs can be written that directly access the DBMS and selectively analyze information in the system. In addition, the system can print and update standardized reports from targeted data. The DBMS can be queried and operated by a novice, but expertise is required to properly input data in order to minimize undesirable results.

Since SCDHS and the other agencies directly using System 2000 are coöperative users of the Stony Brook UNIVAC mainframe, they can utilize the many software packages maintained by the Stony Brook computing center. These include a wide array of standard UNIVAC software programs, dealing with file editing, sorting and manipulation., processing of documents and output, and a number of computer languages (BASIC, FORTRAN-77, COBOL, PL/1, PASCAL, etc.). Other software available at Stony Brook include a Document Processing System, system simulation programs, a Report Program Generator, numerous FORTRAN-callable subroutines, and many statistical and mathematical subroutine packages.

(d) <u>Brookhaven National Laboratory (BNL) System</u>

BNL is currently undertaking a $500,000 groundwater study that will attempt to combine groundwater data from diverse sources into a unified groundwater data base that can be operated on a minicomputer. The geographic scope of the study is limited to several well-defined areas in Nassau and Suffolk counties. The major purpose of the study is to develop prototype statistical and analytical methodologies for combining and collectively analyzing diverse groundwater-related data in a sole-source aquifer region. The data being used comprise a representative sample of that available on Long Island. The system was never intended to utilize a comprehensive set of Long Island groundwater data. Thus, the proposed system is not considered a valid candidate for the data management function.

C. <u>System Management</u>

The management structure under consideration is a two-tiered arrangement, with a committee composed of key agency representatives acting as the decision-making body for Long Island's groundwater data and one of the regional agencies acting as a data liaison/librarian. The major functions of each have been detailed earlier in this chapter, but it may be helpful to summarize them here.

- <u>Managment Committee</u> (MC): The MC would set policy decisions for the data; for example, in what form the data should be sent, how to resolve statistical or technical problems with the data, how the data are to be interpreted or used in conjunction with each other, etc. An additional function that could be undertaken by the MC is the coordination of future agency data collection and analysis efforts. The committee would be aided as needed by outside technical consultants.

° Regional Operations Agency (ROA): The ROA would act as the administrative and support agency for the MC, providing information to be used by the MC in making decisions, and would also serve as an information center/data librarian. This would involve the development and maintenance of a current index of the data, responses to information and data requests and the dissemination of information to potential users. Essentially, the ROA would serve as a guide to the data for parties seeking groundwater information but who are unfamiliar with the system.

1. Management Committee Organization

The MC membership should include representatives of those agencies who now collect and/or utilize groundwater or groundwater-related data. It is anticipated that three types of agency personnel will be involved: 1) technical personnel directly involved with data collection and analysis; 2) technical personnel directly involved with management of the agency data bases; and, 3) management personnel involved with the analysis, interpretation of use of the data.

In terms of membership and voting structure, the MC might consist of a core group of voting members representing key agencies whose data are a part of the system and a satellite group of advisory members, whose combined input will help shape the decisions of the voting membership.

Possible candidates for voting membership include USGS, NYSDEC, NYSDOT, NCDH, SCDHS, LIRPB, SCWA, NCDPW, SCDPW, NYCDH and NYC Dept. of Environmental Protection (NYCDEP).

Possible candidates for advisory membership include BNL, CES, N.Y.S. Legislative Commission on L.I. Water Resource Needs, town environmental personnel and representatives of educational institutions, environmental or conservation organizations, and groundwater consultants. Participation of private interests could be solicited on a voluntary basis.

2. Regional Operations Agency Considerations

Any agency or agencies selected to fulfill the key functions of data librarian, liaison and coordinator outlined in the management needs section of this report should possess the following attributes:

° Familiarity and a working relationship with the many agencies, encompassing all levels of government and in the private sector, that are involved with groundwater monitoring, regulation and research. The ROA must know how decisions affecting groundwater are made, who is making them and must have a working relationship or some type of contact with them in order to be able to promote the use of the data in making those decisions.

° Experience and well-developed abilities in inter-agency coordination, since the proposed system is basically a cooperative network.

° A regional perspective. A key prerequisite for intergrating groundwater data for use is the ability to take an island-wide view of the existing data and hydrologic and geologic regimes.

° Familiarity with: the computerized management system; the types and uses of data being collected; the scope and extent of data in existence; methods of collection and/or reporting; analysis and interpretation; and, the theory and practice of groundwater hydrology, statistics and environmental science. In addition, the ROA must be familiar with data collection, analysis and management personnel in the agencies.

° Concern for both the present and future needs of groundwater data collectors and users.

° Experience and well-developed skills in communications and education in order to insure the widespread and effective dissemination and use of groundwater data.

3. Regional Operations Agency (ROA) Analysis:

The agencies considered for the role of ROA were NYSDEC, USGS, U.S. EPA, BNL and LIRPB. The following paragraphs summarize the analysis of each in terms of the considerations presented in this section.

a. NYSDEC, Region I.

° NYSDEC maintains working relationships with EPA and USGS on the federal level, various state departments (Transportation, Health, Agriculture and Markers), the LIRPB, Cornell University, the State Attorney General and the County D.A.'s, county and city Health Departments, and various regulated parties (water suppliers, wastewater treatment plants, industries, etc.). In addition, as part of its state groundwater management study, it has developed an extensive knowledge of the island's groundwater management framework and has set up an ongoing inventory of agencies' groundwater data and computing capabilities. There has been some contact with local agencies. NYCDEP is represented on NYSDEC's groundwater program, run out of Stony Brook, covers Kings and Queens Counties.

° NYSDEC has had recent experience in coordination as part of its state groundwater study and, together with LIRPB, has sponsored a seminar on groundwater data management information systems. It has some experience in coordination at the local level through various permit procedures.

• NYSDEC, Region I exhibits a regional perspective, but Albany's state concerns and priorities take precedence over those of the region. It is desireable to keep control over data dissemination and use as close as possible to the sources of those data and the agencies that are fully aware of their uses and limitations. In this respect NYSDEC, Region I, which must be responsive to statewide as well as local concerns and which may be constrained by central office priorities, might find it difficult to carry out all of the functions of the ROA and implement the decisions of the Management Committee.

• As a management agency, rather than one involved in day-to-day data collection and analysis, NYSDEC lacks the level of technical expertise of those agencies. On the other hand, its regulatory mandates require it to use, interpret and analyze groundwater data on a day-to-day basis, so it is more familiar with the data and their uses than other agencies. It is a user of the Univac version of System 2000 employed by SCDHS, NCDH and SCWA, and has contacts with the data collection and management personnel in the related agencies.

• NYSDEC's mission includes both immediate and long-term conservation and protection of the state's waters.

• NYSDEC maintains a wide range of information contacts and a substantial public education and outreach program, which will be pursued aggressively by all program managers under NYSDEC's 1982 water program initiatives.

b. U.S. Geological Survey

• Although USGS is a national agency, its sub-district office in Syosset maintains strong local ties. Most of its workload consists of cooperative work with county and local agencies. Official cooperators include SCWA, LIRPB, SCDHS, NCDPW and the Town of Brookhaven. The office has been involved to a greater or lesser degree with most of the groundwater-related work that has been undertaken on the island, and maintains good working relationships with the key agencies. USGS maintains ties with New York City agencies.

• USGS has participated in many cooperative efforts, generally at the request of the initiating agency. Historically, it has limited its involvement to the provision of technical assistance. USGS is currently working with NYSDEC and NYCDEP to determine the extent of potable groundwater resources in Kings and Queens Counties.

• USGS is the nation's leading groundwater data collector and analyst. In addition, it is familiar with the various groundwater data personnel in the agencies as well as the data. It has a working knowledge not only of it's own computer operation but also of the Univac version of System 2000 used by SCDHS at Stony Brook. Together with SCDHS, USGS has developed translation programs for the transmission of data from one system to another.

• USGS exhibits a long range concern in the course of its work, but, as explained earlier, does not confront long-term future management issues other than from a technical standpoint. Most of its studies and work are oriented toward long-term changes in hydrogeologic conditions and water bodies. It also gets involved with short-term characterizations of aquifer and water quality and trends in contamination.

• USGS responds to request from the public for lectures and slide shows on Long Island's hydrogeological regime and issues a wide variety of information pamphlets for public distribution.

c. U.S. Environmental Protection Agency

° Direct EPA involvement on Long Island is minimal. For the most part, EPA's connection with work done on the Island is through cooperative arrangements with NYSDEC, USGS or LIRPB. The working relationship with LIRPB, an agency that has received direct funding from EPA and which administers several federal programs on Long Island, has been very good. There is little connection with local decision-making processes. There are contacts with New York City agencies.

° EPA does not directly involve itself with local coordination activities, but rather looks for ways to integrate and transfer the knowledge and results of its localized studies to other areas of the nation.

° EPA's perspective is national in scope, but the New York office does exhibit a regional perspective. EPA, Region II, encompasses an area that includes Long Island, New York City, and New Jersey.

° EPA, as the agency responsible for the development of water quality standards and quality assurance/quality control procedures, has the technical expertise required. There is no direct connection with Long Island groundwater data management personnel, and EPA has no familiarity with System 2000. There are connections between EPA's STORET System and USGS' WATSTORE.

° Having as part of its mandate the safeguarding and improvement of the nation's waters, EPA takes a long-range planning outlook with regard to its management functions.

° EPA's emphasis on technology transfer and its experience in providing training seminars to state and local agencies are indicative of its commitment to communication and information dissemination.

d. Long Island Regional Planning Board

° LIRPB has working relationships with agencies at all levels of government. As the 208 areawide planning agency, A-95 and Sole Source Aquifer review agency, it deals with federal, state and county agencies. Working in conjunction with the Nassau and Suffolk Planning Departments, which review local zoning actions, and through programs providing technical assistance to local governments, LIRPB has developed an extensive network of local contacts. There are minimal contacts with New York City agencies.

° LIRPB's experience includes the organization and management of public education seminars and informational workshops as part of the 208 Implementation Program, participation on various coordinating committees (e.g., Marine Resources Council, 208 Technical Advisory Committee, NYSDEC's Long Island Groundwater Coordinating Committee, Suffolk County Water Management Committee), and coordination of various agency efforts to implement federal water pollution control programs.

° As a bi-county regional planning agency and the designated areawide planning agency for the federal 208 program, a regional perspective is inherent in LIRPB's activities.

° From its leadership role in the development of the 208 Waste Treatment Management Plan for the Island, and through its participation on cooperative water pollution control and research projects such as the Nationwide Urban Runoff Program and State Groundwater Management Study, LIRPB has developed a working knowledge of the types and uses of groundwater data. However, it is not a technical agency and does not possess the scientific competence of an agency such as USGS.

• LIRPB concerns itself with the future of the bi-county region.

• LIRPB's communications and educational skills have been demonstrated in its provision of technical assistance to citizens and local governments, its work with county legislators to sponsor informational workshops and seminars, and its sponsorship of and staff assistance to the 208 Citizens Advisory Committee.

e. Brookhaven National Laboratory

• BNL, as a research agency funded by several federal agencies, has worked with a wide range of groups, including educational institutions, private industry and business groups, trade associations, towns, and state and county agencies.

It has worked with LIRPB in the past and is now using the LIRPB 208 TAC for consultation and liaison on its previously described groundwater data management project.

• Though BNL works in conjunction with other organizations, most of its research is done in-house. It has experience in coordinating projects done with other national laboratories, educational and private groups, and the efforts of teams of laboratory personnel and independent researchers. With respect to groundwater-related projects, it has had no experience coordinating the activities of management agencies.

