A PRELIMINARY DESCRIPTION OF THE PECONIC BAY ESTUARY

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with contributions by
New York Ocean Science Laboratory
and
Adelphi University, Institute of Marine Science

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Approved for Distribution
J.R. Schubel
J. R. Schubel, Director

A Dedication to Entrepreneurs and Regional Planners

But I behold a fearful sign,
   To which the white men's eyes are blind;
Their race may vanish hence, like mine,
   And leave no trace behind,
Save ruins o'er the region spread,
And the white stones above the dead.

Before these fields were shorn and tilled,
   Full to the brim our rivers flowed;
The melody of waters filled
   The fresh and boundless wood;
And torrents dashed and rivulets played,
And fountains spouted in the shade.

Those grateful sounds are heard no more,
   The springs are silent in the sun;
The rivers, by the blackened shore,
   With lessening current run;
The realm our tribes are crushed to get
May be a barren desert yet.

From "An Indian at the Burial-place of his Fathers"
William Cullen Bryant, 1824.

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ABSTRACT

The hydrographic features of the Peconic Bay estuary are described from the data of a March 1975 cruise by the Marine Sciences Research Center (MSRC) and from a series of cruises in Flanders Bay from 1971 to 1974 by the New York Ocean Science Laboratory (NYOSL).

The Peconic Bay estuary in March was a vertically homogeneous estuary dominated by a strong and turbulent tidal flow. The discharge rate of fresh water into the bay is small in relation to the tidal exchange so that the mean fraction of fresh water was only six per cent. Tidal mixing and exchange in the open bays appears capable of rapidly diluting and dispersing pollutants introduced with fresh water discharges.

Water quality problems presently exist in the vicinity of waste outfalls in tributaries to Flanders Bay and in Sag Harbor. Less easily identified discharges in the commercial harbors of Greenport have caused high total coliform counts resulting in shellfish area closures. Eutrophication in the Peconic River (Meetinghouse, Sawmill and Terrys Creeks) is promoted by nutrient-rich discharges of municipal and duck-farm outfalls. No data were available on the receiving water and sediment quality in Sag Harbor which has received untreated domestic and industrial wastes for many decades.

The existing environmental conditions in the Peconic Bay estuary support a large commercial and sport fishery of considerable economic value. A degree of environmental stability against man-induced stresses is achieved by the dispersive action of the tidal circulation. This resistance to environmental change gives the estuary a capacity, within limits, to absorb future development in the drainage area under prudent resource planning and management.

I. INTRODUCTION

The Peconic Bay estuary lies cradled between the North and South forks of Eastern Long Island, New York (Fig. 1). The estuary consists of a series of connecting bays beginning with Flanders Bay at the head of the estuary into which the Peconic River discharges, and stretches east to form Great Peconic Bay, Little Peconic Bay and on to Shelter Island Sound. Shelter Island Sound opens seaward into Gardiners Bay by means of two tidal channels. At the mouth of the Peconic River is the town of Riverhead, New York (population 7,585 in 1970). Riverhead is readily accessible to the metropolitan area of New York City 130 km (81 st. miles) west by road or rail. Riverhead is the commercial district for the region and a county center.

The drainage area feeding the Peconic Bay estuary is estimated to have a total area of 505 km^2 (195 st. $miles^2$). Land use of the Towns of Riverhead, Southold, Southampton and Shelter Island which abut the estuary is developed for agricultural and residential use with no heavy industry (one exception is a metal plating factory in Sag Harbor). The population trends shown in Table 1 demonstrate that the area population has shown a significant

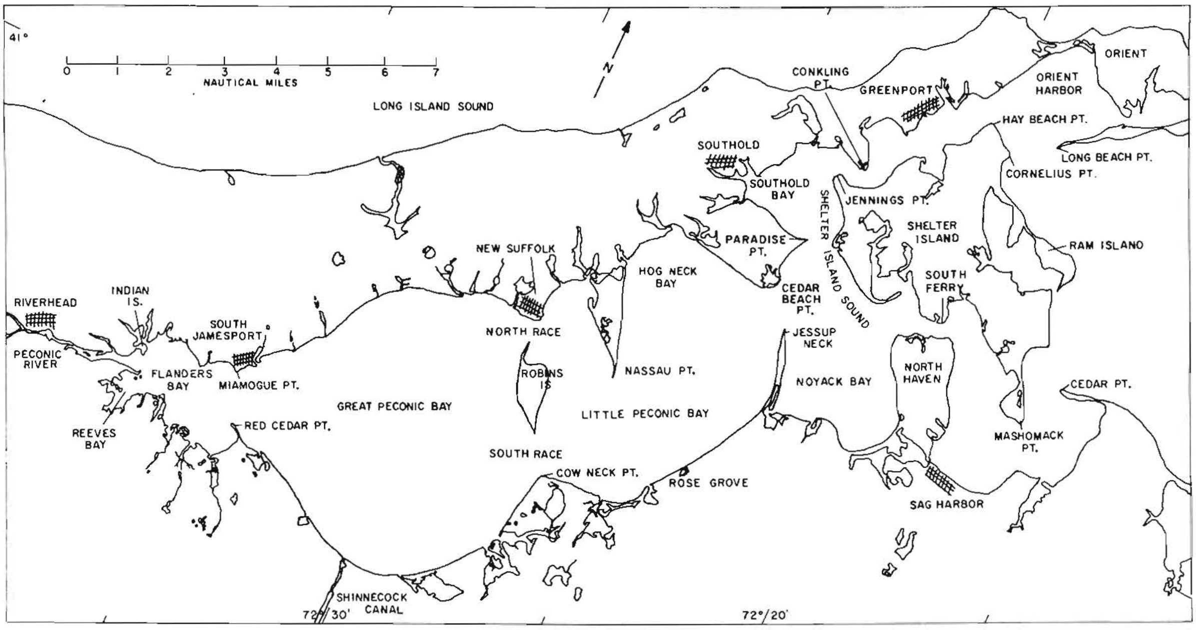

Figure 1. Geographic Features of the Peconic Bay Estuary.

Table 1. Population Trends in the Peconic Bays - Drainage Area

(U.S. Department of Commerce)

	Population		%	Total Area[1]	Population Density individuals/km^2	
Town	1960	1970	Change	(km^2)	1960	1970
East Hampton	8,827	10,980	24.4	186.2	47.4	59.0
Riverhead	14,519	18,909	30.2	174.4	83.2	108.4
Shelter Island	1,312	1,644	25.3	29.4	44.6	55.9
Southampton	26,861	35,980	33.9	438.1	61.3	82.1
Southold	13,295	16,804	26.4	128.1[2]	108.8	131.2
Total	64,814	84,317		956.2		

[1] Nassau-Suffolk Regional Planning Board. 1968. Existing Land Use.
[2] excludes Fishers Island

increase in the 1960 to 1970 decade of 24 to 34 per cent. The resulting increase in population density causes a shift from agricultural use to residential and business, a trend which is expected to continue. The north fork is shown to have the greatest population density where the town of Southold has 131 individuals per square kilometer (340 individuals/miles^2).

The Peconic Bay estuary has served as a rich fisheries resource since 1640 when Southold and Southampton were first settled by Europeans. The fishery in the early history of the Peconics was at first operated by farmers turned part-time fishermen in response to local markets. A significant commercial coastal whaling industry was pursued until 1750 by fishermen living along the Peconics although whales were found seaward of the estuary. Whaling continued to be a lucrative industry in the region. Between 1820 and 1845 whaling was pursued on a global scale with large whaling vessels sailing from Sag Harbor, Greenport, Jamesport and New Suffolk (Mather, 1887).

The first large scale commercial fishery in the Peconic Bays came in the 1830's when it was realized that menhaden could be used as a cheap but excellent fertilizer in addition to being a source of oil (Mather, *loc. cit.*). Large bunker processing factories were operated at Sag Harbor, Orient, Southold and Shelter Island (Mather, *loc. cit.*).

In 1844, the Long Island Railroad finished a track from Long Island City to Greenport, New York which shortened the transport from several days by sail to 5 hours by rail. With access to larger markets, the fisheries in the Peconics expanded. By the 1880's, the Peconic and Gardiners Bay supported an extensive pound net, oyster, scallop, quahog, soft clam, eel and menhaden fishery. With the exception of the menhaden fishery, these fisheries continue to the present day.

In 1969, the last year in which the National Marine Fisheries Service published market landing data by area, Area 8 (Gardiners, Peconic and adjoining bays) reported a total fish landing of 1.3×10^6 pounds and a total shellfish landing of 1.9×10^6 pounds. Region 8 reported the largest landings caught within state waters for weakfish (*Cynoscion regalis*), bay scallops (*Aquipecten irradians*), blowfish (*Sphaeroides maculatus*), porgy (*Stenotomus chrysops*), oyster meats (*Crassostrea virginica*) and butterfish (*Poronotus tricanthus*). The fish are largely caught by pound nets and small draggers. The bay scallop landings in Region 8 account for 83 to 98% of the market landing for New York State for 1955, 1960, 1965 and 1969 and presumably for intervening years.

It is virtually certain that the intense sport fishery within the Peconic Bay estuary exceeds the commercial fishery particularly in supporting local businesses geared to servicing this activity. The most sought after species by anglers include winter flounder (*Pseudopleuronectes americanus*), striped bass (*Morone saxatilus*), blue fish and snapper (*Pomatomus saltatrix*), weak fish (*Cynoscion regalis*) and porgy (*Stenotomus chrysops*). The sport fishery coupled with recreational usages of the bays and their aesthetic attraction for tourism are important to the local economy.

The importance of the Peconic Bay estuary as a nursery and spawning ground to the regional coastal fisheries remains unestimated despite evidence that it is substantial. Perlmutter (1939) after conducting a survey of young fish and eggs in all Long Island coastal waters concluded "the general area extending from Great Peconic Bay eastward to Montauk Point and vicinity is relatively more important as a spawning and nursery area for most of the so-called summer fishes than any other region of the island." Because fish eggs and larvae are delicately adjusted to their surroundings, any environmental modifications in the estuary should carefully be weighed for their impact on the coastal fisheries.

Despite the fact that the Peconic Bay estuary is a unique marine resource with a demonstrated capacity for absorbing various exploitive pressures for over 300 years, nevertheless, very little basic information is available about the estuary's physical, chemical, biological or geophysical characteristics. The absence of this information precludes a rational management of this estuary that is now faced with increasing and competitive demand.

The waters of the Peconic Bay estuary are routinely sampled for shellfish sanitation purposes by the New York State Department of Environmental Conservation and since 1975 the surface water quality of the Peconic Bays has been monitored by Suffolk County Department of Environmental Control. These data are, of course, insufficient to describe the nature of an ecosystem and no criticism of either S.C.D.E.C. or N.Y.S.D.E.C. is intended. These regulatory agencies design specific sampling programs to carry out their regulatory functions but not to unravel the complex web of causes and events which drive an ecosystem. Nevertheless, the data produced by such a monitoring program, provide valuable supplementary data to an ecosystem investigation.

A search of the literature unearths only a limited number of published reports on the Peconic Bay estuary. Appendix A includes a listing of all published reports of variable quality and pertinence of which we are aware. The more important of these previous studies include: a commercial fisheries survey in 1887 (Mather, 1887), a shellfish sanitation survey in 1908 (New York State Department of Health, 1908), and a biological survey of New York's coastal waters in 1938 (New York State Conservation Department, 1939).

More recent studies in the Peconic Bays include the series of cruises to be discussed in this report, a technical report on surface salinity and phytoplankton relationships (Nuzzi, 1973), and a number of papers on the fisheries sponsored by the N.Y.S. Department of Environmental Conservation (Briggs, 1965, 1968; Finkelstein, 1969; Perlmutter et al., 1956; Poole, 1966).

Four recent or ongoing studies of the Peconic Bays may provide new information when the data becomes available. One is a study of fish larvae from a sampling program over several years by Steven Ferraro at the State University of New York at Stony Brook. The second is an investigation of bay bottom sediments under the direction of Dr. Nicholas K. Coch at Queens College. A third modeling study by Douglas Crocker at the State University of New York at Stony Brook calculates residual currents over a diurnal tidal cycle using tidal heights at the open boundary to drive the circulation. The fourth, directed by Professor J. R. Welker at the Marine Science Center, Southampton College, New York, is a continuing study since 1968 of Flanders Bay, adjoining salt creeks, and the lower Peconic River. These data include temperature, salinity, nutrient chemistry, and phytoplankton identification.

This report was undertaken for the Nassau-Suffolk Regional Planning Board to begin the assembly and interpretation of existing water property data related to the Peconic Bays. The data used in this report are primarily based on a comprehensive cruise of the Peconic Bay estuary sponsored by the Marine Sciences Research Center in March 1975, and on a series of cruises by the New York Ocean Science Laboratory in Flanders Bay from 1971 to 1974.

This report is not intended to be a comprehensive analysis of the Peconic estuary hydrography but rather a preliminary description of the estuary based on limited available data. It evaluates the existing water quality and offers suggestions on needed research.

II. GEOGRAPHIC AND HYDROGRAPHIC CHARACTERISTICS OF THE PECONIC BAY ESTUARY

The Peconic Bay estuary consists of four interconnecting bays or sounds. The distinguishing boundaries defining each water body (shown as dashed lines in Figure 2) consist of necks or spits which constrict the estuary width. The chain of bays extends east from the head of the estuary at Riverhead, New York, to open into Gardiners Bay, a distance of 33 km (20 miles) (Fig. 1). The major point source of fresh water to the estuary is the Peconic River which discharges at Riverhead. The average annual discharge rate is 1 m^3/sec (23 mgd) (Table 2). Based on calculations from this report non-point sources of fresh water from ground water seepage and runoff constitute the greatest source to the bay. It is assumed for this preliminary report that the annual rates of precipitation and evaporation over water are approximately equal.

The Peconic Bay estuary is separated from Long Island Sound on the north by the elongated and narrow land mass that constitutes the Town of Southold. The land width dividing the two water bodies varies from 0.2 to 4 km (0.1 to 2.5 miles). The southern border of the Peconic Bay estuary is formed by the wider peninsula of Southampton Town which isolates the bays from the Atlantic Ocean. The width of the south fork of Long Island varies from 1.5 to 11 km (0.9 to 7 miles). Mass exchange of the Peconic Bay estuary with either Long Island Sound or the Atlantic Ocean is indirect and must take place after mixing in Gardiners Bay. A limited exception to this exists in the case of Shinnecock Canal whereby a small rectified flow leaves Flanders Bay to discharge into Shinnecock Bay.

The chain of bays comprising the Peconic Bay estuary features a convoluted shoreline having numerous necks, islands, bluffs, salt creeks, and marshes. These features are common to a coastal plain estuary formed by the flooding of a river valley (Pritchard, 1955). However, the

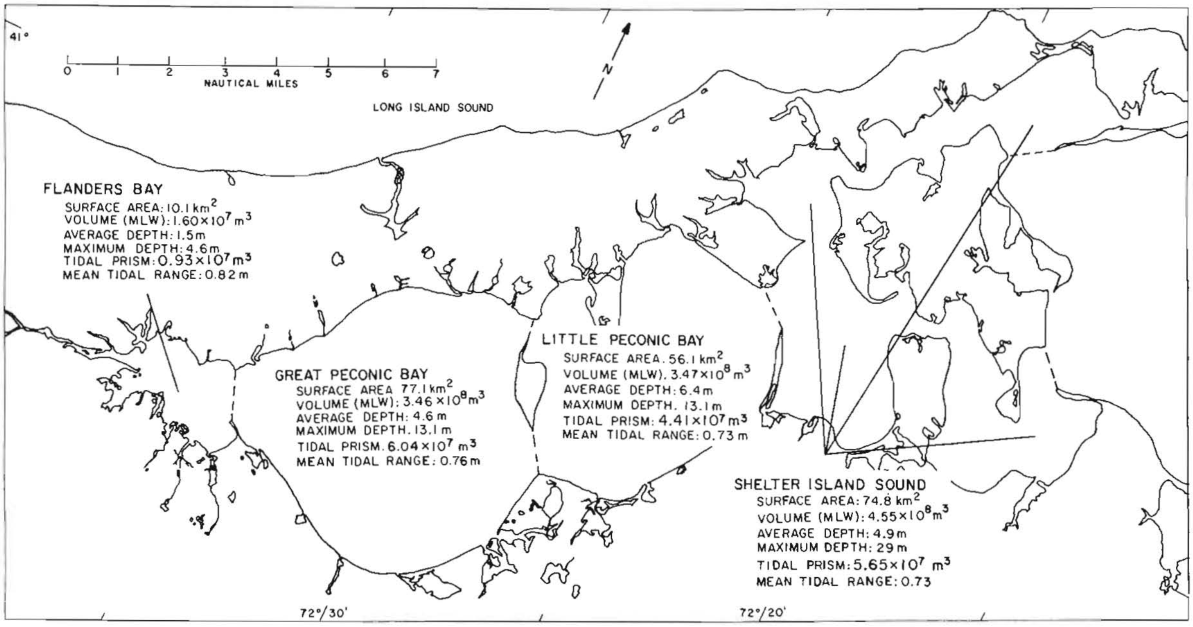

Figure 2. Hydrographic Characteristics of the Peconic Bay Estuary.

Table 2. Gauged Flow of the Peconic River Drainage Area: 194 km^2

Average Discharge Over 32 Year Record: 0.98 m^3/sec.

Average Monthly Discharge (m^3/sec) October 1973 to March 1975

Month	1973	1974	1975*
	Discharge (m^3/sec)		
October	0.86		
November	1.00		
December	1.36		
January		1.78	1.37
February		1.63	1.47
March		1.63	1.50
April		1.91	
May		1.65	
June		1.38	
July		0.78	
August		0.65	
September		0.81	

*Estimated - personal communication; Tony Spinello, U.S.G.S., Mineola, New York.
From U.S. Geological Survey, Mineola, New York.

river valley now occupied by the Peconic Bay estuary was formed both by stream erosion and by the action of glacial deposition. Two terminal moraines were deposited on Long Island during stages of the Laurentide Glacier which began 50,000 years ago and receded 10,000 years ago (Teal and Teal, 1969). The oldest and southernmost moraine, called the Ronkonkoma moraine, forms the southerly line of hills which compose the south fork eastward to Montauk and Block Island. The ice mass receded and then stalled to form a second moraine, termed the Harbor Hills moraine, which formed the north fork of eastern Long Island extending eastward to form Plum Island, Fishers Island to Cape Cod. The glacial deposits outwashed from the moraines form the substrate of the bays and coastal plains and range from erratic boulders, gravel and sand to fine silt and clay. Brennan (1973) found that the sediment composition of the Peconic Bays range from moderately to well sorted and fine to coarse grained. The coarsest sediments were found in deeply scoured tidal channels. Mid-bay sediment samples collected in Great Peconic, Little Peconic and Noyack Bays contained poorly sorted sandy muds containing a high content of fine organic debris. Brennan considered that the origin of the organic material was duck-farm drainage.

Blocking the entrance to the Peconic Bay estuary is Shelter Island which confines tidal flow into channels to the north and south of the island. Tidal circulation in these narrow but deep channels is vigorous where surface currents reach 1 m/sec (2 knts) off Hay Beach Point, and 0.9 m/sec (1.7 knts) at Mashomack Point. The tidal flow in these channels is turbulent which promotes active mixing of the water column during each tidal excursion. The sill or limiting depth over which saline water from Gardiners Bay must flow to enter the Peconic Bay estuary is 10.4 m (34 ft) in the north channel west of Long Beach Point and 6.1 m (20 ft) in the south channel off Mashomack Point.

A second outlet to the ocean exists in Great Peconic Bay where the 1.5 km (0.9 miles) long Shinnecock Canal connects with Shinnecock Bay. Shinnecock Bay is open to the Atlantic Ocean by means of an inlet 5.2 km (2.8 n miles) south of the canal. However, the canal, used for boat navigation, serves as a minor outlet for Great Peconic Bay drainage because the canal is locked during tidal current sets from Shinnecock Bay. The canal is maintained by Suffolk County. Data were not available on the volume of this flow.

The basic hydrographic characteristics are summarized for the Peconic Bay estuary in Table 3 and for the individual bays with defined boundaries used in this report in Figure 2.

The constricted passages separating the bays are often locations of tidal races. In the passages between Shelter Island Sound and Little Peconic Bay, between Jessups Neck and Cedar Beach (Fig. 1), spring tidal currents reach 1.1 m/sec (2.2 knts) (Coast and Geodetic Survey, 1958). The strongest tidal currents in the Peconic Bay estuary occur in the South Race which separates Little Peconic Bay from Great Peconic Bay, between Cow Neck and Robins Island (Fig. 1). Here spring flood currents may reach 1.2 m/sec (2.4 knts). Vertical eddy turbulence in the races actively mixes the water column during each phase of the tidal oscillation. Standing wave fields generated in the races under certain conditions of running tides and opposing winds often present a severe hazard to small craft.

Tides dominate the circulation and mixing of water in the Peconic Bay estuary. The wind is of secondary importance in dispersal and mixing for the following reasons: (1) except for Flanders Bay, the bays are relatively deep, (2) the bays are sheltered by encircling land masses, (3) the mouth of the estuary is sheltered by islands. Both Shelter Island at the entrance to the estuary and Gardiners Island further east protect the estuary from incoming wind waves and swells generated in Block Island Sound or the Atlantic Ocean.

Fetches (unobstructed distance for wind flow over water) are short within the bays so that sea states are limited to rough chops (short-period waves) with less than two-meter wave heights even under strong gale conditions. Storm surges created by northeast to southeast winds cause flooding of low lying areas within the bays. Highest tides of record within the bays have reached 2.4 m (8 ft) along the north shore and 2.6 m (8.5 ft) along the south shore (U. S. Department of Commerce, 1950-1969). Conversely, strong and sustained northwest winds reinforce the ebb causing abnormally low tides. Normally covered shallow areas become exposed, an event used to advantage by knowledgeable shellfish diggers.

The tidal range is fairly uniform from Gardiners Bay to Flanders Bay where the mean variation over the study area is less than 0.12 m (5 in). The mean tidal range is 0.76 m (2.5 ft) in Gardiners Bay, decreases to 0.7 m (2.3 ft) in Shelter Island Sound, and increases to 0.82 m (2.7 ft) at South Jamesport.

The tidal bulge arrives in Riverhead 2.9 hours after it reaches Gardiners Bay because of frictional resistance and constriction of tidal flow in channels or passages separating the bays. The successive positions of the crest of the

Table 3. Basic Data for the Peconic Bay Estuary

Surface Area	218 km^2
Depth, Average	4.7 m
Depth, Maximum	20 m
Length, Riverhead to Long Beach Point, Orient	33 km
Width, Range	0.5 to 9.8 km
Volume (MLW)	11.64×10^8 m^3
Tidal Prism	17.0×10^7 m^3
Mean Tidal Range	0.76 m
Average Flushing Time	56 days
Net Fresh Water Flux to Gardiners Bay (March, 1975)	4 to 8 m^3/sec
Net Fresh Water Flux to Gardiners Bay, Annual Average	3 to 5 m^3/sec
Salinity, Average, Bays	28 ppt
Fresh Water in Bay	6 %
Drainage Area, Total	505 km^2
Peconic River[1]	194 km^2
Population Tributary to Bay (1970)[2]	84,000
Precipitation on Drainage Area, Annual Average[3] (Bridgehampton /63 yr. record/)	1.16 m

[1] U.S. Geological Survey, Mineola, New York

[2] U.S. Department of Commerce, Bureau of Census

[3] U.S. Department of Commerce, NOAA, Environmental Data Service, 1972

tidal bulge over a time series can be represented by a family of cotidal lines. Weyl (1974) has plotted the cotidal lines for equal range and phase in the Peconic Bay estuary based on tide and tidal current tables (Fig. 3).

In the absence of fresh water discharges in the estuary the salinity of the estuary would be the same as that of Gardiners Bay. Fresh water discharges into the Peconic Bays, however, dilute the sea water. The balance resulting from the rate of fresh water input to the estuary and its removal through exchange with Gardiners Bay water is an index of the effectiveness of tidal circulation. The fraction of fresh water in the bay can be estimated from the salinity gradient existing between Gardiners Bay and the average salinity of the Peconic Bay estuary. Using data taken during the March 1975 cruise by MSRC, the salinity of Gardiners Bay can be taken as 29.40 ppt. The average salinity of the Peconic Bay estuary (salinity values for Flanders Bay used data from a March 1973 cruise of the New York Ocean Science Laboratory) is estimated at 27.7 ppt. Then the fraction

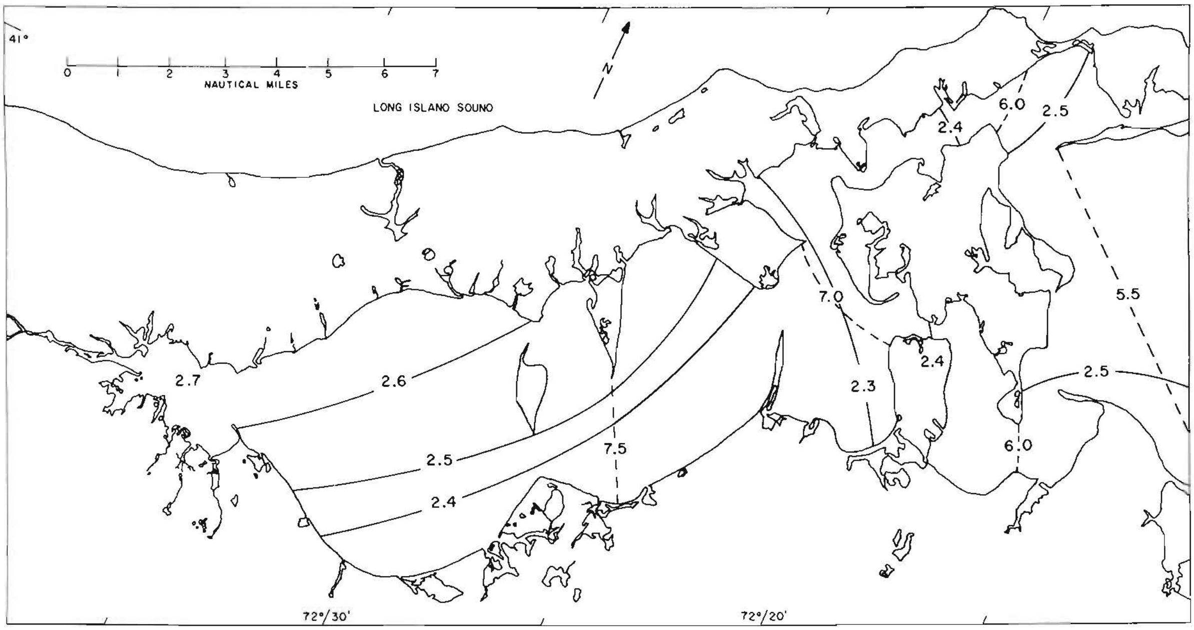

Figure 3. Mean Tidal Range and Phase. The phase is the time in hours after the moon crosses the meridian of Greenwich to the middle of the time interval on falling tide between high and low.