• As a semi-independent research arm of the federal government, BNL generally takes a national perspective, but its studies are specifically targeted to the northeastern states. It is not a local agency and, thus, has no mandate to restrict its consideration to Long Island.

• BNL employs some of the most highly qualified experts available in the United States, and this expertise includes the areas of interest defined by this requirement.

° Long-range planning is a key component in the types of simulation and modeling studies in which BNL specializes.

° BNL has experience in running training seminars, workshops and federal research programs; and public education is one of its more important functions.

IV. Recommendations

A. System Recommendations

1. The key groundwater-related agencies should combine their respective data into a network of interconnected data bases centered around the UNIVAC 1100/System 2000 DBMS at Stony Brook. This would constitute the first step toward the development of an island-wide data management systems yielding the following benefits:

   a. A more complete understanding and characterization of Long Island's aquifer system.

   b. A system of checks and verifications on existing data that should reduce uncertainty and improve the credibility of existing groundwater data bases; lead to stronger, more definitive conclusions and policy guidelines with respect to groundwater; and, identify areas of erroneous and misleading data.

   c. A more efficient way for the individual agencies to manage their own data. By dedicating data management personnel to the task of learning System 2000 and by either obtaining access to an existing terminal or purchasing one separately, the individual agencies can improve the organization, manipulatibility and retrievability of their own data, thus improving the data's direct utility while at the same time enabling them to combine their data with that of other agencies.

d. An understanding of the role of land use in groundwater quality evaluations and management decisions.

e. An identification of knowledge gaps and information needs for future work.

f. A basis for improved communication and cooperation among the agencies working with groundwater-related data.

g. An enhancement of the transfer of local data to federal and state agencies through the development of direct transfer programming, which would ease the burden of federal and state reporting requirements on the local agencies.

2. As a necessary pre-condition to the attainment of recommendation #1, potential data contributing agencies should be induced to initiate efforts to assure that their data, whether it is now in computer-compatible format or in paper format, is compatible with the Intel-System 2000 System at Stony Brook. In some cases this will mean the development of conversion programs to change data formats from one system to another. In other cases new data formats compatible with System 2000 will be developed for paper data that is presently not in computer-compatible format. The inducement for agency participation is the agencies' own interest in MIS development, the availability of a sophisticated DBMS (System 2000), mainframe and extensive software capability at a nominal charge, and easy access to other agencies' data in the system.

3. Those agencies having computerized data should manage their own data files on accounts at the Stony Brook Univac mainframe, but should

provide for public access so that any member of the system can access the data directly. Those agencies having computerized data not on the Stony Brook Univac System should enter into a data sharing arrangement with at least one agency in the Univac System, or work with those agencies in the system to develop transfer programming that would enable their data to be used directly by the system and vice-versa. Those agencies having non-computerized data in paper format should provide their data to the system for the appropriate conversion to computerized format in exchange for programming and keypunching assistance, access to the data of the member agencies and a more efficient means of managing their own data.

B. Management Recommendations

1. The Management Committee. There are a number of agencies on Long Island that routinely collect groundwater data or utilize them in the course of their regulatory or planning functions. These agencies would be called upon to incorporate the data they have collected, and will collect, into the island-wide management system. They also have historically been required, in a number of instances, to render judgments, based on their own or other agency data. If all data is integrated into a network of connected data bases, the agencies would have a direct interest in the network's organization and utility.

Consequently, representatives of the following agencies or organizations should be appointed to form a Data Management Committee:

- Long Island Regional Planning Board
- Long Island Water Conference
- Nassau County Department of Health
- Nassau County Department of Public Works
- New York City Department of Health

- New York City Department of Environmental Protection
- N.Y.S. Department of Environmental Conservation
- Suffolk County Department of Health Services
- Suffolk County Department of Public Works
- Suffolk County Water Authority
- U.S. Geological Survey

When constituted, the Data Management Committee should direct its attention to the following important matters:

(a) The development of operational specifications and cost estimates for the desired integrated management information system. An electronic data processing consultant and/or computer systems analyst may be needed to advise on costs, system design and equipment selection.

(b) The establishment of procedures leading to the integration of all groundwater data bases that already exist in computer-compatible form, eliminating redundancies where they may occur.

(c) The review of data bases that are not yet on computer-compatible media. This includes not only water quality data, but all information that may be relevant (e.g., land use), selection of useful data and its conversion to computer-compatible form.

(d) The development of standardized procedures and equipment specifications to be used on Long Island. These should cover well drilling technology, field procedures, laboratory analyses and data entry.

(e) The review of all previously collected data in order to determine their validity, integrity and utility in the light of the adopted standard procedures.

(f) The investigation of the suitability of existing groundwater models as predictive tools. Retention of a consultant for this purpose should be considered.

(g) The adoption or development of a means to pinpoint the precise geographic location of wells, sampling stations and points of significant contamination and relate them to various data files. The ability to segregate data by geographical and political boundaries should be stressed.

(h) The allocation of funds for the purchase of appropriate hardware and software packages, if necessary.

(i) The development of a consultation mechanism with Long Island decision-makers, in order to inform them as to the form and content of information and output that could be made available to them; therby, to develop general reporting formats tailored to their needs; and, help them identify specific information formats for decision-making on specific problems. This interchange should result in a computerized library of standard forms.

2. Regional Operations Agency (ROA) Functions. The primary function of the groundwater data management system should be to provide groundwater-related information to decision-makers, so that they may incorporate groundwater considerations into their decisions. Such decision-makers include the county executives; county, town and village officials; zoning and planning boards; legislators, etc. There is an urgent need to make sure that the groundwater impacts of such measures as subdivision approvals and building permits, zoning changes and capital budget reviews, among many others, are properly assessed and considered in arriving at a

judgment.

Hitherto, the LIRPB has been providing inputs relating to demography land use, economics, and numerous other topics to precisely the same group of decision-makers, for precisely the same purposes. In addition, the LIRPB has also traditionally been an information source for developers and other private persons. By undertaking to provide groundwater information to this category of enquirer, the LIRPB would be relieving other agencies of some of the load that they now carry.

Furthermore, the LIRPB has been lead agency for several federally-funded programs pertaining to, or involving, groundwater quality. These programs include the Coastal Zone Management Study, the 208 Waste Treatment Management Plan, the 208 Implementation Program, and the Nationwide Urban Runoff Program. It is recommended that the LIRPB extend its responsibilities to include an expanded groundwater information provision function.

In light of the above considerations, the LIRPB should assume the administrative and information dissemination functions of the ROA outlined earlier. Its coordinating and promotional talents can be used to organize and support the Management Committee, to provide a liaison between data generators and data users, and to encourage local decision-makers and elected officials to increase the use of groundwater data in their decision processes.

NYSDEC, Region I has already developed a computerized index of Long Island groundwater data management systems (MISCAT) and, as discussed in Section II, is planning to establish two additional public files. In addition, it has funding available to maintain and update the index as

Koppelman, Lee E., Project Director. Long Island Comprehensive Waste Treatment Management Plan. Long Island Regional Planning Board, Hauppauge, N.Y.: Vols. I and II, July 1978.

Long Island Regional Plannig Board. Continuing Planning for 1979-1982, Work Plan for 208 Plan Implementation. Hauppauge, N.Y.: July 1979.

Long Island Regional Planning Board, N.Y.S. Department of Environmental Conservation. Seminar on Groundwater Data Management Information Systems. Hauppauge, N.Y.: March 1982. Unpublished transcript.

Myott, D., Nassau County Department of Health. Personal Communications, 1982.

Naidu, J. Assessing Aquifer Impacts from Diverse Surveillance Data. Brookhaven National Laboratory, Upton, N.Y.: April 20, 1982.

New York State Department of Environmental Conservation. "Report on Data Management System," Task L-II-Ie, Long Island Groundwater Management Project. Stony Brook, N.Y.: June 1, 1982. Unpublished report.

Porter, Keith S. et. al. Groundwater Information: Allocation and Data Needs. Center for environmental Research, Cornell Univerity, Ithaca, N.Y.: 1982.

Robbins, S., Suffolk County Department of Health Services. Personal Communications, 1982.

Swick, C., Long Island Regional Planning Board. Personal Communications

Tanenbaum, E., Long Island Regional Planning Board. Personal Communications, 1982

U.S. Department of the Interior, Geological Survey, U.S. Environmental Protection Agency. Urban Hydrology Studies Program Technical Coordination Plan - Working Draft. Syosset, N.Y.: February 1979. Unpublished report.

U.S. Department of the Interior, Geological Survey. WATSTORE, USGS: INF-74-23. Information brochure.

U.S. Department of the Interior, Geological Survey. WATSTORE--National Water Data Storage and Retrieval System of the U.S. Geological Survey--User's Guide. Syosset, N.Y. Unpublished report.

Whited, William. "Hardware: What's on the Market." Planning, Vol.47, #10, October 1981.

Wilenitz, I., Potech, Inc. Personal Communications, 1982.

Wirenius, D., Suffolk County Department of Health Services. Personal Communications, 1982.

Wolzein, F., New York State Department of Environmental Conservation. Personal Communications, 1982.

U.S. DEPARTMENT OF COMMERCE
National Technical Information Service

PB-269 433

Primary Productivity and Basic Food Chain Relationships in Two Long Island Bays

New York State Dept of Environmental Conservation, Albany

Prepared for

National Marine Fisheries Service, Washington, D C

Mar 77

PB 269 433

APPROVED
BY J.E. Carlson
DATE 3-24-77

UNITED STATES
DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL MARINE FISHERIES SERVICE

COMMERCIAL FISHERIES RESEARCH AND DEVELOPMENT ACT

COMPLETION REPORT

STATE: New York

PROJECT NO.: 3-182-R

PROJECT TITLE: Primary Productivity and Basic Food Chain Relationships in two Long Island bays.

PERIOD COVERED: June 1, 1973 - March 31, 1976

PREPARED BY: R. E. Fox DATE: 3/8/77
Senior Aquatic Biologist (Marine)

APPROVED BY: [illegible] DATE: 3/8/77
D[illegible]tor, Division of Marine
[illegible] Coastal Resources

#663393

8/14/80 OT

ABSTRACT

A three year study was undertaken to determine primary productivity and basic food chain relationships in two Long Island embayments.

The areas chosen were Moriches Bay and Shinnecock Bay, located on the southern shore of Long Island. Moriches Bay receives waste loadings from treated wastes and sludge deposits originating from past and present duck farms located on tributaries to the bay. Shinnecock Bay is connected via a coastal canal (Quantuck Canal) to Moriches but does not have any major sources of pollution located along its shoreline.

The study was designed to determine water quality in the two bays, sediment distribution, the effects of precipitation on water quality and phytoplankton populations.

Analyses of the data do not indicate any significant differences between the two bays on the basis of the parameters chosen. The average salinity of Moriches Bay was 1.6 parts per thousand (o/oo) lower than the average salinity of Shinnecock Bay (27.5 o/oo versus 29.1 o/oo).

INTRODUCTION

Geography:

Moriches and Shinnecock Bays are coastal embayments located along the southern shore of Suffolk County, Long Island, New York. The bays are protected from the Atlantic Ocean by a narrow barrier beach, although each is connected directly to the Atlantic Ocean by means of a shallow tidal inlet. Narrow Bay connects the western portion of Moriches Bay to Great South Bay; Moriches Bay and Shinnecock Bay are connected via the Quantuck and Quogue Canals while the northern portion of Shinnecock Bay is connected to Great Peconic Bay by Shinnecock Canal, (see Figure I).