———— Range of Mean Tide (feet) -------- Phase of Mean Tide (hrs)

(P. K. Weyl, 1974)

of fresh water in the bay in March 1975 was 29.4 ppt - 27.7 ppt/29.4 ppt x 100 = 6.1 per cent. Therefore, the magnitude of the tidal flux is seen to greatly exceed fresh water discharges into the bay. This is of importance to the water quality of the estuary since pollutants commonly enter the estuary with fresh water effluents. Thus, we can anticipate that pollutants introduced into the Peconic Bay estuary will be subject to relatively rapid mixing and diffusion by the tides.

If we consider fresh water as a pollutant, it is possible, using data of the March 1975 cruise, to make some first order approximations of the fresh water drainage and flushing times in the Peconic Bay estuary. Weyl (1974) developed a pollution susceptibility model of the coastal and bay waters of Nassau and Suffolk counties. The model, based on a careful analysis of tide and current tables, defined tidal amplitude and phases for the region (Fig. 3). These tide analyses were used to create a series of pollution susceptibility contours which describe the relationship of a unit flux of a pollutant to its resulting concentration. Weyl formulates the relation as:

$$C = PS_{ss} \times P$$

C equals the pollutant concentration in parts per billion. P equals the discharge rate of the pollutant in metric tons per day, and PS_{ss} equals the steady state pollution susceptibility which was derived by Weyl as:

$$PS_{ss}(x) = \int_{x=0}^{X} (2/F(x)T)dx$$

x is the location along the longitudinal axis of an estuary from mouth to head

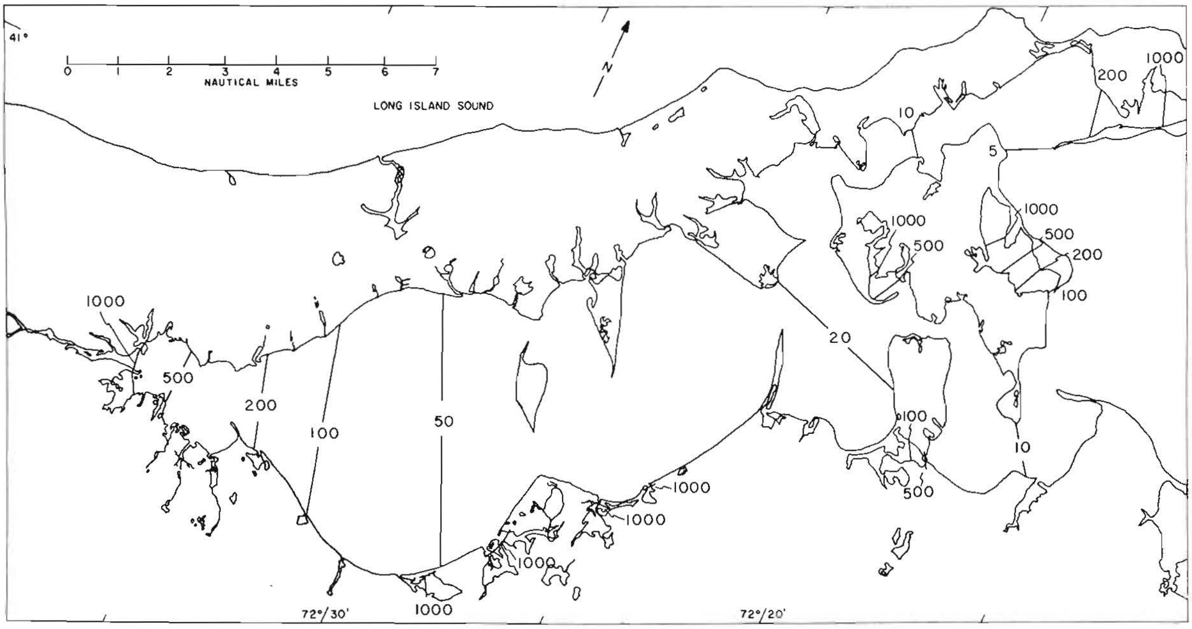

Figure 4. Steady State Pollution Susceptibility ($\frac{\text{ppb day}}{\text{ton}}$) Contours (From: Weyl, 1974).

expressed in kilometers. T is tidal excursion in kilometers. F is the average scalar tidal flow in km^3/day. PS$_{ss}$ has the units of day/km^3 or day/10^9 metric tons with values ranging from 0 to 1,000. Weyl calculated pollution susceptibility contours for the Peconic Bay estuary (Fig. 4).

Using these steady state pollution susceptibility contours, we can proceed to compute the fresh water flux into the estuary using salinity data obtained in the March 1975 cruise. The salinity and PS$_{ss}$ at the junction between Flanders Bay and Great Peconic Bay (Red Cedar Point), Great and Little Peconic Bays (Robins Island), Little Peconic Bay and Shelter Island Sound (Jessups Neck), and Shelter Island Sound and Gardiners Bay (Cedar Point) were estimated and given as shown.

Location	Salinity ppt	Fresh water per cent	PS$_{ss}$ (Figure 4)
Cedar Point	29.4	0.00	5
Jessups Neck	29.0	1.4	22
Robins Island	28.5	3.2	43
Red Cedar Point	27.1	8.5	250

The salinity at the entrance to Flanders Bay (Red Cedar Point) was 27.1 ppt having been diluted by 8.5 per cent of fresh water from the 29.4 ppt salinity water entering from Gardiners Bay (Cedar Point). Such a dilution would result from a fresh water addition of 0.085 x 10^9 ppb/275 day/10^9 metric ton = 340,000 metric tons/day, equivalent to a fresh water input of 3.9 m^3/sec using the relation of Weyl (1974) where $P = C_{(ppb)}/P_{ss}$. The fresh water flux into the bay at Robins

Island and Jessups Neck is similarly calculated as 8.6 m^3/sec and 7.4 m^3/sec, respectively. While the computed values of fresh water flux at Robins Island and Jessups Neck are in reasonable agreement, the discharge rate calculated at the entrance to Flanders Bay is low. This may be an error in the estimated pollution susceptibility value or the measured salinity may not be representative of the average dilution. However, for a first order approximation the range of the calculated fresh water flux into the estuary can be estimated as 4 to 8 m^3/sec. In a steady state balance the rate of fresh water input equals the net flux of fresh water from the estuary. Since these calculations are based on peak flow periods (Table 2) the average annual net flux of fresh water to Gardiners Bay is two-thirds of the stated values, or 3 to 5 m^3/sec.

The flushing or residence time of an estuary is the average time required to replace the existing fresh water in the estuary at a rate equal to the fresh water discharge. Using Weyl's model, the flushing time of the various bays of the Peconic Bay estuary may be estimated by adapting a method used by Weyl and Robbins (1975).

The residence time for each bay is calculated by:

$$T_n = \Sigma\ PS_{k,n}\ V_k$$

where $PS_{k,n}$ is the estimated average steady state pollution susceptibility value in bay k (Fig. 4) caused by a unit discharge in bay n and V_k is the bay volume at mean tide. Using the above equation we derive the residence time T_n for each bay.

	$PS_{k,k}$	V_k (km^3)	T_n (days)
Flanders Bay	450	0.02	55
Great Peconic Bay	70	0.38	48
Little Peconic Bay	30	0.37	32
Shelter Island Sound	18	0.48	22

As one might anticipate, the flushing time is shown to increase as the unit of fresh water is discharged at points progressively further into the estuary. Thus the residence time in the estuary for fresh water discharges in Flanders Bay is approximately 8 weeks (55 days) whereas discharges in Shelter Island Sound are flushed from the estuary in an average of 3 weeks (22 days).

A. *Flanders Bay*

Flanders Bay forms the head of the estuary where it receives the discharge of the Peconic River and the drainage of several small creeks. We define the boundaries of Flanders Bay as indicated by the dashed lines in Figure 2. Flanders Bay is the smallest and shallowest bay in the estuary system.

The large relative tidal prism of Flanders Bay is 65 per cent of the mean low water (MLW) volume of 1.60×10^7 m^3 whereas the tidal prism to MLW volume relation in the other two bays is less than 18 per cent. Tidal mixing and exchange with the water of Great Peconic Bay is a process which promotes rapid dilution and dispersion of contaminants introduced into Flanders Bay. Without the diluting and dispersion action of this tidal exchange, Flanders Bay would be particularly vulnerable to present pollution inputs by man.

The Peconic River serves as the receiving waters for three secondary treatment plants. Two treatment plants discharge into the headwaters of the Peconic River and are operated by Brookhaven National Laboratory, Upton, New York, and Grumman Aerospace Corporation, Calverton, New York, respectively.

The Brookhaven National Laboratory discharges secondarily treated laboratory and domestic wastes into the river approximately 23 km (14 miles) upstream from the river mouth (Energy Research and Development Administration, 1975). The volume of the chlorinated effluent is 0.07 m^3/sec (1.5 mgd). Monitoring of the effluent and receiving waters is routinely performed by Brookhaven National Laboratory. Infrequent sampling of the Peconic River has been conducted by the Bureau of Radiological Pollution Control, N.Y.S. Department of Environmental Conservation (N.Y.S.D.E.C.) and by Suffolk County Department of Environmental Control (S.C.D.E.C.). The estimated average mass input of monitored nutrients from this outfall is 15.7 kg/day (34.5 lbs/day) NO_3-N and 4.2 kg/day (9.2 lbs/day) total P. Above ambient concentrations (but within regulated standards) of tritium, strontium-90 and cesium-137 measurable immediately below the point of discharge are not detectable at the river mouth (N.Y.S.D.E.C., 1972).

The Grumman Aerospace Corporation located at Calverton, New York discharges 0.001 m^3/sec (0.034 mgd) of treated wastes (S.C.D.E.C., 1975, on file). The mass flux of nutrients discharged in August 1975 contained 0.01 kg/day NO_3-N (0.02 lbs/day) and 2 kg/day (4.4 lbs/day) TKN. The outfall discharges into a short tributary to the Peconic River approximately 18 km (11 miles) upstream of the river mouth.

The Peconic River is highly productive and supports a dense growth of aquatic plants. Biologically active substances discharged into the river, whether by outfalls or runoff, are rapidly assimilated and recycled in the river ecosystem. Therefore, a major portion of the nutrients entering the river is fixed as plant tissue. Local observations suggest that a substantial organic input to Flanders Bay occurs during periods of heavy runoff when free and floating aquatic vegetation, such as duck-weed, is flushed downstream (Jim Pim, S.C.D.E.C., personal communication). This vegetation can become highly dispersed throughout the estuary before remineralization by microorganisms is completed.

Mean nutrient concentrations shown in Table 4 were measured in the Peconic River at the gauging weir located approximately 6.9 km (4.3 miles) upstream of the river mouth. The nutrient concentrations show high seasonal variability. The estimated daily mass input to Flanders Bay, using an average river discharge rate of 1 m^3/sec (U.S.G.S., 32 year gauging record), is 20.7 kg/day (45.5 lbs/day) NH_3-N; 1.2 kg/day (2.6 lbs/day) NO_2-N; 32 kg/day (70 lbs/day) NO_3-N; 70.8 kg/day (156 lbs/day)

Table 4. Background Concentrations of Monitored Dissolved Nitrogen and Phosphorus Fractions in the Peconic River over period 1972 - 1975. (Data from Suffolk County Department Environmental Control).*

	NH_3-N	NO_2-N	NO_3-N	Ortho-PO_4-P	Total-PO_4-P
# samples (N)	16	16	16	8	8
Mean Concentration (μ M/l)**	17.1	1.0	26.4	26.4	3.5
Standard Deviation	±11.4	±0.9	±20.7	±27.4	±4.8

*(Station PR1, Lat. 40° 54'49", Long. 72° 41'14" at U. S. G. S. gaging weir)

**(to convert nitrogen value to mg/l multiply by 0.014;
to convert phosphorus value to mg/l multiply by 0.031).

soluble phosphate-P; and 9.5 kg/day (21 lbs/day) total phosphate-P. The unusually high orthophosphate concentration probably results from three duck farms located on the river. No data on the total or particulate nitrogen concentration of the river are available, but because of the flushing of aquatic plants, these concentrations may be high following heavy precipitation.

The town of Riverhead discharges 0.03 m^3/sec (0.7 mgd) of secondarily treated municipal wastes near the Peconic River mouth (immediately west of Cross River Bridge, Fig. 5). (S.C.D.E.C., 1975, data on file). The reported BOD load averages 128 kg/day (282 lbs/day).

Data on the nutrient composition of this waste effluent are limited but three separate analyses taken in 1975 averaged 285.7 µM/l NO_3-N + NO_2-N and 1,757.2 µM/l of total Kjeldahl nitrogen (S.C.D.E.C., data on file). The average daily discharge of these nitrogen fractions can therefore be estimated at 10.4 kg/day (23 lbs/day) of NO_3-N + NO_2-N and 64 kg/day (140 lbs/day) of total nitrogen. Ammonia and phosphate fractions were not monitored.

Other important sources of nutrient wastes are surface runoff, seasonally periodic agricultural drainage and duck-farm outfalls, and continuous inputs such as ground water seepage.

In the past, the uncontrolled drainage of duck wastes made significant contributions to the eutrophication of certain shallow bays in eastern Long Island (FWPCA, 1966, 1967). In the last few years, the duck-farm industry has become highly regulated and secondary treatment of duck wastes prior to discharge is mandatory. The treated effluent from duck farms must have less than 50 mg/l BOD, less than 50 mg/l suspended solids, and less than 70/100 ml MPN total coliform (Dennis Moran, N.Y.S.D.E.C., personal communication). These regulations may be one factor in a decline in the number of duck farms in Suffolk County to approximately 30 farms in 1975 although the number of ducks raised has remained relatively constant. In 1975 there were five wet duck farms in operation in the Flanders Bay drainage area (Cooperative Extension Association of Suffolk County, fact sheet). The farms are located on Meeting House Creek, Peconic River, Sawmill Creek and Terrys Creek. These five farms account for approximately 37 per cent of the ducks raised in Suffolk County.