Moriches Bay is approximately 8 miles in length and Shinnecock Bay is approximately 6 miles long. Both vary from one to three miles in width. Depths in each bay average about five feet and exceed ten feet in only a few areas such as the intercoastal channels.

History and Importance:

Moriches Bay has a history of problems related to water pollution. A storm caused closure of Moriches Inlet during 1951-53 reduced the mean tidal range from 0.6 feet to 0.2 feet and decreased the total volume exchange by about 65 percent.[1] During the time the Inlet was closed, a "bloom" of planktonic microorganisms (*Nannochloris atomus*) occurred throughout the bay, practically excluding the more normal estuarine plankton flora. These blooms of *Nannochloris* gave the water its characteristic green color and presumably caused the decline of shellfish populations by suffocation attributed to low dissolved oxygen levels. Such phytoplankton blooms were found to result from the chemical nature of the pollutants and the physical and chemical conditions in the bay waters associated with its reduced flushing rate.[2]

---

1 Nichols, M. M.
2 WHOI #58-57

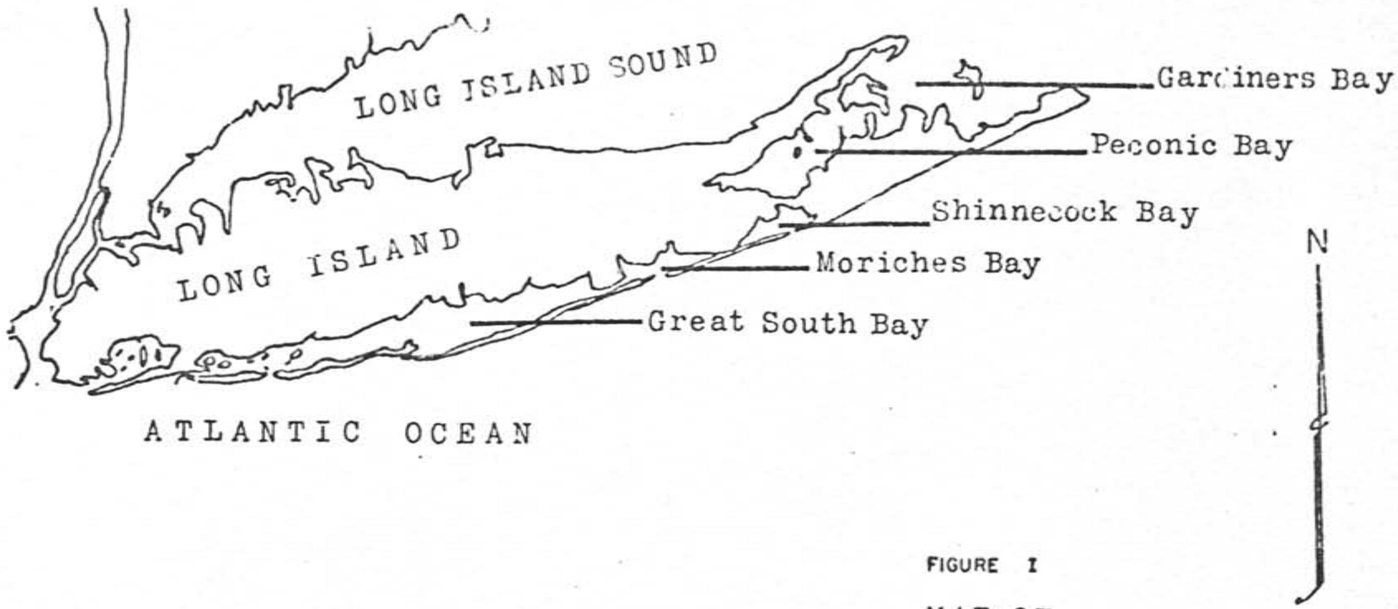


FIGURE I

MAP OF
LONG ISLAND WATERS

0 5 10 20 30
nautical miles

Moriches Bay receives drainage from many fresh water streams along its northern shoreline. A large duck farming and processing industry also flourished in this same area, discharging duck wastes directly into Moriches Bay through these estuarine tributaries. Although duck farming activities have been significantly reduced in recent years, leachates from decades of sludge buildup continue to affect the bay waters. More than half of the productive bay bottom is considered uncertified from a bacteriological standpoint by the State and is thus closed to the harvest of shellfish.

Shinnecock Bay is in a relatively pristine condition, receiving limited fresh water drainage of land pollutants. There is essentially no duck farming or any other industry affecting water quality. Compared with Moriches Bay, the human population along the shoreline is relatively sparse and natural beaches and marshlands abound. Virtually all of Shinnecock Bay is classified as certified by the State and thus open to the harvest of all species of shellfish.

Coastal lagoons such as Moriches and Shinnecock Bays are important because many fish of commercial value spend part of their lives within these areas. Some species spawn and the young mature within the protected confines of the lagoon. Concerning management of estuarine fisheries, J. L. McHugh stated, "Well over half of our domestic commercial fish catch is based on estuarine dependent species. Typical fishery resources of these estuaries are oysters, clams, crabs, shrimp and a variety of coastal and anadromous fishes which use the inshore estuary seasonally".[3]

Speaking of estuaries, Thomas R. Glenn, Jr. of the Interstate Sanitation Commission stated that "more applied biological research is urgently needed to provide engineers and planners with the necessary facts so that abatement programs can achieve water quality necessary for aquatic life".[4]

Although Moriches and Shinnecock Bays are similar in many respects, the duck farming activities located along the northern shoreline of Moriches Bay do result in a major nutrient loading to Moriches not found in Shinnecock Bay.

This study was designed to investigate the relationship between water quality and the primary producers in these environments. Primary productivity and basic food chain structures were also investigated for comparative purposes between the two Bays.

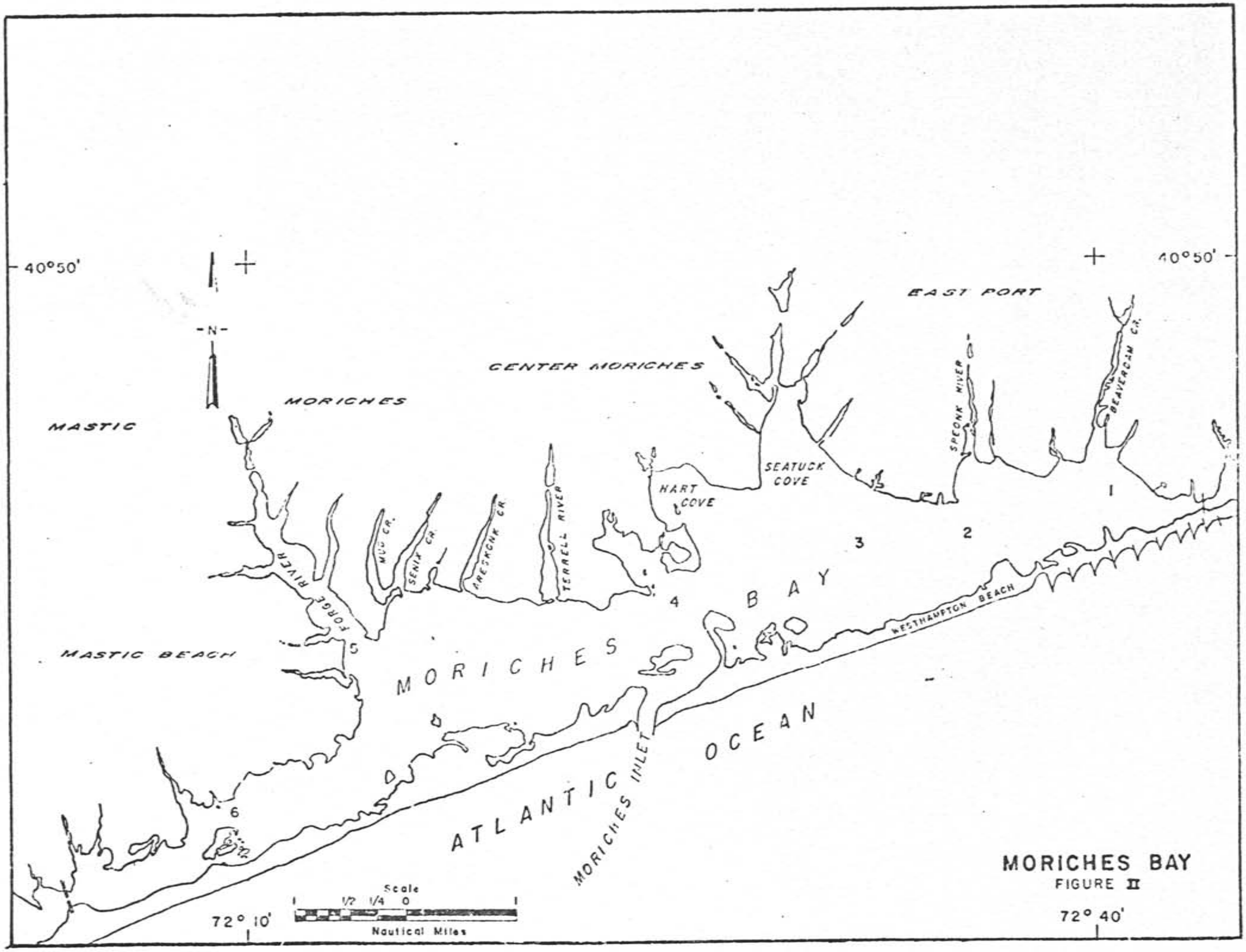
It is felt that a basic understanding leading to an intelligent usage of these environments can lead to continued productivity of these embayments as spawning and nursery grounds essential to the continuation of a viable fishing industry.

METHODS AND MATERIALS

Job I) Determination of water quality: Six (6) primary stations were established in each bay. The location of each station is shown in Figure II for Moriches Bay and in Figure III for Shinnecock Bay. Measurements were recorded at each station for dissolved oxygen, salinity and temperature. Water samples were also collected at these stations throughout the duration of the project. These samples were returned to the laboratory and analyzed for suspended solids, nitrogen and phosphorus. Determinations were made in accordance with Standard

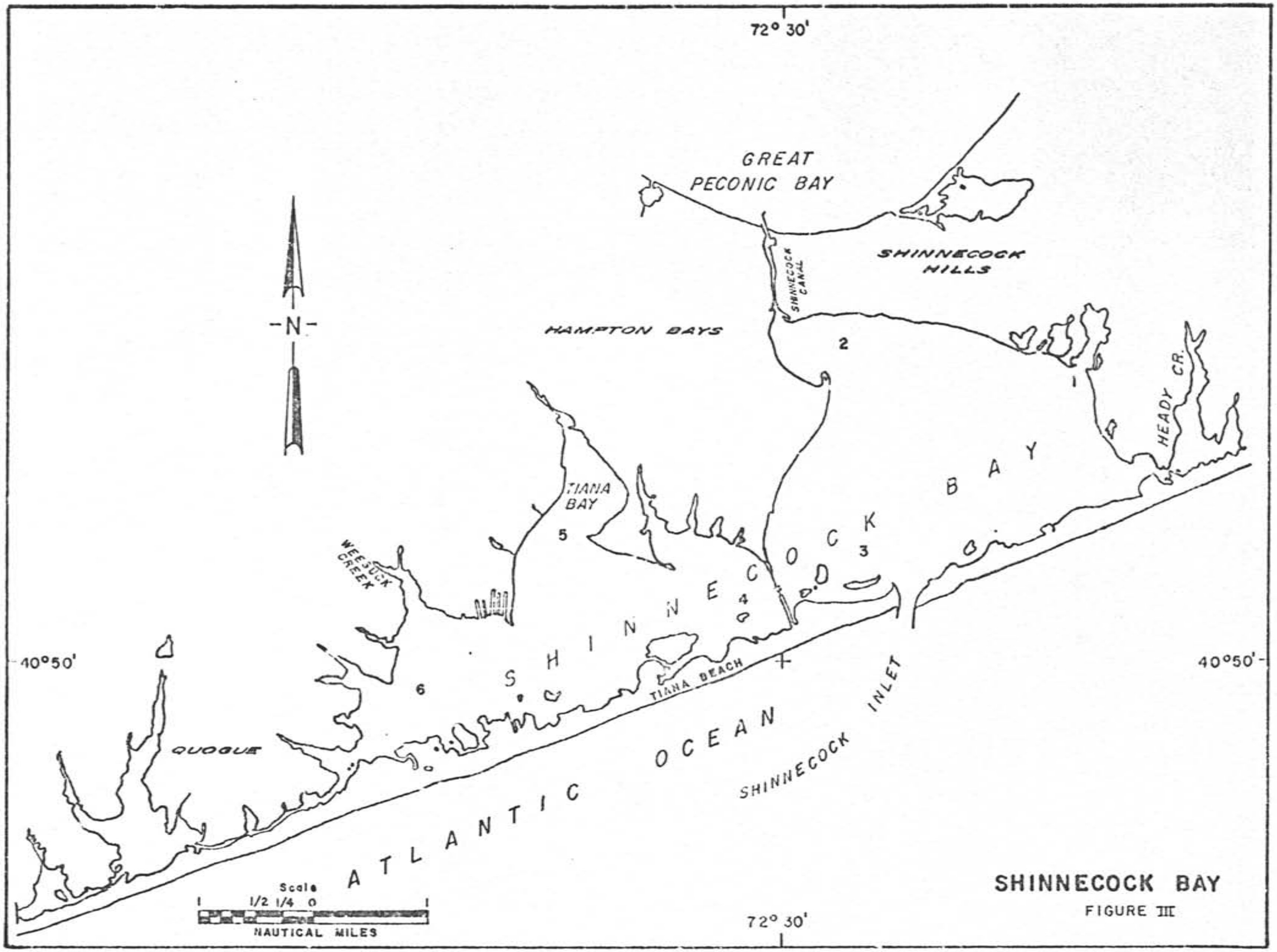
---

3 A Symposium of Estuarine Fisheries, Amer.Fish.Soc.Special Pub., No. 3, 1966
4 A Symposium of Estuarine Fisheries, Amer.Fish.Soc.Special Pub., No. 3, 1966



MORICHES BAY

FIGURE II



SHINNECOCK BAY

FIGURE III

Methods for Analysis in Seawater.[5] Measurements for each sample date are averaged for each bay and presented graphically by Figures IV through IX.

Job 2) Determination of sediment distribution: Samples for sediment analysis were collected throughout each bay either by diving or by means of a grab sampler. Each sample was mechanically sorted and graded. Those samples which were comprised of a silt/clay fraction (grain size less than .063mm.) exceeding 15 percent were subjected to hydrometer measuring techniques to further differentiate these types.[6] Most samples were further analyzed to quantify organic content.

Sediment distribution maps showing sediment gradients were prepared for each bay (Figures X and XI).

Job 3) Determination of the effect of precipitation on nutrient levels in Moriches Bay: A major portion of the chemical nutrients were believed to enter Moriches Bay as a result of land runoff and duck sludge erosion following precipitation. Ten stations (Figure XII) along the northern shore of the bay were sampled during extended periods of dry weather and also following periods of recorded rainfall. A one liter sample was taken and analyzed for nitrogen and phosphorus concentrations.

Job 4) Determination of phytoplankton populations: Water samples were collected at the six primary stations (Figures II and III) for analysis of phytoplankton populations. Samples consisted of one liter of water which were preserved immediately following collection. Upon return to the laboratory, each sample was allowed to settle and was then decanted so that the total phytoplankton population of one liter was contained in 100ml. of sea water. The samples were stored in this condition until microscopic examinations were made.

In preparation for each analysis, a 10ml. portion of the 100ml. sample was further concentrated to 1.0ml. by centrifugation. A fraction of this 1ml. sample was then counted using a standard Palmer nannoplankton counting chamber with a Whipple disc in the microscope ocular. All counts were conducted at a magnification of approximately 440 X. Due to the magnification and concentrations involved, each organism counted represents 433 organisms per 1.0ml. of original sample.

The data obtained in the first, second and third segments of this project are presented in Tables I, II and III respectively. The Genus of organisms identified is listed in Column A. Column B indicates the percent of stations in each bay at which the organism was found at least once during the sample period. Column C indicates by percentage, the number of samples containing an organism compared to the total number of samples counted in each bay. Column D indicates the relative percent of each organism out of the total organisms counted for each bay.

RESULTS AND DISCUSSION

Job 1) Water quality: Determinations of salinity, temperature, dissolved oxygen, suspended solids, nitrogen and phosphorus were made on samples collected from six stations in each bay (Figures II and III) throughout the project.

---

5 Strickland and Parsons, 1968.
6 Shepard, Francis P., 1954.

The measurements for each sampling date are averaged for each bay and presented graphically in Figures IV through IX.

Measurements within each bay do change from one sample date to another, although average values for each bay indicate the seasonal variations. The higher values for nitrogen, phosphorus, suspended solids, temperature and dissolved oxygen alternate between the bays. Maximum, minimum and mean values for these parameters are presented in Table I. These values are obtained from measurements made at each primary sampling station (Figures II and III) during the project's three segments. No significant differences between Shinnecock and Moriches Bays are indicated for nitrogen, phosphorus, suspended solids, temperature and dissolved oxygen.

However, there is an observed salinity difference between Shinnecock and Moriches Bays. This difference, although slight, may be important. The average salinity for all stations in Moriches Bay for the three year period is 27.5 parts per thousand while the corresponding value for Shinnecock Bay is 29.1 parts per thousand. The average salinity for Moriches Bay is 1.6 parts per thousand lower than for Shinnecock Bay.

This salinity difference may be an important factor in the production of hard clams (Mercenaria mercenaria). Large concentrations of hard clams exist in many areas of Moriches Bay. Shinnecock Bay is much less productive for hard clams when compared with Moriches. If the hard clams in Moriches Bay are existing near the upper level of their salinity range, then an increase in average salinity of 1.6 parts per thousand in Shinnecock Bay may be significant with the higher levels proving detrimental to spawning, setting, growth or other biological functions necessary for successful hard clam production.

Job 2) Sediment distribution: Twenty-eight samples for sediment analysis were collected from Shinnecock Bay and forty-one from Moriches Bay. Sample sites were distributed throughout each bay.

Analyses of data indicated that three basic types of sediment were present. The general categories into which all samples fit are as follows:

1. Sand (comprising 95 percent or more sand).

2. Sandy silt (sand with up to 30 percent silt).

3. Sand-silt-clay (sand with up to 50 percent silt and up to 10 percent clay).

Shinnecock and Moriches Bays have similar amounts of sand calculated on a percentage basis of total samples. The percentage of sediment samples in the sand category is 46 percent for Shinnecock and 51 percent for Moriches Bay. However, a dissimilar relationship is observed for the sandy silt and sand-silt-clay categories. Sandy silt compositions were found in 14 percent of the Shinnecock samples and 27 percent of the Moriches samples. Similarly, the sand-silt-clay compositions were found in 40 percent of the Shinnecock samples and 22 percent of the Moriches Bay samples. Sediment distribution maps based on the 3 categories above are presented in Figures X and XI.

Job 3) Precipitation and nutrient levels: Nitrogen and phosphorus analyses were conducted at ten sampling sites along the northern portion of Moriches Bay (Figure XII). Samples were collected for this portion of the study from April through October 1975 on 21 occasions. The purpose of this study was to

Water samples collected from typical blooms have been found to contain 50,000 to 100,000 organisms per milliliter of water. It should be emphasized that these phenomena usually last a few days and cause no permanent alteration to the environment.

CONCLUSION

This project was designed to obtain and compare chemical and physical characteristics of two adjacent marine environments relative to primary production and basic food chain structures. The two bays chosen are similar in most respects, with the noted exception that extensive duck sludge deposits are still located in streams tributary to Moriches Bay. The study was undertaken to detect basic ecological differences, if any, between these two bays. An intensive investigation of the relationships between water quality, sedimentation and basic food chain organisms found in the two environments was undertaken.

No significant difference exists between bays based on measurements of suspended solids, dissolved oxygen, nitrogen, phosphorus or temperature. A small but possibly important difference exists for salinity measurements. Based on all measurements made during this project, the average salinity of Moriches Bay is 1.6 parts per thousand lower than that of Shinnecock Bay. This difference may be a major factor for the greater hard clam production from Moriches Bay as compared to Shinnecock Bay.

Analyses of sediment samples showed similar sand content of the sediments for both bays. A dissimilar relationship between bottom sediments exists for smaller grain size categories. The sand-silt content of Moriches Bay is twice that of Shinnecock while the sand-silt-clay content of Shinnecock is twice that of Moriches.

Phytoplankton populations were enumerated for each bay during each project segment. Data comparison indicate little difference between the two bays. This similarity of phytoplankton populations is attributed to the similarities in water quality determined for each environment.

In order to explore a possible relationship between storm water runoff and nutrient concentrations, samples were collected from Moriches Bay before and after rainfall and analyzed for nitrogen and phosphorus content. Although there are indications of higher levels following rainfall, not enough consistent data are available to warrant conclusions as to the effect of rainfall on nitrogen and phosphorus levels in Moriches Bay.

Data collected during the project did not indicate any major ecological differences between Shinnecock and Moriches Bay with the exception of the average salinity values. Salinity values in Shinnecock Bay were 1.6 parts per thousand higher than those in Moriches which could be a significant factor since salinities in both bays are near the upper salinity ranges for hard clam propagation. Reported landings for hard clams have been higher for Moriches compared to Shinnecock Bay.

The apparent nutrient loading of Moriches Bay is not reflected by measurements of physical and chemical parameters made during this project. Both bays appear to offer equal potential as spawning and nursery grounds for numerous species of finfish of commercial importance found in the marine waters surrounding New York.