Since 5 x 10^6 ducks were reported raised in Suffolk County in 1975 (Cooperative Extension Association of Suffolk County, fact sheet), we estimate that 1.85 x 10^6 ducks per year were raised by the five duck farms in the Flanders Bay drainage basin. The reported treated effluent discharge from the five duck farms is estimated to average 0.07 m^3/sec (1.7 mgd) (N.Y.S.D.E.C.), Summary Tables, 1975). The nutrient content of this waste load is highly variable but averaged data from 14 duck farms in Suffolk County during 1975 are given in Table 5. Each flock of ducks takes seven weeks to grow for market with six to seven flocks raised over a continuous period of 42 to 49 weeks. The mass of nitrogen and phosphate discharged by the five duck farms in the Flanders Bay drainage area can be estimated at 176 kg/day (389 lbs/day) total nitrogen-N; 127 kg/day (280 lbs/day) NH_4-N; 47 kg/day (103 lbs/day) NO_3-N; and 68 kg/day (149 lbs/day) PO_4-P (calculated from Summary Table, 1975, N.Y.S.D.E.C.). The duck farms appear to remain the largest point source of nutrients to Flanders Bay. Duck farms may cease wet discharges by 1985 under the provisions of the National Pollutant Discharge Elimination System administered by the Environmental Protection Agency (Dennis Moran, personal communication).

The northern half of Flanders Bay is closed to shellfishing. This closure is regulated by the N.Y.S. Department of

Table 5. Effluent Analysis from Duck Waste Treatment Plants 1975 Summary Table (Source: New York State Department of Environmental Conservation)

	Total Nitrogen			
	TKN-N	NH_4-N	NO_3-N	PO_4-P
Mean concentration (mg/l)	27.8	20.07	7.39	10.68
Standard deviation	±12.4	±12.4	±17.17	±10.3
Number of samples (N)	18	17	18	13

(Analysis by N.Y.S. Department of Health)

Environmental Conservation and is based on total coliform bacterial counts which consistently exceed 70 mpn/100 ml (Fig. 5).

B. Great and Little Peconic Bays

Great Peconic and Little Peconic Bays with arbitrary boundaries given in Figure 2 constitute the middle section of the Peconic estuary. Because the two bays have many similar characteristics, they will be discussed together. The data of Figure 2 show the general dimensions and features of the two water bodies. Great Peconic Bay has the largest surface area of the bays in the estuary and is 37 per cent greater in area than Little Peconic Bay. On the other hand, Little Peconic Bay has a greater average depth (6.4 m, 21 ft) than Great Peconic Bay (4.6 m, 15 ft). The bays are deepest in their southern sections and slope up to shallow sand flats in their northern ends.

At the boundary separating the two bays is Robins Island which restricts tidal exchange between the bays to passages north and south of the island. The major tidal flux takes place through the south race rather than the shallower and less direct route for flow to the north of the island. The tidal flow in the south race is highly turbulent so that exchange between the bays is well mixed. A second tidal race occurs at the boundary between Little Peconic Bay and Shelter Island Sound where tidal exchange is also turbulent. Therefore, the tidal exchange between these bays appears to dissipate some tidal energy by vertically mixing the water and preventing the build-up in summer of a highly stratified water column. Such a mechanism will maintain well oxygenated water even in summer months. No vertical profiles of T, S or DO have been made in summer to test this speculation.

The data of Figure 5 show that the water quality of the two bays presently satisfies all regulatory agency criteria and that there are no closures to shellfishing. The bays are highly productive in bay scallops supporting a seasonal commercial fishery by local baymen. At present, development of the drainage area surrounding the bays is residential and farming with some business activity servicing boating or tourism. There are no identifiable large point source dis-

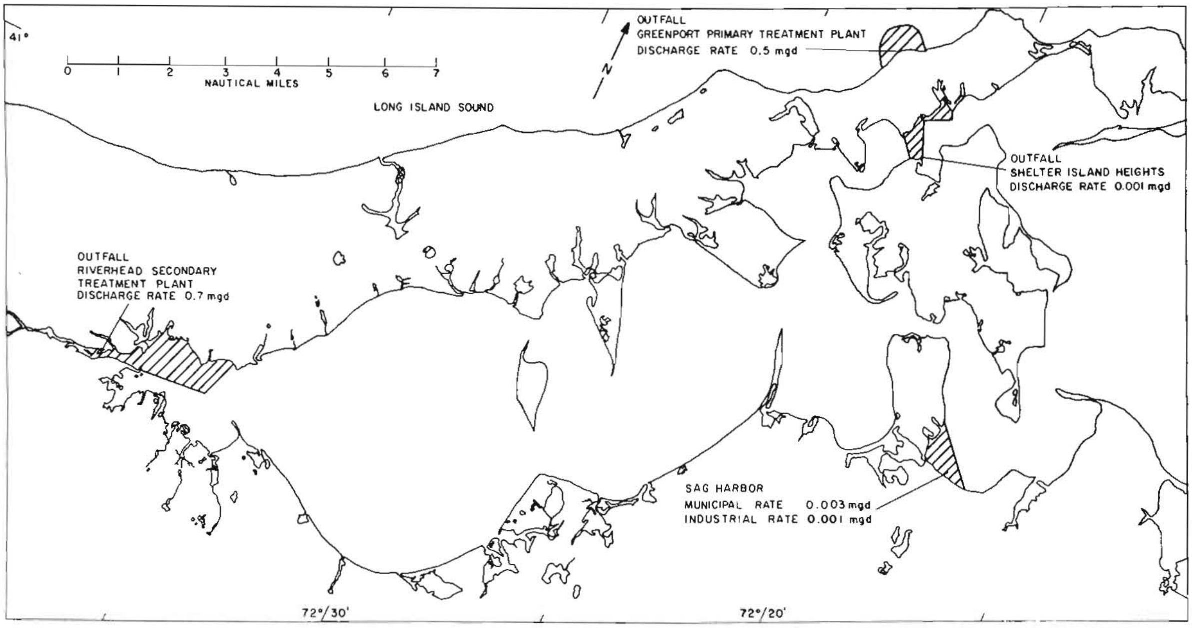

Figure 5. Areas Closed to Shellfishing and Location of Municipal Waste Outfalls 1975.
(New York State Dept. of Environmental Conservation, 1975)
(1968 Inventory Municipal Waste Facilities, EPA)

charges into the bays. Fresh water inputs into Great and Little Peconic Bays, other than Flanders Bay, are due to runoff, ground water seepage, and precipitation.

C. *Shelter Island Sound*

This water body has a very irregular geometry composed of small bays connected by deep but narrow channels. Shelter Island Sound has the largest mean low water basin volume of the bays, and although its average depth is less than that of Little Peconic Bay some channels in Shelter Island Sound reach a depth of 29 m (95 ft).

Bordering on Shelter Island Sound are several centers of commercial activity, such as Southold Village, Greenport, Shelter Island Heights, and Sag Harbor. Both Shelter Island Heights and Sag Harbor have outfalls which use the estuary for discharge (Fig. 5). The Greenport sewage district discharges secondarily treated wastes into Long Island Sound.

The Shelter Island Heights outfall services approximately 80 families and discharges 3×10^{-4} m^3/sec (7×10^3 gpd) of untreated domestic wastes in the off-season and 8×10^{-4} m^3/sec (19×10^3 gpd) during July and August. The outfall is located near Dering Harbor.

Sag Harbor has two outfalls, one discharging untreated municipal wastes, the other discharging industrial and domestic wastes from a metal plating factory. The municipal outfall discharges 8×10^{-4} m^3/sec (1.8×10^4 gpd) in winter and the discharge increases to 1×10^{-3} m^3/sec (3×10^4 gpd) in summer. The industrial discharge comes from a plant which makes watch cases--a process which requires metal plating. The factory has operated since 1881. The present discharge is 5×10^{-4} m^3/sec (12×10^3 gpd) of which 4×10^{-4} m^3/sec (9×10^3 gpd) represents industrial waste. The industrial wastes include nickel, fluoride, copper, cyanide, chromium, cadmium and arsenic (S.C.D.E.C., data on file). The town of Sag Harbor is presently in the process of constructing a secondary treatment plant which is expected to be operational by 1977. The metal plating factory will hook into the town sewage system when it becomes operational. No data were available on the composition of the Sag Harbor bottom sediments. Primarily because of these outfalls, shellfish area closures are regulated in the vicinity of the outfalls (Fig. 5).

The vigorous tidal circulation in the channels of Shelter Island Sound is complex, with local areas of strong currents and reversing eddies. Weyl (1974) estimated that 58 per cent of the tidal flux passes through the north channel of Shelter Island.

III. SURVEY METHODS AND ANALYTICAL TECHNIQUES

Physical, chemical and biological data in this report are based on survey cruises conducted by the New York Ocean Science Laboratory at Montauk, New York, and by the Marine Sciences Research Center, State University of New York at Stony Brook.

Marine Sciences Research Center
14 to 16 March 1975 Cruise

During March, 1975, the Marine Sciences Research Center sailed R/V ONRUST to the Peconic Bay estuary for a three-day comprehensive oceanographic survey of this last essentially undescribed bay system on Long Island. The scientific party included Dr. Joseph Cassin and Mr. Robert Batky, Adelphi University, bacterial analysis; Dr. Iver Duedall, MSRC, supervised water chemistry; Dr. Wayne Esaias, MSRC, chlorophyll analysis; and Mr. C. D. Hardy, MSRC, as chief scientist.

As shown in Figure 6, 32 hydrographic stations were occupied during the March cruise. No measurements were taken in Flanders Bay because navigation in the narrow channels was hazardous under existing weather conditions.

Water chemistry samples and physical oceanographic data were taken using the Plunket system developed by MSRC. The Plunket is a semi-automated sea water sampling system that permits immediate readout and recording of *in situ* temperature, salinity, dissolved oxygen, pH, turbidity and *in vivo* chlorophyll. The system consists of a submersible pump which pumps sea water from a desired depth to an instrument module on board ship. Details of the water sampling system are given by Hulse (1975). Instrumentation and the estimated precision of instrumental analyses made are given in Table 6. Water chemistry samples were frozen for later analysis ashore.

The nutrients NO_2^-, NO_3^- were determined using a Technicon^R Autoanalyzer II following procedures of Strickland and Parsons (1972). NH_4^+ was determined on the same instrument by the indophenol method. Total phosphate was determined by oxidation with persulphate. Particulate organic carbon and nitrogen samples were collected on glass fiber filters, frozen and later analyzed by a Hewlett-Packard CHN analyzer (Model 185). Acetanalide was used as a standard. Chlorophyll *a* was measured fluorometrically using a Turner Design fluorometer (Model 10-005R). Chlorophyll concentration was calibrated by acetone extraction using spectrophotometric and fluorometric techniques described in Strickland and Parsons (1972).

Water samples for coliform analysis were taken by Adelphi University personnel in sterile, 150 ml glass bottles and processed immediately. A three series five tube dilution for each medium was used. A Lactose Broth was used for presumptive MPN tests. Presumptive positive tests were confirmed by transfer to Brilliant Green Bile Broth (BG) and Difco EC Medium (EC).

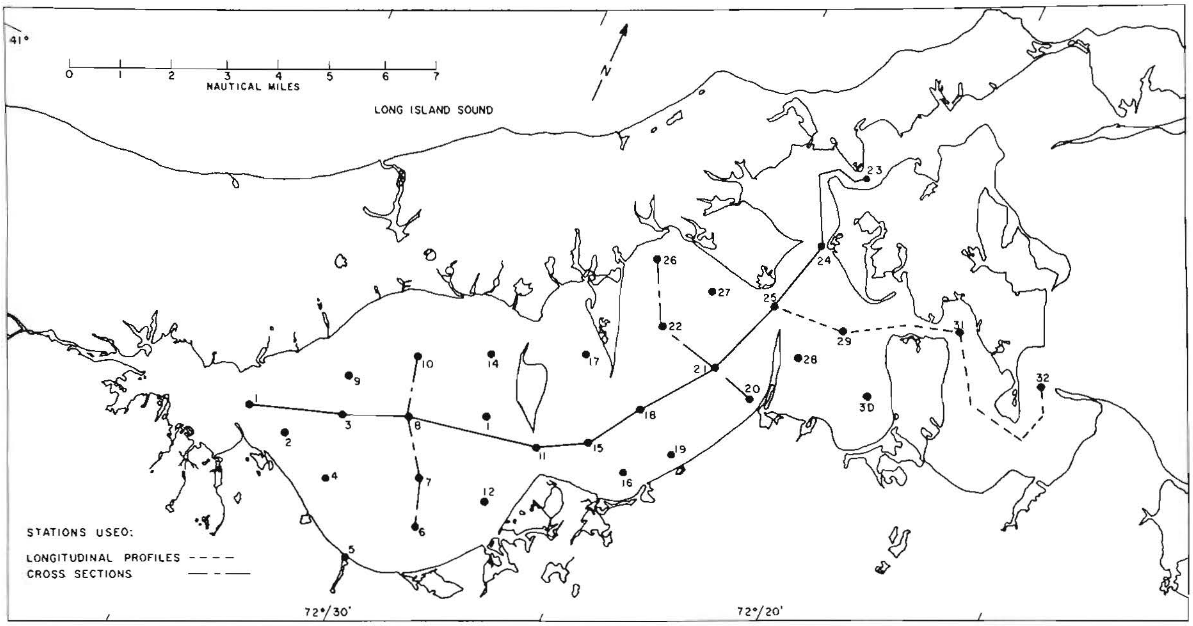

Figure 6. Station Locations Cruise 750314-16. Marine Sciences Research Center. Peconic Bays - Shelter Island Cruise 14 - 16 March 1975.