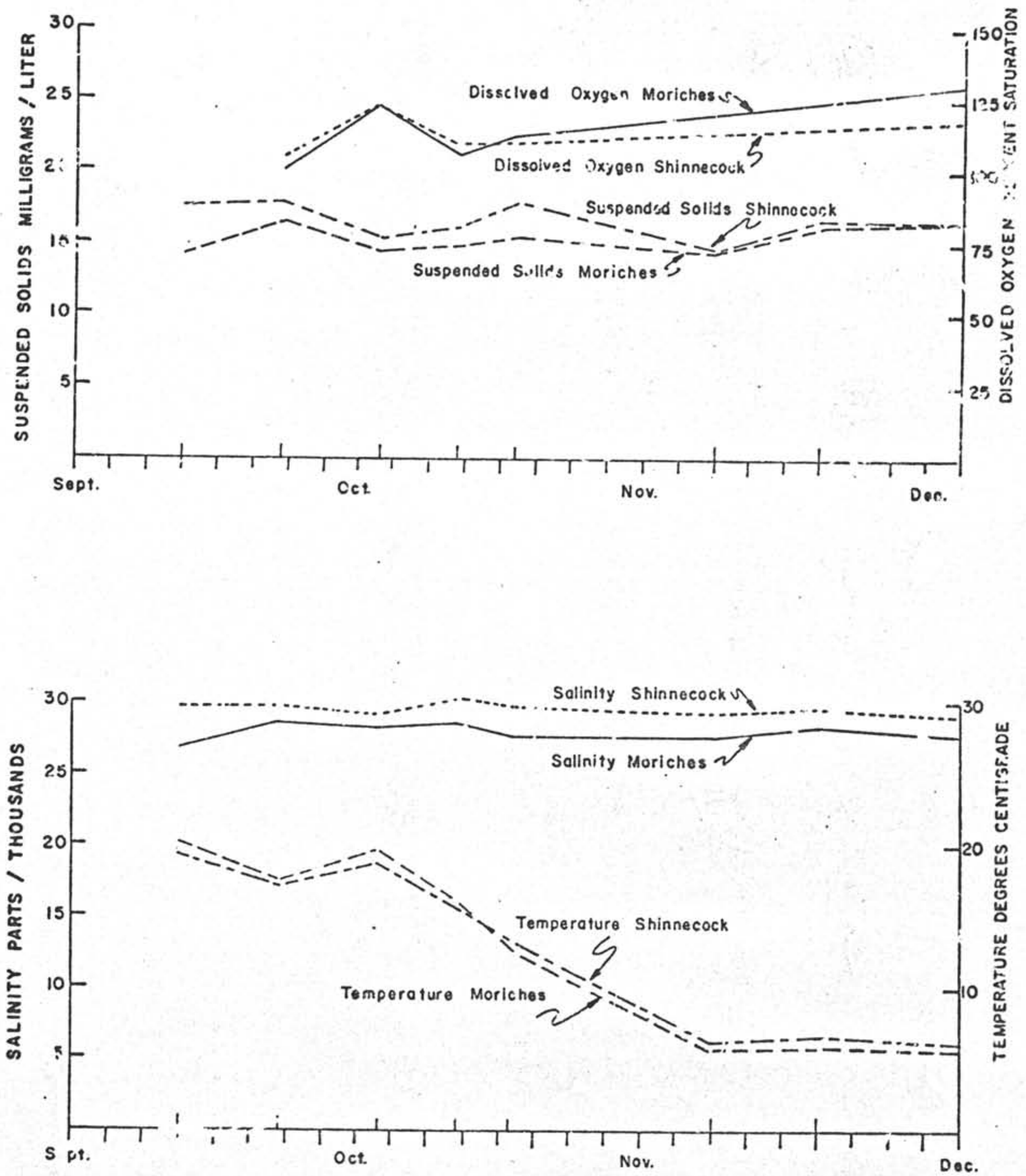
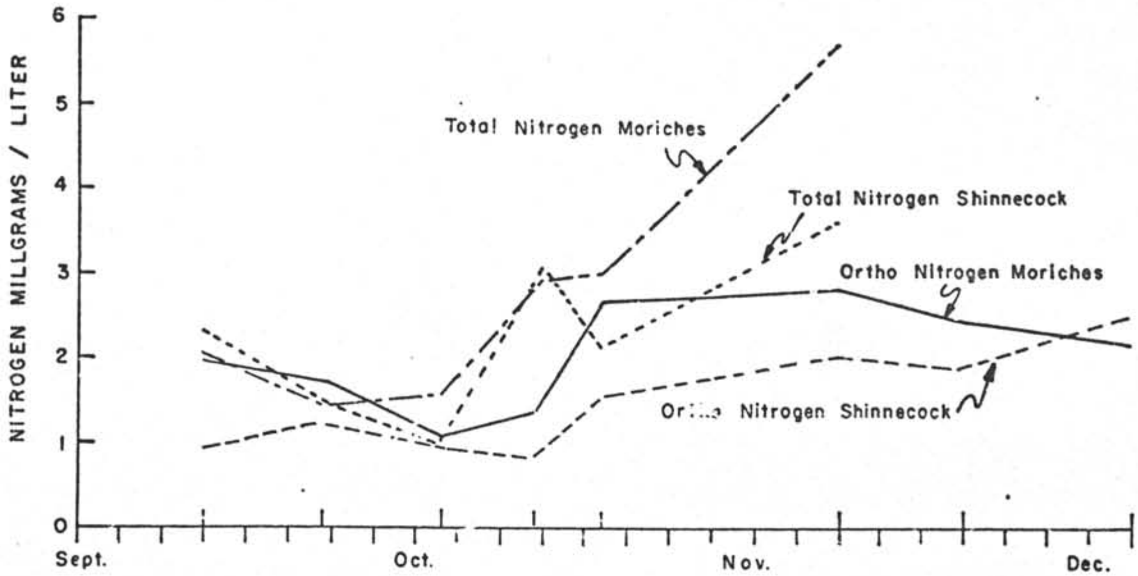


FIGURE IV
Segment I — 1973



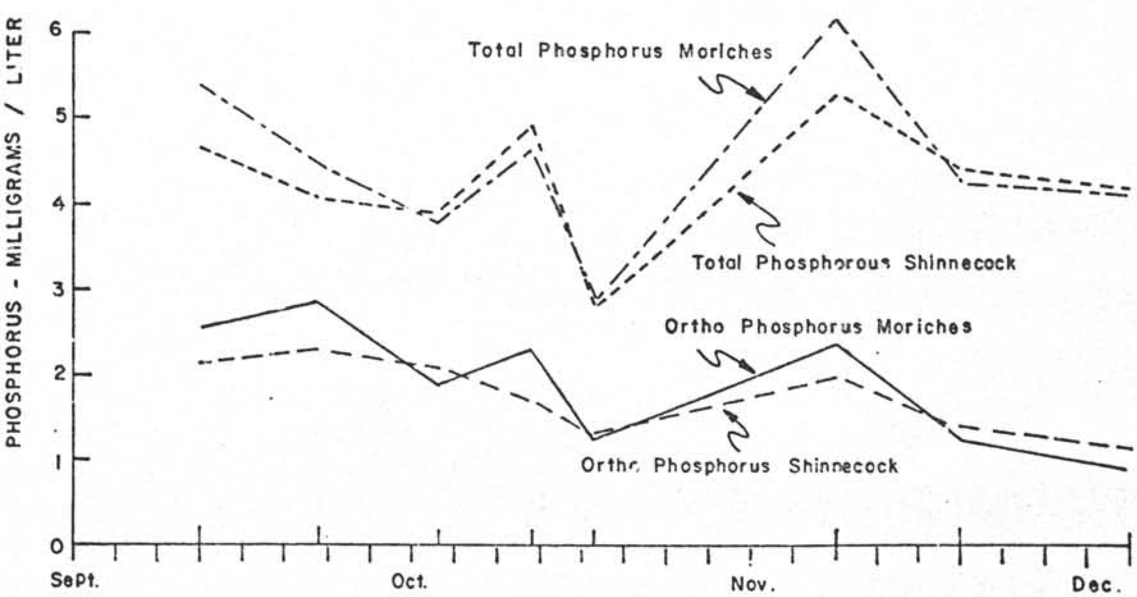
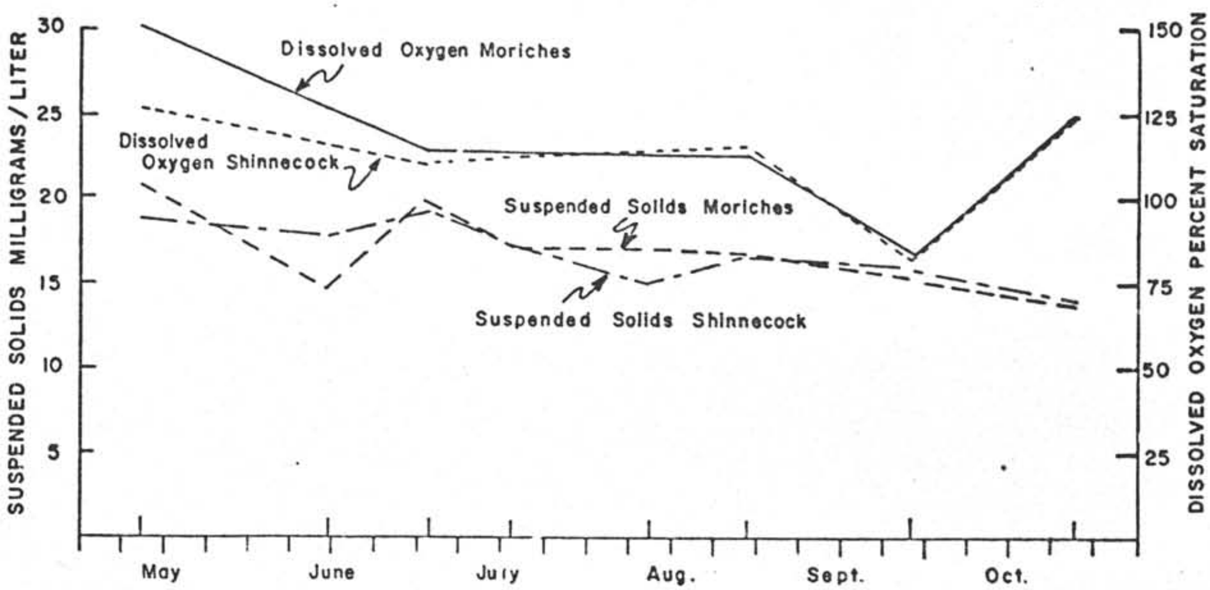


FIGURE V
Segment I — 1973



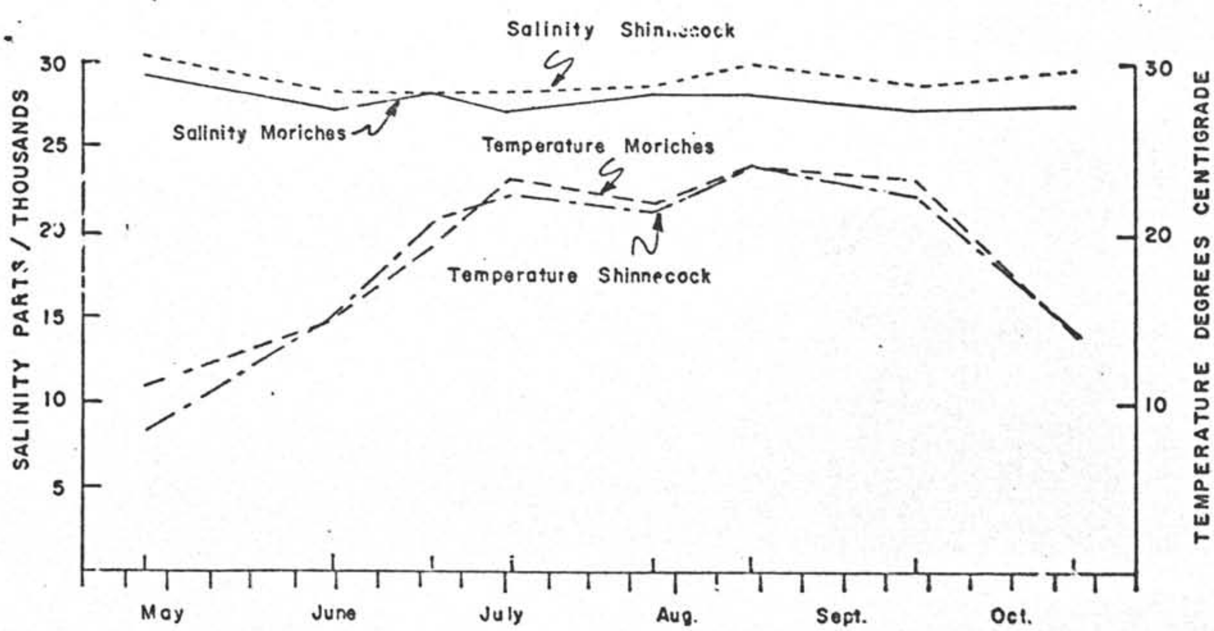


FIGURE VI
Segment 2 — 1974

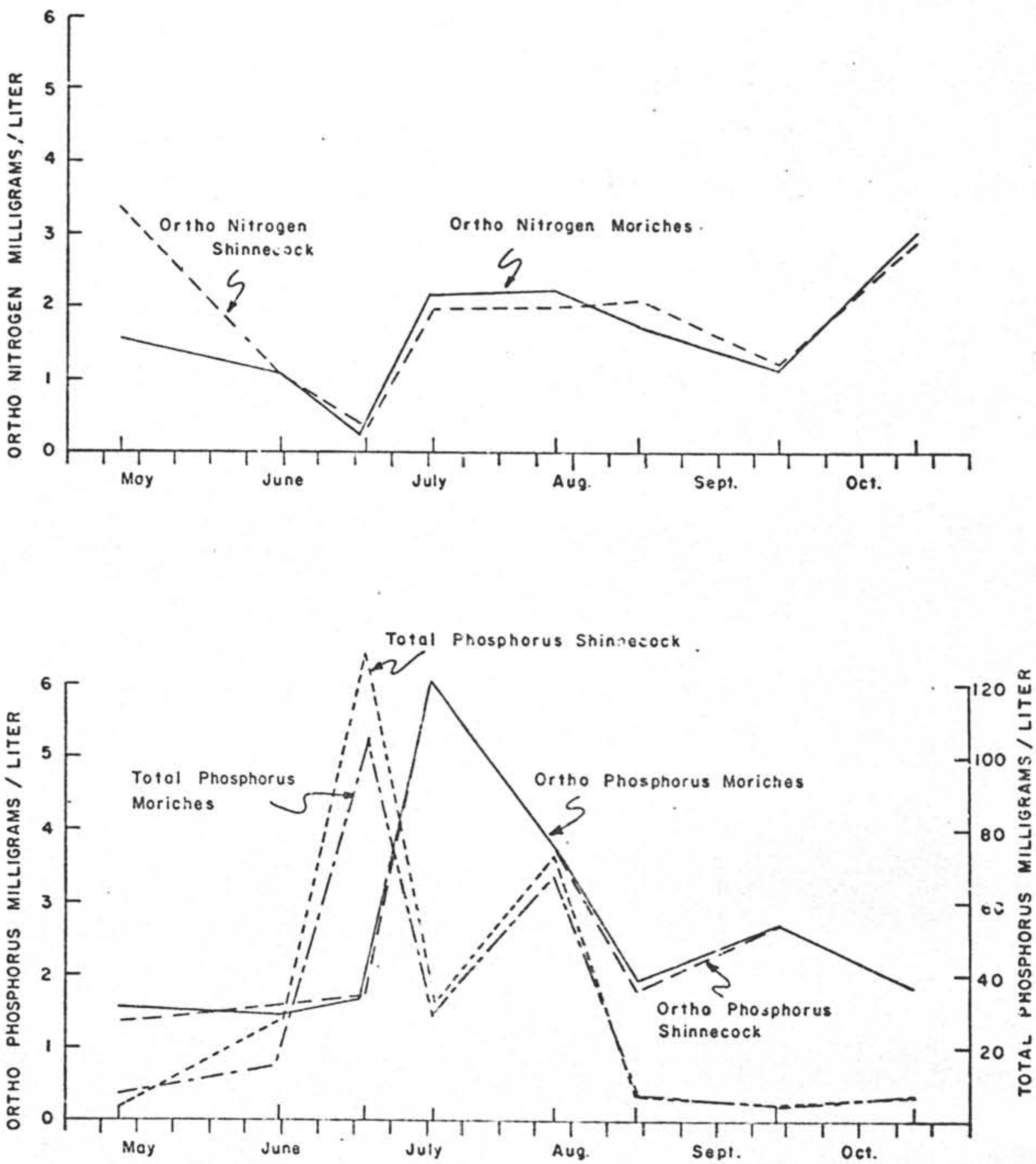
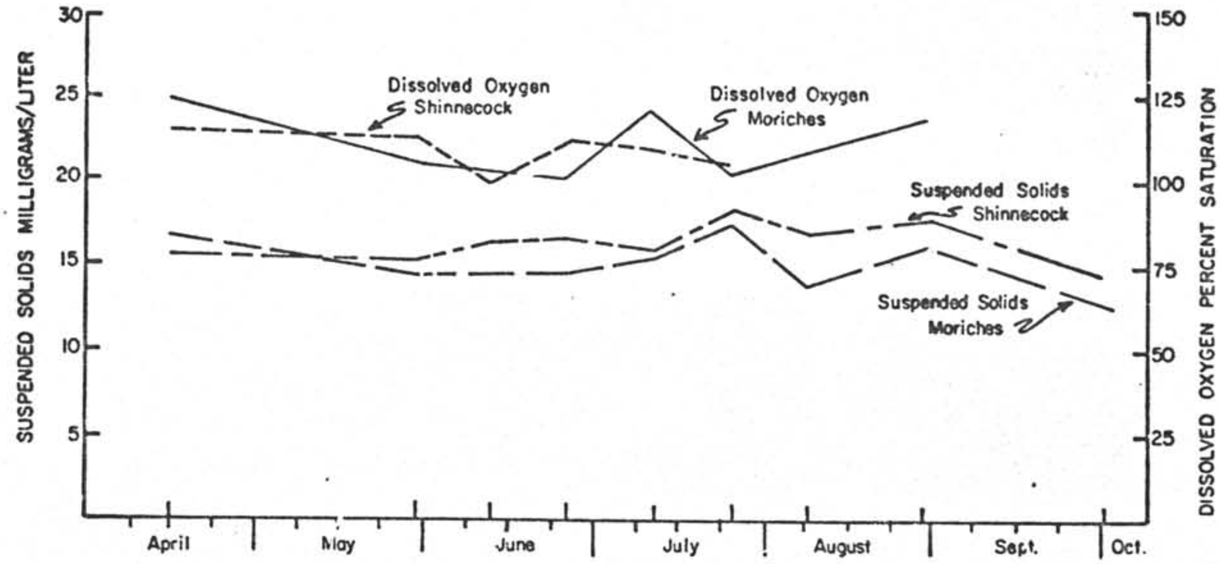


FIGURE VII
Segment 2 — 1974

14



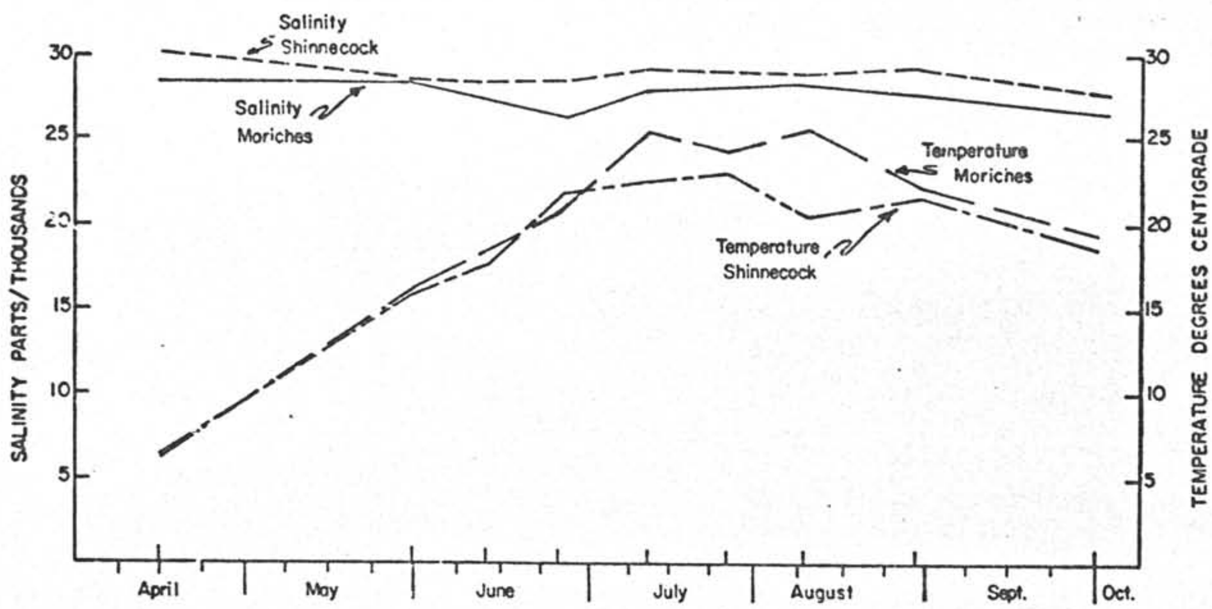
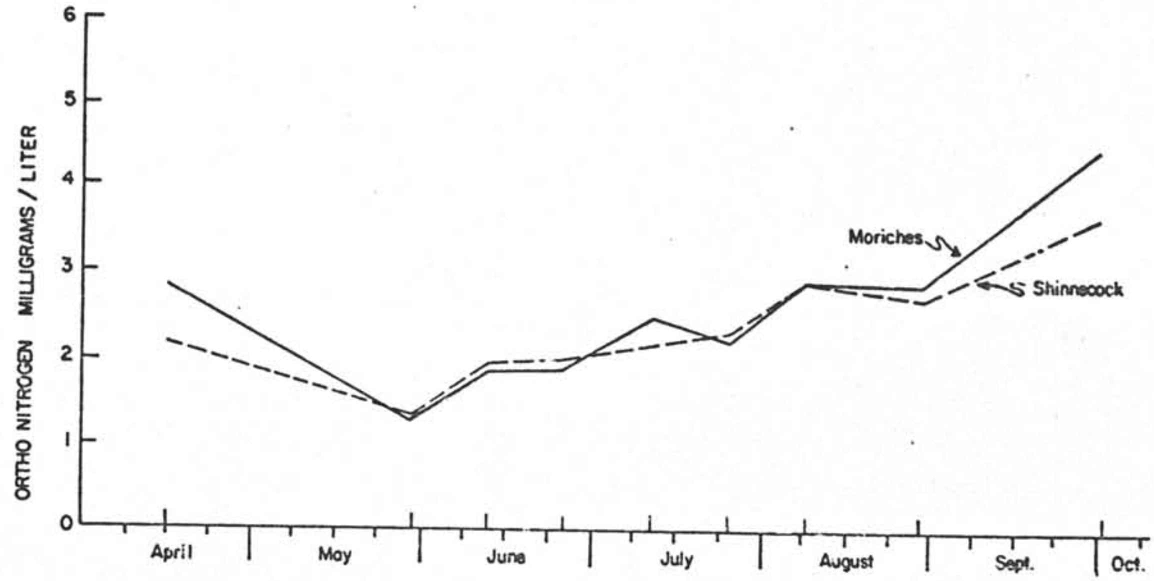