New York Ocean Science Laboratory Cruises 1971 to 1974

NYOSL conducted a series of cruises in the Peconic Bay estuary with a special emphasis on Flanders Bay. A synoptic survey of the entire estuary took place on 17 April 1971 by using two Boston Whalers, which took surface samples at a total of 25 stations, where one Whaler sampled along the north shore as the other sampled the south shore of the estuary. The hydrographic stations are indicated as A and H series in Figure 7. Because these samples were taken over a short interval of the tidal cycle (3 to 4 hours), they provide a useful picture of surface property distributions at a moment in time. Beginning in September 1972 and continuing with cruises in November 1972, March 1973, June 1973, August 1973 and January 1974, NYOSL initiated a cruise series called the Chain of Bays project which consisted of five or six stations located in Flanders Bay and lower Peconic River. The six stations are identified as the CB series shown in Figure 7. The cruise used a Boston Whaler to sample each station three times over a tidal cycle of six hours. Each cruise, therefore, took surface and bottom measurements (at deeper stations only) under ebb and flood conditions.

Temperature was measured using a bucket thermometer for surface measurements and a bathythermograph for bottom measurements. *In situ* salinity was taken on the April 1971 cruise using a Beckman RS-5 salinometer. During the Chain of Bays project, bottled samples were returned to the laboratory for salinity measurement with a Beckman RS-7 bench salinometer (Hollman, personal communication). Dissolved oxygen was measured by modified Winkler titration (Strickland and Parsons, 1972) in the laboratory using samples prepared in the field.

Nutrient analyses followed the procedures in Strickland and Parsons (1972). The trace metals, Fe and Zn, were

Table 6. Plunket System Instrumentation Specifications

Property Measured (Quantity Reported)	Instrument (Manufacturer and Model No.)	Estimated Instrumental Precision
Temperature (°C)	Glass probe thermistor Fenwal Electronics Model GB 32 MM 172 Framingham, Mass.	±0.05°C
Salinity (0/00, ppt)	Bissett-Berman San Diego, Calif. Salinograph Model 6600T	±0.05 ppt
Dissolved O_2 (ppm, % saturation)	Oxygen meter and Polarographic Electrode Yellow Springs Model 54 Yellow Springs, Ohio	±0.1 ppm
Chlorophyll-a[1] (mg/m^3)	Fluorometer Model 10-005R Turner Designs Palo Alto, Calif.	± mg/m^3
Turbidity (mg/l)	Secchi disc	±0.2 m
	Fluorometer Model 111 G. K. Turner Associates Palo Alto, Calif.	calibrated against suspended sediment
pH (pH units)	pH Meter Model 12 Research Corning Scientific Instruments Medfield, Mass.	±0.1 pH

[1] calibration by acetone extraction and spectrophotometer using UNESCO equation (Strickland and Parsons, 1968). Also, see: Carl J. Lorenzen (1966), A Method for the Continuous Measurement of in-vivo Chlorophyll Concentration, Deep-Sea Research 13:223-227.

measured using a Beckman 440 atomic absorption spectrophotometer (DuBois, personal communication).

IV. FIELD OBSERVATIONS

The three-day March 1975 cruise aboard the R/V ONRUST took place during and after a strong northeast storm. Winds on 14 March blew from the east at 10 to 14 m/sec (22 to 31 mph) with higher gusts. Air temperatures ranged between 0° and 1°C with rain and snow. Weather conditions improved on 15 March when winds shifted to the west at 8 to 10 m/sec (20 to 22 mph) dropping to less than 4 m/sec (9 mph) by 16 March. Wave heights on 14 March reached 1.1 m (4 ft) in Great Peconic Bay. The easterly storm winds were sufficiently strong to insure that the water column was well mixed. Local or small-scale anomalies in the horizontal distribution of water properties in the bay are presumed to have been rapidly dispersed by the wind and therefore would be expected to differ from patterns established under normal prevailing winds. However, the cruise data can be usefully applied to understanding the large-scale distribution of water properties in the bay.

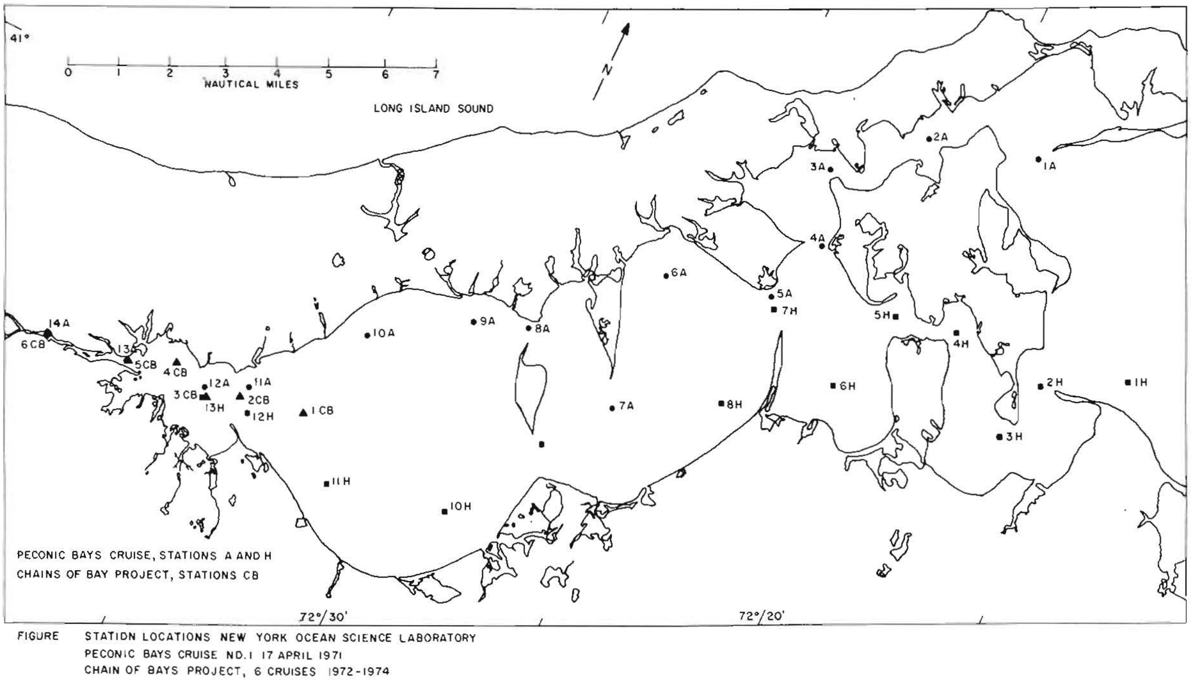

Figure 7. Station Locations New York Ocean Science Laboratory Peconic Bays Cruise No. 1 17 April 1971. Chain of Bays Project, 6 Cruises 1972-1974.

The New York Ocean Science Laboratory cruises from 1971 to 1974 are a valuable data source because their sampling program was designed to measure short-period tidal variations in the water properties in Flanders Bay as well as seasonal trends.

A. *Temperature*

The importance of water temperature in regulating both physical and biological events in the estuary makes it an essential environmental measurement. Changes in water temperature result from solar heating, atmospheric heat exchanges or from mixing with other water masses. Horizontal variations in water temperature over space create density gradients which establish circulation of the water to restore density equilibrium. Temperature controls rates of biological activity and frequently is the stimulus that triggers spawning or dormancy. Mortality results from exceeding the normal range of temperature to which biological organisms are adapted.

The data of Figure B1 for the March 1975 cruise show a temperature variation of less than 1° within the range of 2.5° to 3.4°C. Highest temperatures occurred at the head and at the mouth of the bay. The temperature maxima of Gardiners Bay water were expected because Gardiners Bay is in direct exchange with the reservoir of heat stored in subsurface waters of Block Island Sound and the Atlantic Ocean. The water of Gardiners Bay upon entering the shallow Peconic Bay estuary loses heat by conduction, radiation, and evaporation in winter. This heat loss is hastened in the shallower estuary by the vertical mixing of the water column in the turbulent tidal flow.

However, the temperature maximum existing at the entrance to Flanders Bay and in a narrow band along the southern

Table 7. Daily Air Temperatures for Selected Coastal Weather Stations of Eastern Long Island from 9 to 16 March 1975. (NOAA - Environmental Data Service, 1975)

		Day							
	°C.	9	10	11	12	13	14	15	16
Bridgehampton	Max	1.7	5.0	5.0	10.0	11.1	3.9	5.0	6.7
	Min	-8.8	-9.5	0.6	1.7	3.3	0.0	-3.2	-3.8
Greenport Power Plant	Max	7.8	1.1	5.0	6.7	10.6	10.6	5.0	5.0
	Min	-9.5	-8.8	-2.8	0.0	3.3	1.1	-3.2	-2.8
Riverhead Research	Max	4.4	6.1	6.1	6.1	11.7	7.2	5.0	7.8
	Min	-8.8	-7.2	0.0	1.7	5.0	0.0	-2.2	-3.8

shoreline of Great Peconic Bay appears anomalous because the small volume and shallow depth of Flanders Bay should allow rapid heat exchange with the atmosphere. Daily air temperatures for one week prior to and during the cruise (Table 7) indicate that warmer air temperatures existed in the area on 12 and 13 March. It appears that temperature maximum of Flanders Bay is the effect of more rapid response of this shallow bay to atmospheric heat exchange than elsewhere in the estuary. The surface temperature contours (Fig. B1) suggest that the water moving seaward from Flanders Bay may move as a narrow band along the southern shore of Great Peconic Bay.

Longitudinal profiles of the vertical temperature distribution are shown in Figure B8. The vertical contours show that both Great and Little Peconic Bays are well mixed. Shelter Island Sound displays a small vertical thermal stratification in the north channel around Shelter Island, but no vertical stratification in the south channel.

The cross-section temperature profile of Great Peconic Bay (Fig. B12) reveals a north-south temperature gradient with warmer water apparently moving seaward from Flanders Bay along the Southampton shore. The cross-section profile of Little Peconic Bay (Fig. B12) reveals only a small north-south gradient of 0.1°C.

Surface temperatures in April 1971 (Fig. B16) indicate that Gardiners Bay water temperature lags behind the vernal warming of the estuary. The colder Gardiners Bay water is present in the north channel of Shelter Island Sound but not in the surface water of the south channel. The temperature range in April 1971 was 6.3° C in Gardiners Bay to 9.3° C at the Peconic River mouth.

Water temperature surface measurements in Flanders Bay by the New York Ocean Science Laboratory show a seasonal temperature range of 5° C in January to 27° C in August (Fig. B21, B26, B30, B35, B40 and B46). These data show that temperature fluctuation during the tidal cycle generally do not vary by more than 1° C at a station.

B. *Salinity*

Variations of salinity over the estuary result from fresh water discharges, unequal precipitation and evaporation rates in time/space or mixing between different water masses. Like temperature, salinity differences create density gradients. Differences in salt concentration affect biological processes such as the osmotic balance of marine organisms. Salinity can be a limiting factor in the distribution of stenohaline organisms, those narrowly adapted to salinity variations.

Surface salinities in March 1975 are shown in Figure B2. The salinity gradient between Gardiners Bay and the entrance to Flanders Bay was 2.3 ppt with the salinity ranging between 27.1 ppt and 29.4 ppt. A lower salinity band appears to exist from Flanders Bay and along the south shore of Great Peconic Bay. Such a pattern was established in the temperature profiles previously discussed.

The longitudinal salinity profiles (Fig. B9) show that the water column had little vertical gradation. Station 15 had the largest gradient of 0.7 ppt. Cross-section salinity profiles (Fig. B13) show that the most saline water in Great and Little Peconic Bays form the bottom water in the middle of the bays which are areas of minimal tidal turbulence. The salinity structure of this estuary in March 1975 reveals an absence of two-layered stratification commonly associated with estuaries. The Peconic Bay estuary appears to fit most closely the description of a vertically homogeneous estuary (Pritchard, 1955; Cameron and Pritchard, 1963). Such estuaries exist when the tidal flow greatly exceeds fresh water discharge. Circulation in this type of estuary is in a horizontal plane.

Surface salinity distributions measured in the NYOSL April 1971 cruise (Fig. B17) are similar to the distribution found in March 1975. How the salinity of Gardiners Bay varies with spring runoff from southern New England, particularly the Connecticut River, is not known.

Seasonal salinity variations are shown (Fig. B22, B27, B31, B36, B41, and B47) to be highest in the fall (September, November) and lowest in spring (March). Salinity variations over a tidal cycle are shown to be as much as 2 ppt.

C. Sigma-t

The sigma-t (σ_t) value is a shorthand expression used by oceanographers to represent the density of water. The relationship is expressed as σ_t = (density-1) x 10^3. Therefore, the σ_t value of a water sample having a density of 1.02345 gm/cm^3 would be expressed as 23.45. σ_t values are computed from the measured temperature and salinity of the sample using equations of the U. S. Navy (1952). The accuracy of σ_t values is dependent on the quality of the temperature and salinity measurements. σ_t relationships are important for physical and mathematical descriptions of estuarine circulation.

A weak surface σ_t horizontal gradient of 1.8 was present between the entrance to Flanders Bay and Gardiners Bay (Fig. B3) in March 1975. The vertical density structure along the longitudinal axis of the estuary (Fig. B10) was slight, usually less than 0.1 gm/cm^3. Cross-section density profiles of Great and Little Peconic Bays (Fig. B14) show north-south σ_t gradients of less than 0.2 gm/cm^3 with lower density water to the south. This suggests that a weak seaward flux of low density water is deflected to the right by the Coriolus effect in Great and Little Peconic Bays.

The surface σ_t values from the NYOSL April 1971 cruise (Fig. B18) show a small lateral gradient with lowest densities along the Southampton shore.