FIGURE VIII
Segment 3 — 1975



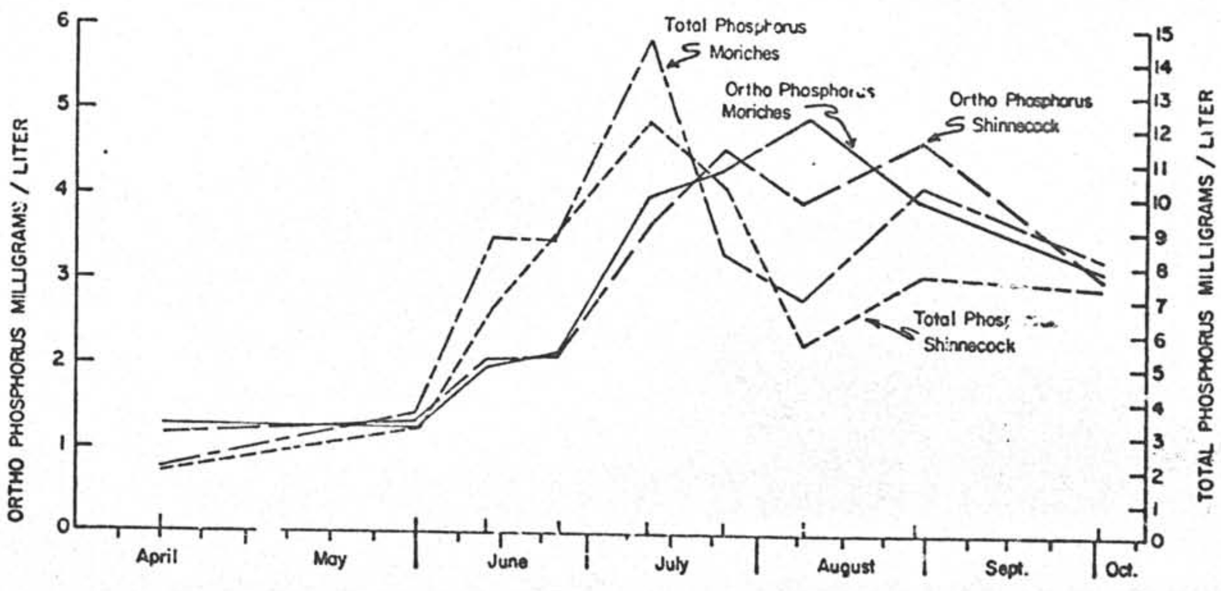
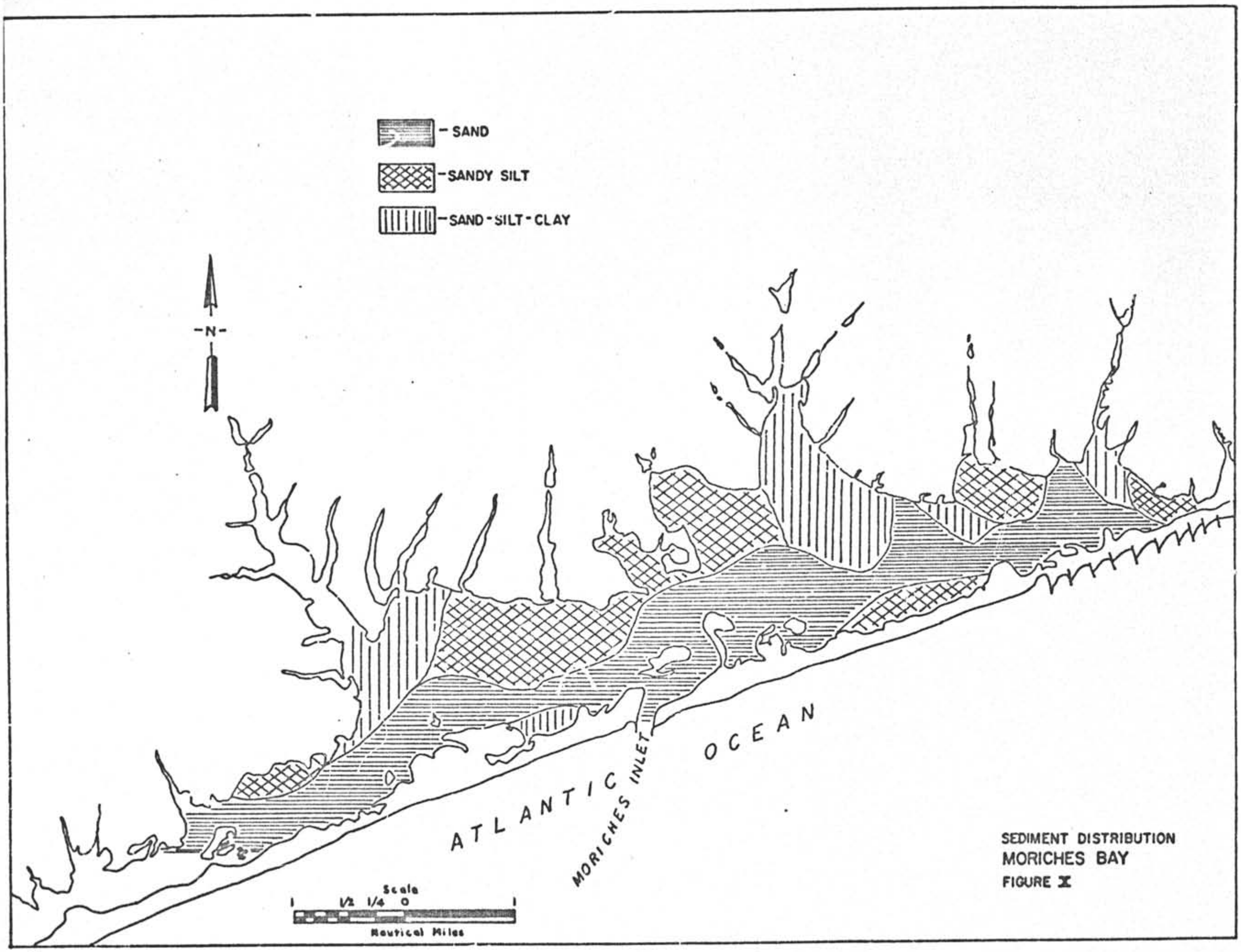
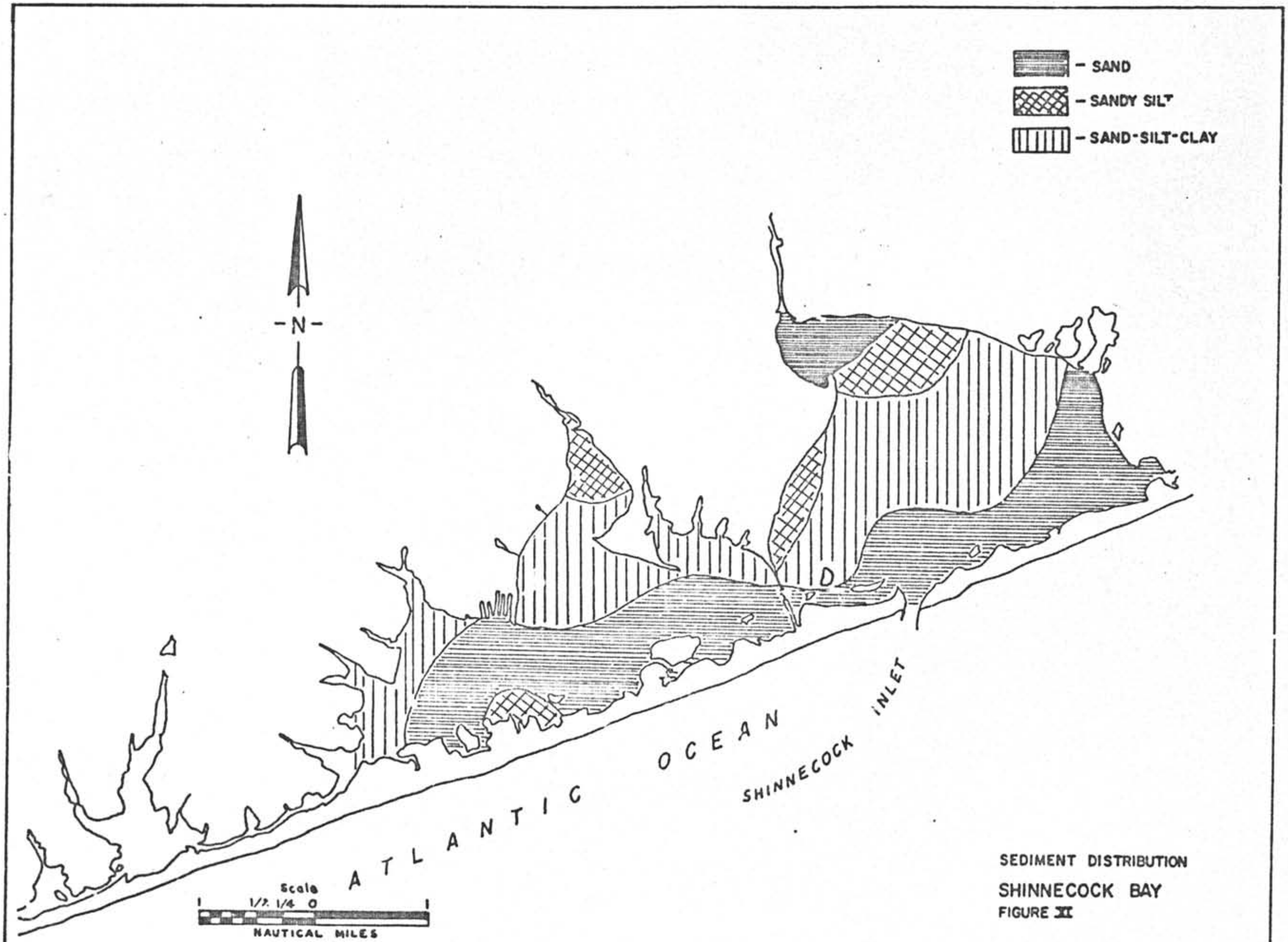