D. Dissolved Oxygen (DO)

The DO distribution within a water body reflects an interplay between diffusional exchange at the air-sea interface, vertical and horizontal mixing within the water column, and biological generation and consumption. In shallow coastal waters where vertical mixing and diffusional exchange across the sea surface are reasonably rapid, changes in DO concentrations are generally the result of biological activity. The concentration of DO in the water column is used by regulatory agencies as an indicator of the presence of excessive loads of oxygen-demanding wastes. Dissolved oxygen measurements also reveal eutrophic conditions where the discharge of nutrient-rich pollutants may sustain excessive growths of photosynthesizing plants. In the temperate zone, dissolved oxygen consumption shows seasonal variation because biological activity is temperature dependent.

The DO concentrations during the March 1975 cruise ranged between 10 ppm and 11 ppm, thus exceeding 90 per cent saturation throughout the estuary. This is a typical condition during winter months in New York coastal waters. The northeast storm which preceded the cruise insured that diffusional exchange across the air-sea interface achieved a physical equilibrium.

Surface DO concentrations measured by NYOSL in September 1972 and August 1973 (Fig. B23 and B42) generally exceeded 100 per cent saturation. Highest DO concentrations usually occurred in the Peconic River. All measurements exceeded 5 ppm, which is the specified minimum for class SA waters in New York State.

E. Nutrients: Dissolved Inorganic Nitrogen: NH_3^+, NO_2^-, NO_3^-, Total Nitrogen and Total Phosphate

Inorganic nutrients are required by photosynthesizing green plants as the raw material from which organic matter is created. The abundance or scarcity of mineral nutrients is the principal factor controlling the quantity of organic matter produced by photosynthesis in an ecosystem. Some nutrients are normally present at low concentrations in the water and, therefore, may be depleted from the water by plant uptake. Moreover, the utilization ratios of nutrients are relatively constant. For example, plants assimilate five to 15 atoms of nitrogen for each atom of phosphorus. Therefore, the concentration of dissolved nitrogen in the water must be greater than that of phosphorus if all the phosphorus is to be assimilated. Ryther and Dunstan (1971) found that the coastal ocean waters are commonly deficient in nitrogen and that phosphorus is present at surplus concentrations. These authors concluded that the availability of nitrogen was the decisive factor in limiting or promoting phytoplankton growth.

The data of Figures B4 and B5 show very low concentrations of dissolved ammonia and nitrate during the March 1975 cruise. Dissolved nitrogen concentrations within the estuary were generally lower than concentrations representative of Gardiners Bay water. The total phosphate concentrations shown in Figure B15 were similar throughout the estuary, ranging between 0.6 and 0.9 µM/l. Total particulate nitrogen concentrations ranged between 60 and 150 µg/l and total particulate carbon ranged between 190 and 1,110 µg/l. Total particulate carbon and nitrogen are measures of the quantity of carbon and nitrogen fixed in the process of photosynthesis as organic material. The concentrations measured in March indicate the presence of a moderate to abundant standing stock of living and inert organic matter.

The April 1971 cruise data of NYOSL in Figure B19 show low orthophosphate concentrations of 1.05 to 0.15 µM/l except at the mouth of the Peconic River where concentrations were a factor of four greater. The series of cruises in Flanders Bay by NYOSL provides measurements of nitrate and phosphate during all seasons and these are shown in Figures B24, B28, B29, B32, B33, B37, B38, B43, B44, B48 and B49. In winter, nitrate concentrations approached an annual maximum in the Peconic River (Stations 6, 6; Fig. B28, B32 and B48) but considerably lower amounts existed at stations further east. Nitrate concentrations were low in January 1974, generally less than 0.6 μM/l, whereas in March orthophosphate concentrations of 2.4 μM/l existed in the Peconic River. Stations nearer Great Peconic Bay had only trace concentrations. In June, the concentration of nitrate was depleted at all stations except Station 6 in the Peconic River and at the surface of Station 4 (Fig. B37). Orthophosphate concentrations, however, showed a significant increase from winter (Fig. B38). A similar trend was repeated in August where nitrate was virtually exhausted from the water column except in the Peconic River (Fig. B43). Orthophosphate concentrations were anomalously high both in August 1973 and September 1972 (Fig. B44 and B24). In November 1972, the concentration of dissolved nitrate had increased within the western sections of Flanders Bay, whereas orthophosphate concentrations were somewhat lowered (Fig. B32 and B33).

From these measurements, scattered over several years, a seasonal trend emerges in the concentration of dissolved nitrate and orthophosphate. In winter, the concentration of nitrate in Flanders Bay builds up because of decreased biological activity as a result of seasonally lowered temperatures and reduced incident solar energy flux. However, the concentration of phosphate is diminished from concentrations measured in summer. In the Peconic River the nutrients measured were high throughout the year. During spring, summer and fall the dissolved nitrogen is virtually depleted from the water, whereas orthophosphate concentrations have a puzzling increase.

The concentration of phosphate in Flanders Bay has parallels closely matching nutrient distributions reported by Ryther and Dunstan (1971) in Moriches and Great South Bays. In these studies by the Woods Hole Oceanographic Institution, Ryther (1954) used phosphate as a diagnostic index of duck-farm pollution. The seasonal variation in orthophosphate (i.e. a high phosphate concentration in spring, summer and fall, and minimal concentrations in winter) is coincidental with the intensity of duckling production. If present duck-farming practices are the cause of this phenomenon, present background concentrations of orthophosphate should appreciably diminish with the planned change to "dry" farming in the near future.

F. *Chlorophyll*

Chlorophyll is measured as a convenient, although indirect, means to evaluate the standing crop of phytoplankton. Because a time lag exists between the uptake of a nutrient from the water to its fixation in plant tissue, the correlation between nutrient concentrations in the water and the abundance of phytoplankton at any moment in time is not straightforward. A "bloom" of phytoplankton assimilates the available nutrients and growth decreases when a limiting nutrient is depleted. Although growth may be checked, the stock of phytoplankton persists in time until dispersed or removed from the water column by grazing, sinking or decomposition.

Surface chlorophyll concentrations in March 1975 were low throughout the middle of the estuary and reached maximum concentrations greater than 7 mg/m^3 in both Flanders Bay and Gardiners Bay as shown in Figure B6. A horizontal profile of chlorophyll distribution, seen in Figure B11, reinforces the picture of greater standing stocks at both the head and the mouth of the estuary. By the middle of March Long Island Sound is in a post-bloom condition following the intense winter bloom that reaches a peak in February (Riley and Conover, 1967). One can speculate that the discharge of nutrients into Flanders Bay from the Peconic River sustained growths of phytoplankton long after phytoplankton uptake elsewhere in the estuary had exhausted the nutrients in the surrounding water. The reason for a greater standing stock of phytoplankton in Gardiners Bay appears to stem from the higher concentration of nitrate (Fig. B5) available for uptake. The source of this nitrate may be the deeper waters of Block Island Sound or runoff from the Connecticut River. The seasonal nutrient budget and its relation to regional productivity in both the Peconic Bay estuary and Gardiners Bay is deserving of a more detailed study.

The data of Figure B20 show that surface chlorophyll concentrations in the Peconic Bay estuaries measured by NYOSL in April 1971 reflect a low abundance of phytoplankton throughout the bay, except in Flanders Bay and the Peconic River (Fig. B20). Chlorophyll measurements taken in Flanders Bay between 1972 and 1974 present a picture of moderate to abundant standing stocks of phytoplankton existing at all seasons of the year (Fig. B25, B34, B39, B45 and B50). Maximum chlorophyll concentrations were measured in the offing of Indian Island (Peconic River mouth) where concentrations exceeding 30 mg/m^3 were not uncommon. Such concentrations are patchy and show large variations at a location over the tidal cycle. At times such as June 1973 (Fig. B39) much of Flanders Bay sustained growths of phytoplankton which must be considered excessive or eutrophic. Usually eutrophic growths are confined to the Peconic River mouth or the creeks to the north (Sawmill, Terrys and Meetinghouse Creeks) which are the receiving waters for duck farms (J. R. Welker, personal communication). Excessive phytoplankton growths are, therefore, most intense in the immediate area of nitrogen discharges. Again, like the nitrogen and phosphate distributions, this condition has similarities to the condition observed by Ryther and Dunstan (1971) in tributaries servicing duck farms in Moriches and Great South Bays.

G. Coliform Bacteria

Dr. Joseph Cassin and Mr. Robert Batky, Adelphi University Institute of Marine Science, sampled coliform bacteria during the March 1975 cruise. The raw data results are given in Tables 8 and 9. Numbers in parentheses indicate number per 100 ml. Numbers per 100 ml are those statistically derived most probable number (MPN) in the standard MPN table.

All water and sediment total and fecal coliform counts were low typically ranging between 0 and 2 with a maximum total coliform count of 21 in water (Station 11, Fig. B7) and 22 in the sediment at Station 26.

The bacterial densities measured in March 1975 were well below New York State water quality standard (Article 12, Public Health Law) for Class SA tidal salt waters. Class SA is for usage of shellfish for market purposes and requires a median MPN value in a sample series of less than 70 total coliforms/100 ml.

V. CONCLUSIONS

The Peconic Bay estuary is effected by three factors which provide this water body with a large resilient capacity to counter the exploitive pressures of man. One, the strong tidal flushing in this estuary which rapidly dilutes and disperses contaminants introduced into the open bays; two, the excellent water quality of Gardiners Bay which is the salt water source for the estuary; three, the semi-rural development of the drainage area has allowed reliance upon non-point sources of discharge, principally ground water seepage, for the latent discharge of soluble wastes into the estuary. Exceptions to the latter, where concentrated

Table 8. Water column coliform bacteria counts in the Peconic Bay estuary, 14-16 March 1975 (data of Adelphi University, Institute of Marine Science)

Station*	TOTAL Presumptive	Confirmed	Fecal
1	2-0-0 (5)	2-0-0 (5)	2-0-0 (5)
2	1-0-0 (2)	1-0-0 (2)	1-0-0 (2)
3	0-0-0		
4	1-0-0 (2)	1-0-0 (2)	1-0-0 (2)
5	1-1-0 (4)	0-1-0 (2)	0-1-0 (2)
6	0-0-0		
7	0-0-0		
8	1-0-0 (2)	1-0-0 (2)	0-0-0
9	3-1-0 (11)	3-1-0 (11)	3-1-0 (11)
10	1-0-0 (2)	0-0-0	
11	4-1-1 (21)	4-1-1 (21)	4-1-1 (21)
12	2-0-0 (5)	2-0-0 (5)	2-0-0 (5)
13	1-0-0 (2)	1-0-0 (2)	1-0-0 (2)
14	0-0-0		
15	1-0-0 (2)	0-0-0	
16	0-0-0		
17	0-0-0		
18	1-2-0 (6)	1-1-0 (4)	1-1-0 (4)
19	0-0-0		
20	0-0-0		
21	0-0-0		
22	0-0-0		

*Sample depth 4 m

Table 9. Water column and sediment coliform bacteria counts in the Peconic Bay Estuary, 14-16 March 1975 (data of Adelphi University, Institute of Marine Science)

	TOTAL					
	Presumptive		Confirmed		Fecal	
Station	Water	Sediment	Water	Sediment	Water	Sediment
23	3-0-0 (11)	0-0-0	1-0-0 (2)	-	1-0-0 (2)	-
24	1-0-0 (2)	1-0-0 (2)	1-0-0 (2)	0-0-0	1-0-0 (2)	-
26	0-0-0	4-2-0 (22)	-	0-0-0	0-0-0	0-0-0
28	1-0-0 (2)	0-0-0	0-0-0	-	-	-
29	0-0-0	0-0-0	-	-	-	-
30	0-0-0	0-0-0	-	-	-	-

pollutants are discharged from point sources, are areas of existing water quality problems. These point sources exist in Flanders Bay from duck farm outfalls and a municipal outfall; in Sag Harbor from both municipal and industrial outfalls, and from amorphous discharges associated with waterfront commercial activity in Greenport and Stirling Harbors.

For the open bay proper, the strong and turbulent tidal flux greatly exceeds the total fresh water discharge rate into the estuary. The mean fraction fresh water volume of the bay was calculated as 6 per cent for March 1975. Therefore, the salt content of the estuary may be more effected by changes in the salinity of Gardiners Bay than fluctuations of fresh water drainage within the estuary. The mean flushing time for a unit of water introduced into Flanders Bay is calculated as fifty-five days. The net flux of fresh water discharged from the estuary is 3 to 5 m^3/sec.

The turbulent tidal circulation causes the estuary to be well mixed. Water property gradients exist in the horizontal plane but vertical gradients, in such physical properties as temperature and salinity, appear small or absent. Surface temperature and salinity isocontours suggest that a weak fresh water plume moved seaward from Flanders Bay as a narrow band along the south shore of Great Peconic Bay.

The vertical structure of the water column has not been measured during summer months. It is presumed that tidal mixing inhibits the development of a strong thermal gradient allowing oxygen renewal of the bottom water during critical periods of high oxygen demand. A detailed physical description of this estuary in summer is needed to quantify the biological demand capacity of the bottom water.

The scarcity of dissolved inorganic nitrogen in the open bays appeared to be the limiting factor to primary production from late winter to early fall. Such was not the case at the head of the estuary where high concentrations of soluble nitrogen existed throughout the year in the Peconic River and certain salt creeks on the north shore of the bay. The availability of this nitrogen supported dense growths of microalgae in the lower Peconic River and other observers (J. R. Welker; J. Foehrenbach, personal communications) have reported similar algal blooms in Meeting House, Sawmill and Terry Creeks. These eutrophic growths of algae assimilated the bulk of the available nitrogen before it entered Flanders Bay.

Anomalously high orthophosphate concentrations were measured by NYOSL in Flanders Bay and the Peconic River which closely match the condition reported by Ryther (1954) in Moriches and Great South Bays as being symptomatic of duck-waste pollution. Maximum orthophosphate concentrations in Flanders Bay occurred from spring to fall coincidental with the intensity of duckling production.

There are well recognized gross symptoms of water quality problems in Flanders Bay, such as shellfish bed closures due to high coliform counts and to the eutrophication of tributaries previously mentioned. More subtle effects, whether beneficial or adverse, of the impact of nutrient-rich waste discharges on the estuary ecosystem, particularly in regard to biological community structure, secondary production and distribution, have not been investigated. One factor which ameliorates pollution stress is the diluting and dispersive action of tidal circulation. Some reduction in eutrophication and total coliform bacterial densities may be forthcoming by 1985 when duck farms change to dry farm operations under National Pollutant Discharge Elimination System (N.P.D.E.S.) legislation.

A second chronic water quality problem exists in the estuary at Sag Harbor where untreated domestic and industrial wastes (metal-plating industry) have been discharged from separate outfalls for many years. The existing waste disposal system is scheduled to be revamped by 1977, so that all liquid wastes will hook into a municipal secondary treatment plant. What environmental changes will result from improved waste treatment will be difficult to assess since existing hydrographic, sediment and biological characteristics of the harbor have not been described in the literature.

The key to the general excellent water quality of the Peconic Bay estuary appears to hinge on the vigorous tidal circulation. With exceptions previously noted, the water quality easily satisfies regulated standards of New York State for Class SA tidal salt waters.

The existing environmental quality of this estuary is conducive to the support of a large commercial and recreational fishery. This estuary is believed to be the major spawning and nursery ground for coastal fish species on Long Island (Perlmutter, 1939). The deterioration of environmental quality in this estuary may therefore have regional consequences to the coastal fisheries.

The Peconic Bay estuary presents a challenge to the effectiveness of regional planning and the management of coastal resources. The limited available data suggest that the estuary has an inherent flexibility within limits to absorb, dilute and disperse pollutants without salient and detrimental environmental change. This estuarine capacity to absorb man-caused stress provides resource managers a greater number of alternatives to the future development of the surrounding drainage area as well as the bays.

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APPENDIX A

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APPENDIX B

WATER PROPERTIES FIGURES

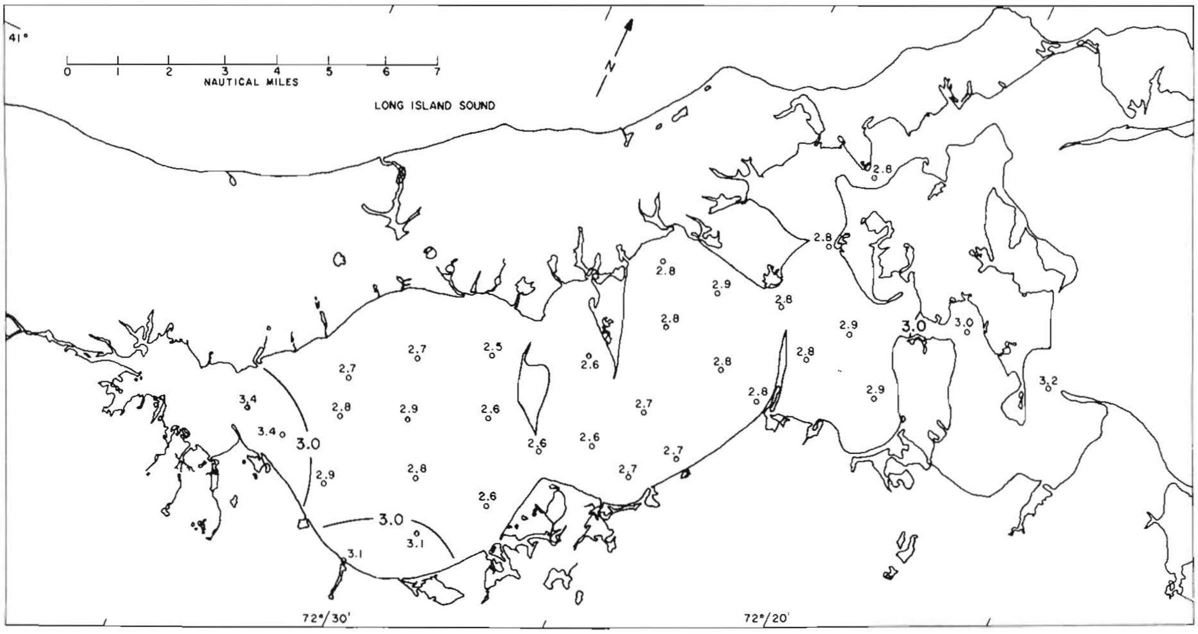

Figure B1. Surface Temperatures (°C at 1 Meter Depth) Peconic Bays 14-16 March 1975.

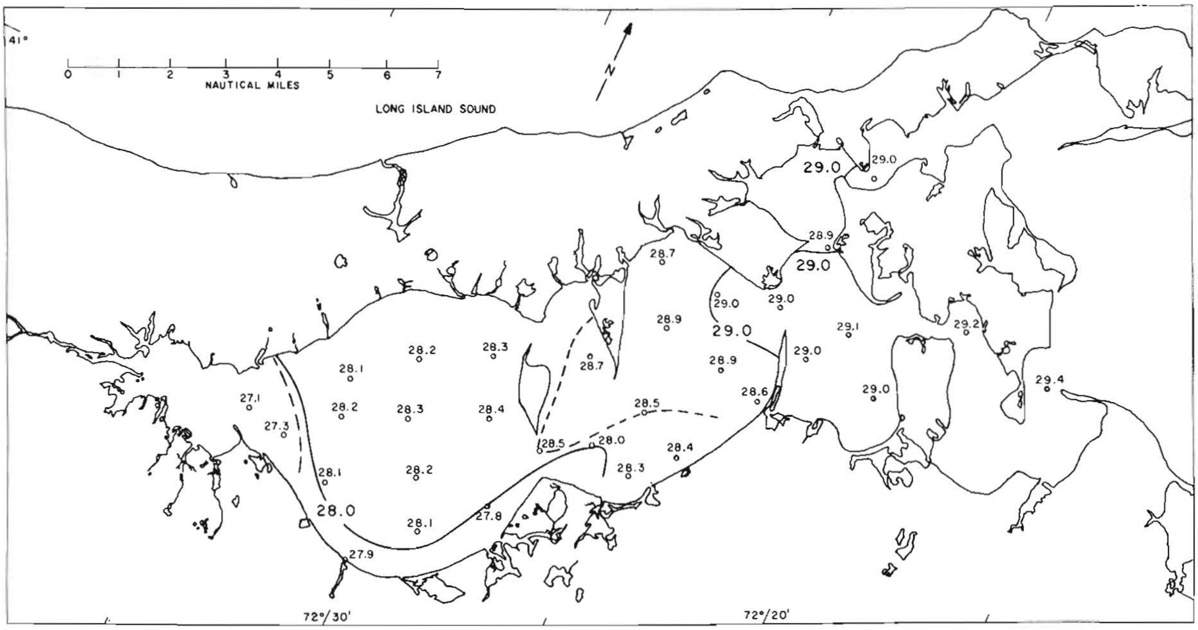

Figure B2. Surface Salinity (°/oo at 1 Meter Depth) Peconic Bays 14-16 March 1975.

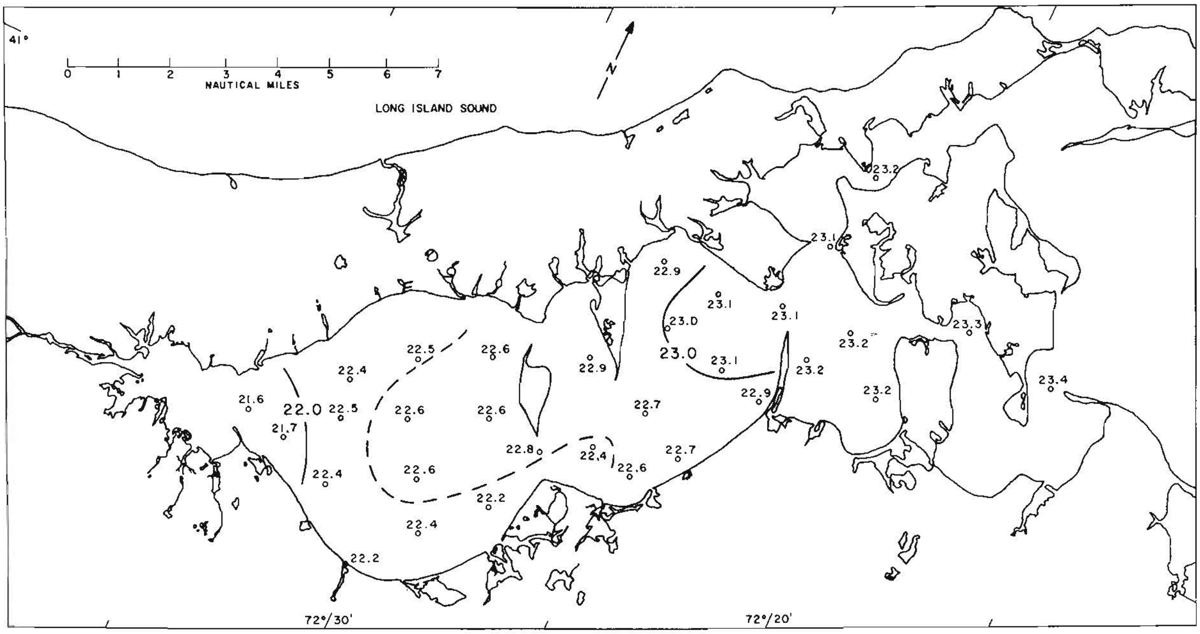

Figure B3. Sigma-t (at 1 Meter Depth) Peconic Bays 14-16 March 1975.

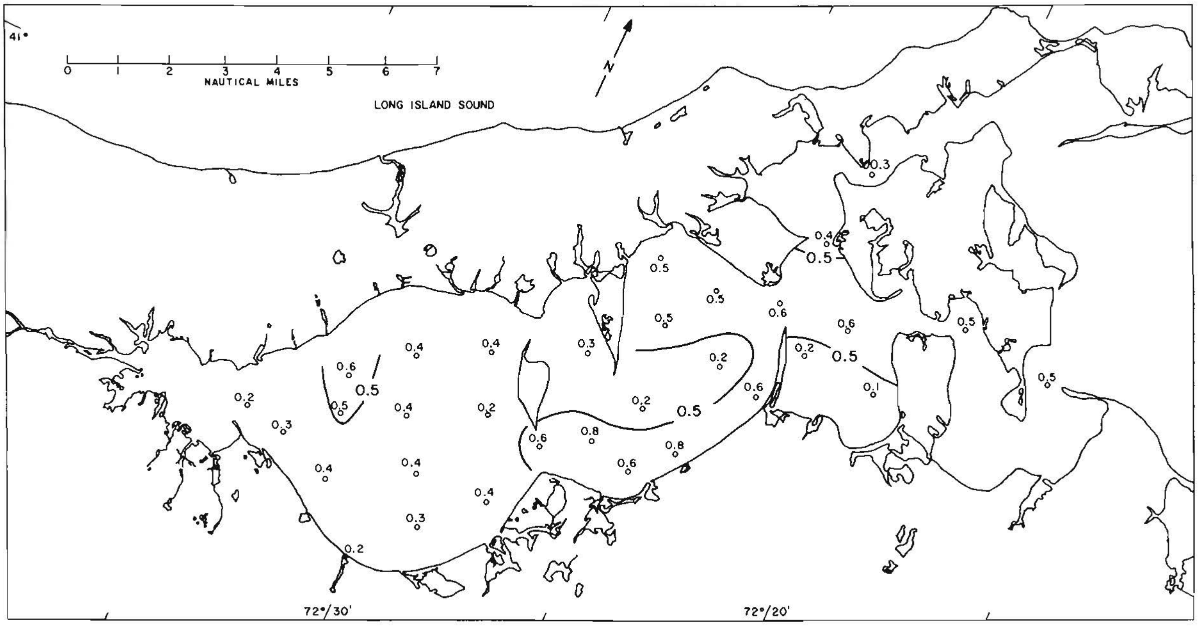

Figure B4. Surface Ammonia (μm/ℓ at 1 Meter Depth) Peconic Bays 14-16 March 1975.

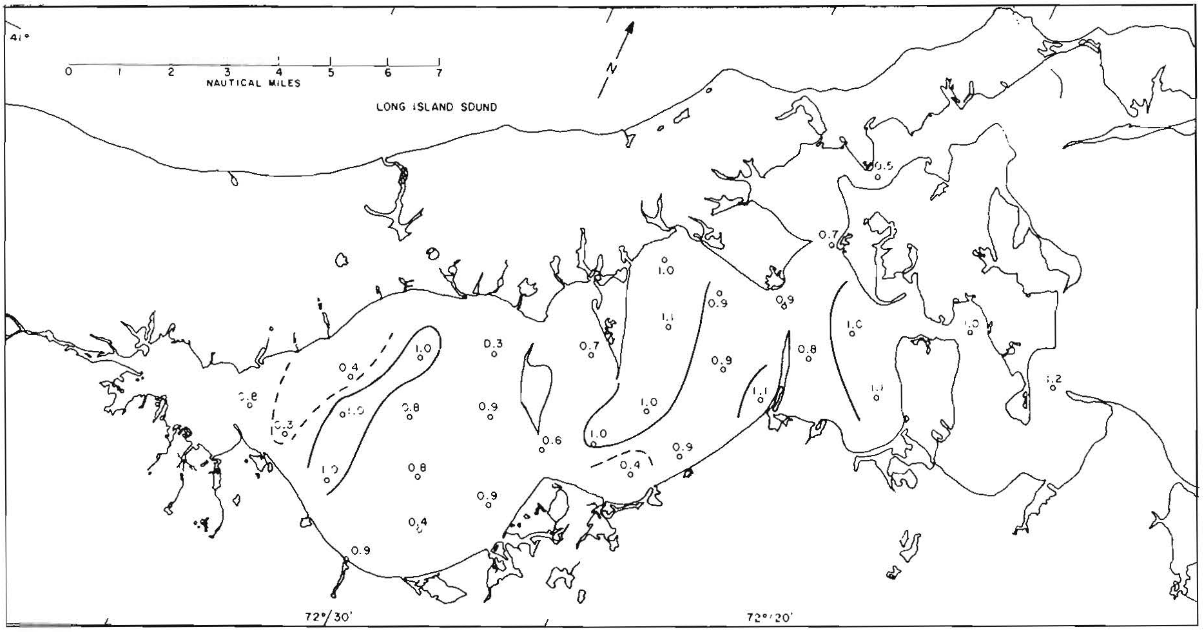

Figure B5. Surface Nitrate (μm/ℓ at 1 Meter Depth) Peconic Bays 14-16 March 1975.