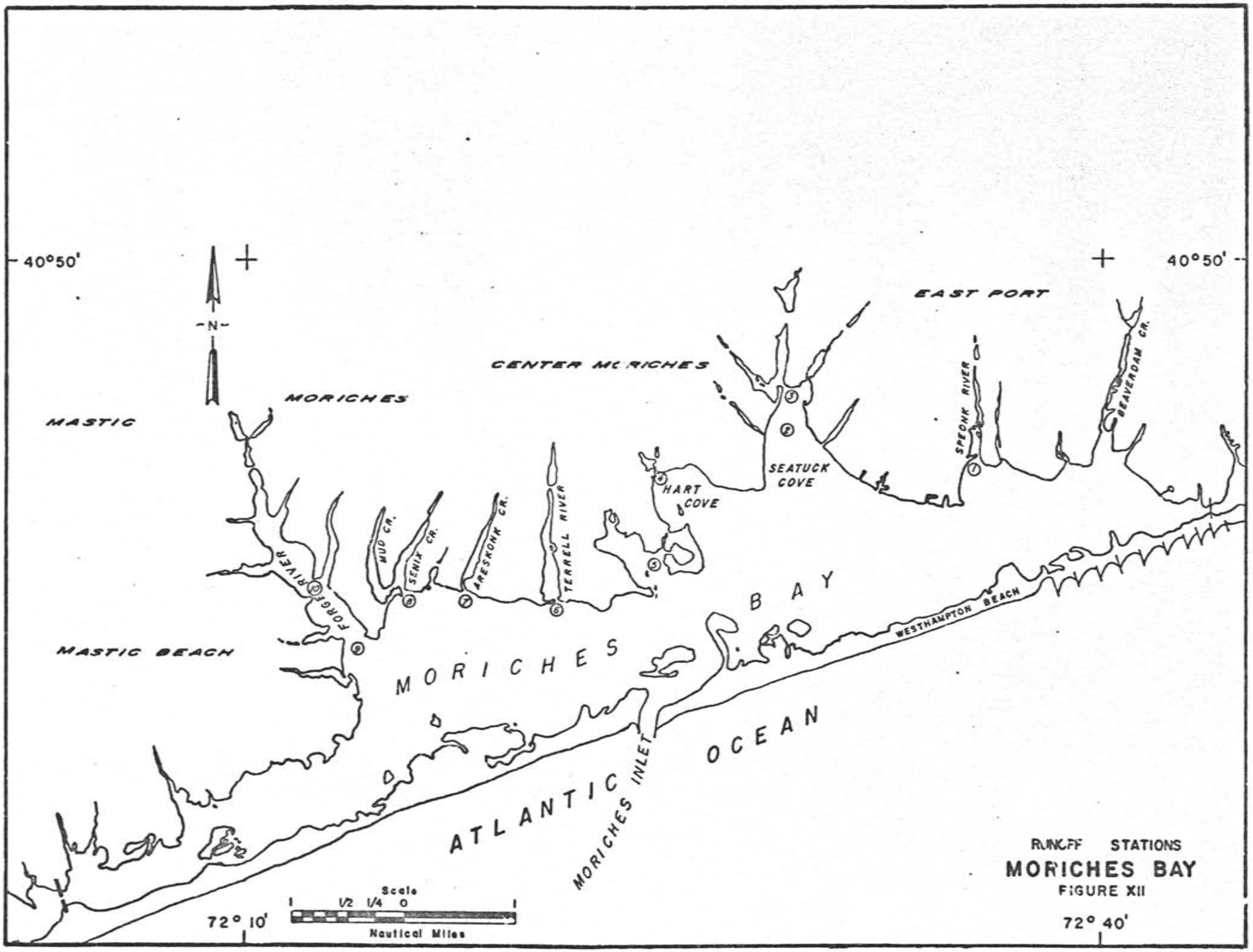
FIGURE IX
Segment 3 — 1975



SEDIMENT DISTRIBUTION
MORICHES BAY
FIGURE X



SEDIMENT DISTRIBUTION
SHINNECOCK BAY
FIGURE XI



RUNOFF STATIONS
MORICHES BAY
FIGURE XII

SUMMARY OF WATER QUALITY

TABLE I

	Shinnecock Bay			Moriches Bay		
	Max.	Min.	Mean	Max.	Min.	Mean
Sal. $^{o}/oo$	30.4	27.7	29.1	29.2	26.1	27.5
Temp.^{o}C.	24.05	6.02	16.62	25.83	5.78	17.26
Nitrogen mg/l	3.68	0.32	2.41	3.20	0.25	2.14
Phos. mg/l	5.95	1.15	2.46	5.92	0.90	2.51
T.Phos. mg/l	126.14	1.75	15.30	105.66	1.92	14.35
Sus.sol.mg/l	18.77	14.0	16.56	20.67	13.0	16.29
D.O. % sat.	126	82	112.53	151	83	114.73

1973 PHYTOPLANKTON DATA

TABLE II

COLUMN A	COLUMN B		COLUMN C		COLUMN D	
DIATOMS	S	M	S	M	S	M
Achnanthes	33%	17%	3%	1%	0.2%	0.1%
Asterionella	50	0	7	0	1.7	0.0
Biddulphia	83	17	24	1	6.5	0.1
Campylodiscus	0	33	0	3	0.0	0.2
Ceratulina	17	17	1	1	0.3	0.5
Chaetoceros	33	0	4	0	0.4	0.0
Cocconeis	100	100	96	79	16.6	22.0
Coscinodiscus	100	100	49	26	9.4	2.9
Cymbella	83	100	18	34	2.0	3.5
Ditylum	0	33	0	3	0.0	0.2
Gyrosigma	50	67	4	12	0.5	0.9
Leptocylindricus	50	33	4	3	1.4	0.6
Licmorpha	33	17	3	3	0.3	0.2
Mastogloia	17	17	1	3	0.1	0.2
Navicula	50	83	6	12	0.5	1.2
Nitzschia	100	100	42	16	8.7	2.5
Opephora	100	100	42	49	6.1	9.8
Pinnularia	17	0	1	0	0.1	0.0
Pleurosigma	67	33	10	6	0.7	0.5
Rhizoselenia	33	17	3	1	0.2	0.1
Skeletonema	100	100	33	22	18.8	35.1
Striatella	33	17	3	1	0.2	0.1
Synedra	0	17	0	1	0.0	0.1
Thalassionema	100	100	18	13	4.3	1.6
Thalassiosira	87	100	13	13	4.9	2.5
Thalassiothrix	33	17	3	1	0.5	0.3
DINOFLAGELLATES						
Amphidinium	17	0	1	0	0.1	0.0
Ceratium	33	83	3	12	0.2	0.9
Exuviella	67	83	10	10	1.0	1.2
Goniaulax	67	100	13	18	2.1	2.3
Gymnodinium	100	100	39	43	7.1	8.8
Noctiluca	17	0	1	0	0.2	0.0
Peridinium	67	0	8	0	0.7	0.0
Prorocentrum	100	100	24	16	3.5	1.5

S = Shinnecock

M = Moriches

1974 PHYTOPLANKTON DATA

TABLE III

COLUMN A	COLUMN B		COLUMN C		COLUMN D	
DIATOMS	S	M	S	M	S	M
Bidulphia	33%	17%	1.21%	0.58%	1.07%	0.2%
Campylodiscus	17	17	0.61	0.58	0.21	0.2
Ceratium	17	0	0.61	0	0.42	0
Cocconeis	100	100	16.97	21.05	11.99	19.08
Coscinodiscus	100	100	17.58	14.04	12.85	10.84
Ditylum	17	0	0.61	0	0.21	0
Gyrosigma	33	17	1.82	0.58	0.64	0.2
Hemiaulus	17	0	0.61	0	0.21	0
Licmorpha	50	50	2.42	1.75	1.28	0.6
Mastogloia	0	17	0	0.58	0	0.2
Melosira	0	17	0	0.58	0	0.8
Navicula	83	100	6.67	7.60	2.57	3.41
Nitzschia	100	100	6.67	4.09	3.43	3.01
Opephora	100	100	15.76	18.71	11.56	11.85
Rhizoselenia	0	17	0	1.17	0	0.6
Skeletonoema	50	0	1.82	0	4.28	0
Synedra	17	0	0.61	0	0.21	0
Thalassionema	50	0	1.82	0	1.28	0
DINOFLAGELLATES						
Exuviella	83	83	4	5	13.28	9.44
Gymnodinium	100	100	10	8	4.93	6.63
Peridinium	0	67	0	2	0	0.8
Prorocentrum	100	100	10	15	29.55	32.13

S = Shinnecock

M = Moriches

1975 PHYTOPLANKTON DATA

TABLE IV

COLUMN A	COLUMN B		COLUMN C		COLUMN D	
DIATOMS	S	M	S	M	S	M
Asterionella	17%	0%	2%	0%	1%	0%
Bidulphia	50	17	12	2	1	/1
Campylodiscus	33	33	5	5	1	/1
Ceratium	17	17	2	2	/1	/1
Chaetoceros	50	33	7	5	3	/1
Cocconeis	100	100	43	60	9	6
Coscinodiscus	100	100	69	50	23	5
Gramatophora	17	0	2	0	/1	0
Gyrosigma	33	33	5	5	1	/1
Leptocylindricus	33	33	5	5	2	9
Licmorpha	17	33	2	5	/1	/1
Navicula	83	100	33	26	6	1
Nitzschia	100	100	29	17	4	1
Opephora	100	100	76	52	17	5
Rhizoselenia	100	50	14	7	5	/1
Skeletonema	33	17	7	2	2	/1
Synedra	17	0	2	0	/1	0
Thalassionema	33	0	5	0	1	0
Thalassiothrix	17	0	2	0	1	0
DINOFLAGELLATES						
Exuviella	100	100	33	29	26	9
Goniaulax	17	33	2	5	1	1
Gymnodinium	67	67	17	14	8	2
Peridinium	17	17	2	2	/1	/1
Prorocentrum	100	100	43	36	6	57

S = Shinnecock

M = Moriches

NOAA FORM 25-13
(2-73)

BIBLIOGRAPHIC DATA SHEET

U. S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

1. NOAA ACCESSION NUMBER NOAA-77060703	2.	3. RECIPIENT'S ACCESSION NUMBER
4. TITLE AND SUBTITLE Primary Productivity and Basic Food Chain Relationships in Two Long Island Bays		5. REPORT DATE March 1977
		6.
7. AUTHOR(S) R. E. Fox		8. REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS New York Division of Marine and Coastal Resources		10. PROJECT/TASK NO. Proj. 3-182-R
		11. CONTRACT/GRANT NO.
12. SPONSORING ORGANIZATION NAME AND ADDRESS NOAA National Marine Fisheries Service Washington, DC 20235		13. TYPE OF REPORT AND PERIOD COVERED Compl. Rept June 1973-March 1976
		14.

15. PUBLICATION REFERENCE New York Division of Marine and Coastal Resources Completion Report for Project No. 3-182-R, for the Period June 1, 1973 - March 31, 1976, March 1977. 23 p, 12 fig, 3 tab.

16. ABSTRACT

A three year study was undertaken to determine primary productivity and basic food chain relationships in two Long Island embayments. The areas chosen were Moriches Bay and Shinnecock Bay, located on the southern shore of Long Island. Moriches Bay receives waste loadings from treated wastes and sludge deposits originating from past and present duck farms located on tributaries to the bay. Shinnecock Bay is connected via a coastal canal (Quantuck Canal) to Moriches but does not have any major sources of pollution located along its shoreline. The study was designed to determine water quality in the two bays, sediment distribution, the effects of precipitation on water quality and phytoplankton populations. Analyses of the data do not indicate any significant differences between the two bays on the basis of the parameters chosen. The average salinity of Moriches Bay was 1.6 ppt (o/oo) lower than the average salinity of Shinnecock Bay (27.5 o/oo versus 29.1 o/oo). (Author)

17. KEY WORDS AND DOCUMENT ANALYSIS

17A. DESCRIPTORS

*Food chains, *Primary biological productivity, Water quality, Precipitation (Meteorology)

17B. IDENTIFIERS/OPEN-ENDED TERMS

Long Island Bays, Sediment distribution

17C. COSATI FIELD/GROUP

4B, 6F

18. AVAILABILITY STATEMENT Released for distribution: Elaine S. Downs	19. SECURITY CLASS (This report) UNCLASSIFIED	21. NO. OF PAGES 25
	20. SECURITY CLASS (This report) UNCLASSIFIED	22. PRICE PC A02/MF A01

NOAA FORM 25-13 (2-73) SUPERSEDES ALL PREVIOUS EDITIONS. ☆ U. S. GPO:1976-0-665-661 '1159

END
DATE
FILMED
8-16-77
NTIS