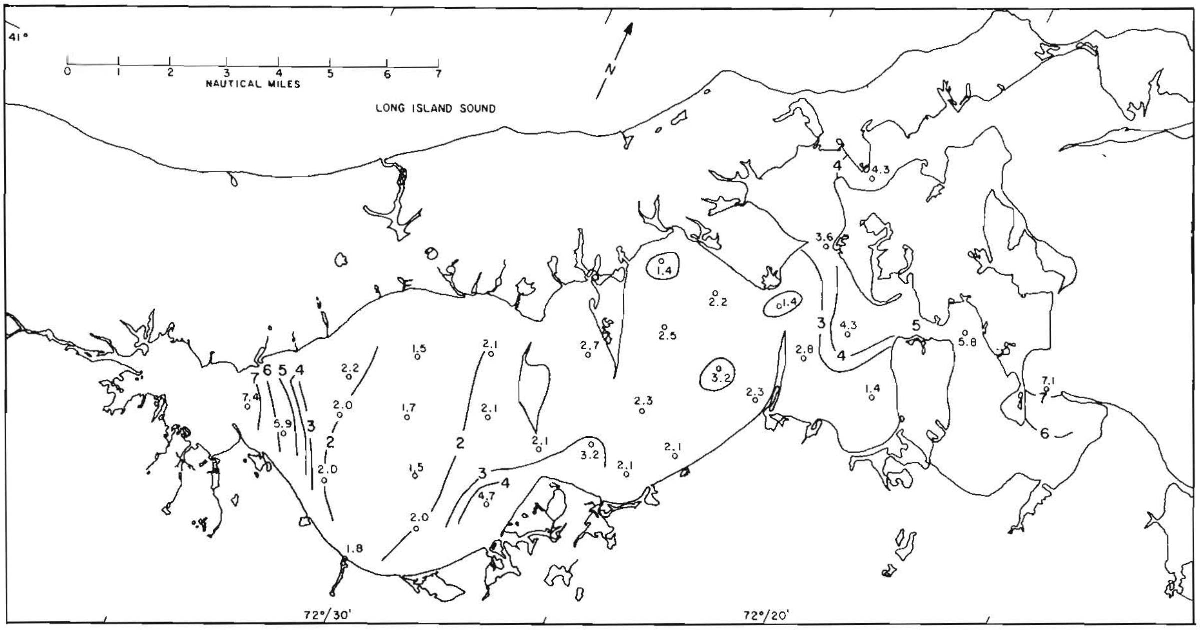

Figure B6. Surface Chlorophyll a (mg/m^3 at 1 Meter Depth) Peconic Bays 14-16 March 1975.

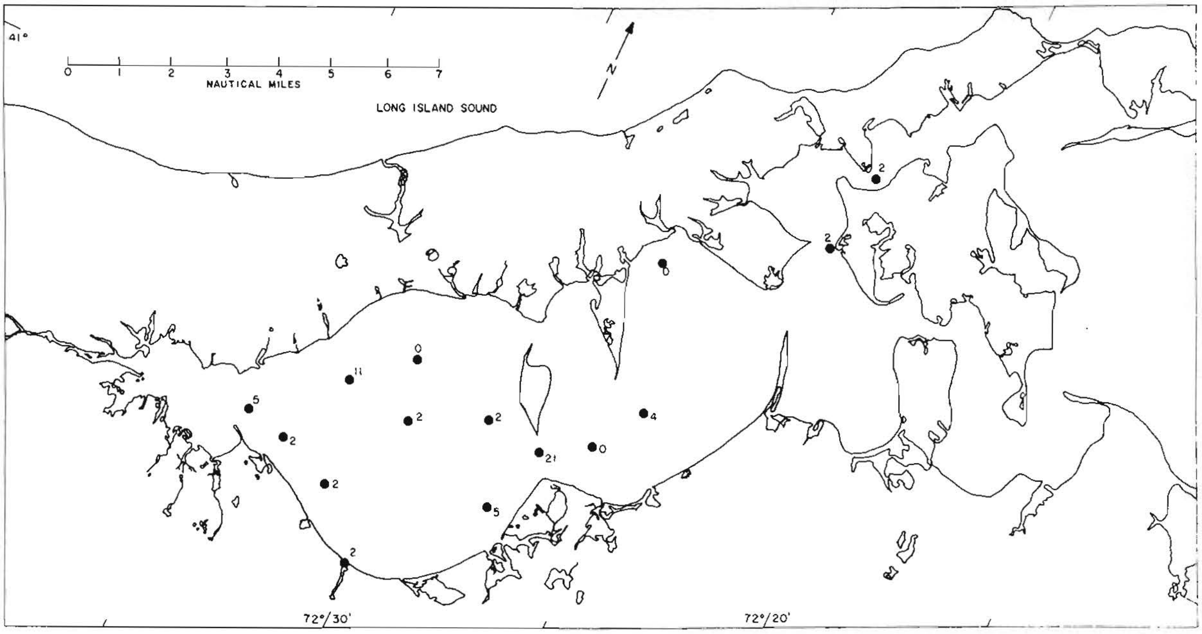

Figure B7. Fecal Coliform Counts (Water Column, 4 Meter Depth) Peconic Bay Cruise 14-16 March 1975.

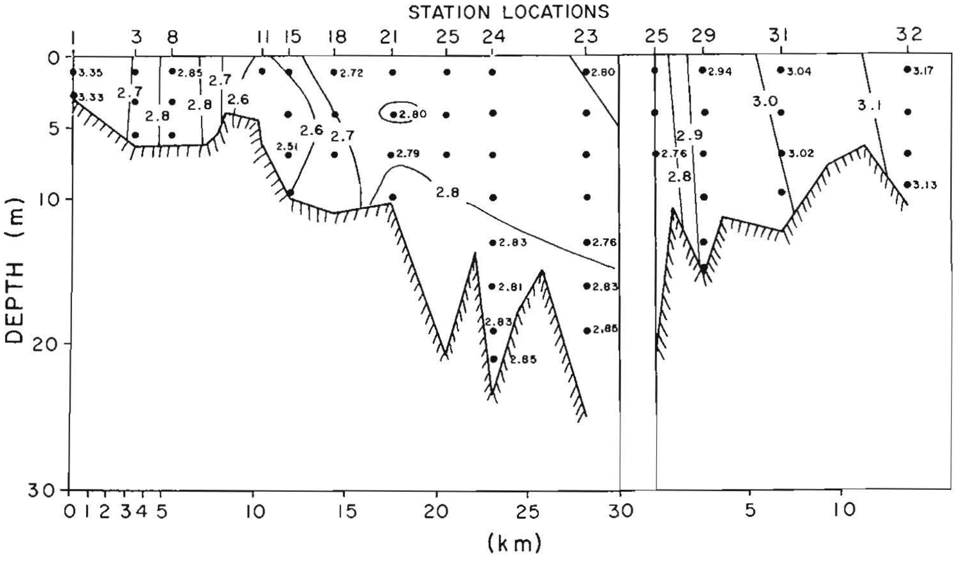

Figure B8. Temperature Profile (°C)
Longitudinal Section - Peconic Bays
South Jamesport - Greenport
14-16 March 1975

Jessups Neck - Cedar Point
16 March 1975

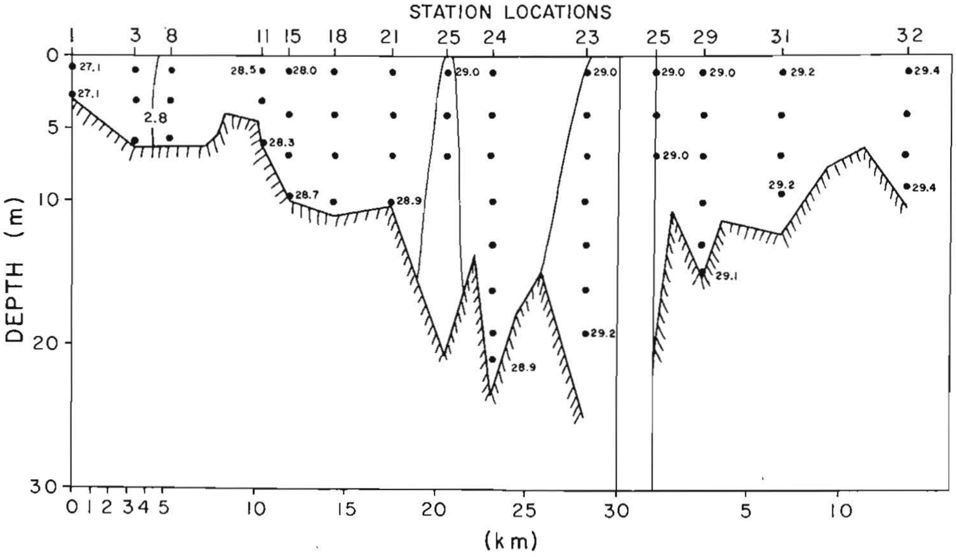

Figure B9. Salinity Profile (ppt)
Longitudinal Section - Peconic Bays
South Jamesport - Greenport
14-16 March 1975

Jessups Neck - Cedar Point
16 March 1975

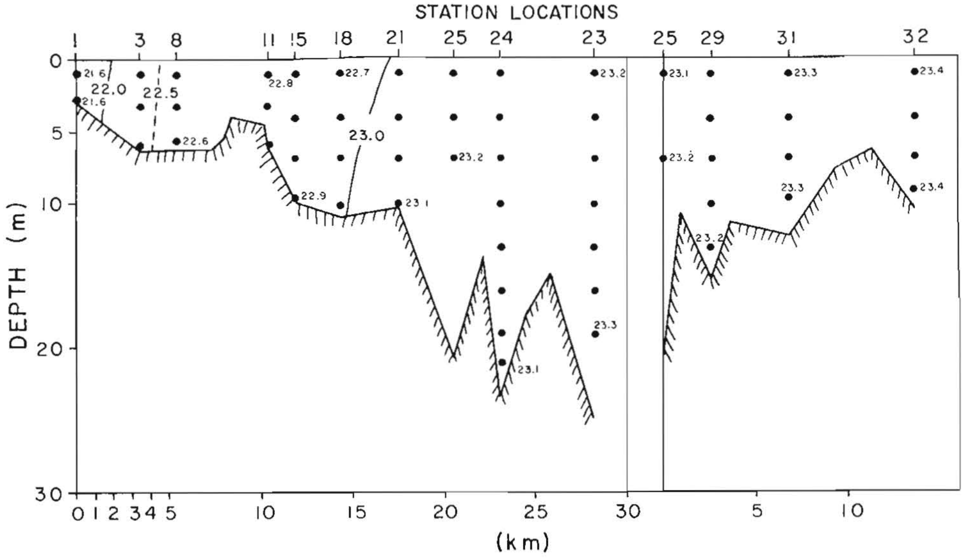

Figure B10. Sigma-t Profile
Longitudinal Section - Peconic Bays
South Jamesport - Greenport
14-16 March 1975

Jessups Neck - Cedar Point
16 March 1975

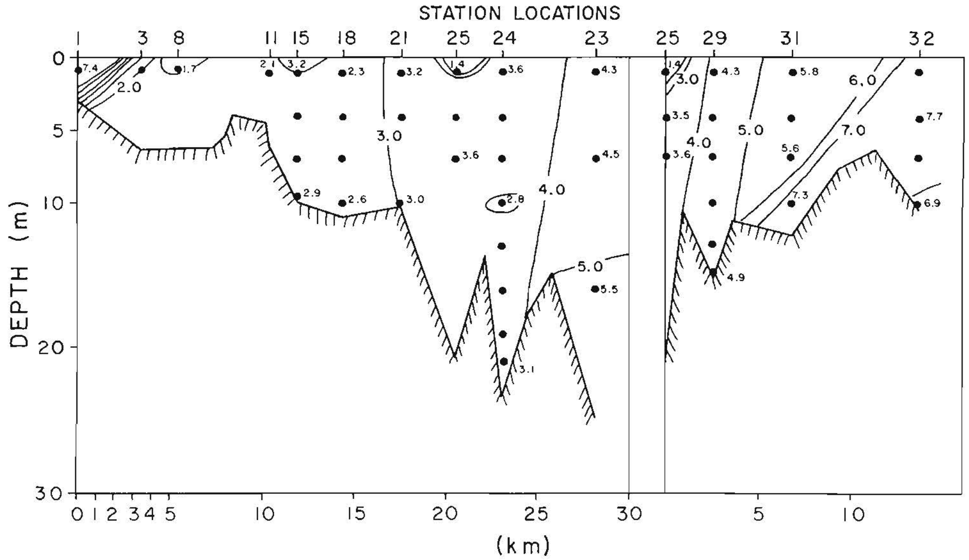

Figure B11. Chlorophyll-a Profile
Longitudinal Section - Peconic Bays
South Jamesport - Greenport
14-16 March 1975

Jessups Neck - Cedar Point
16 March 1975

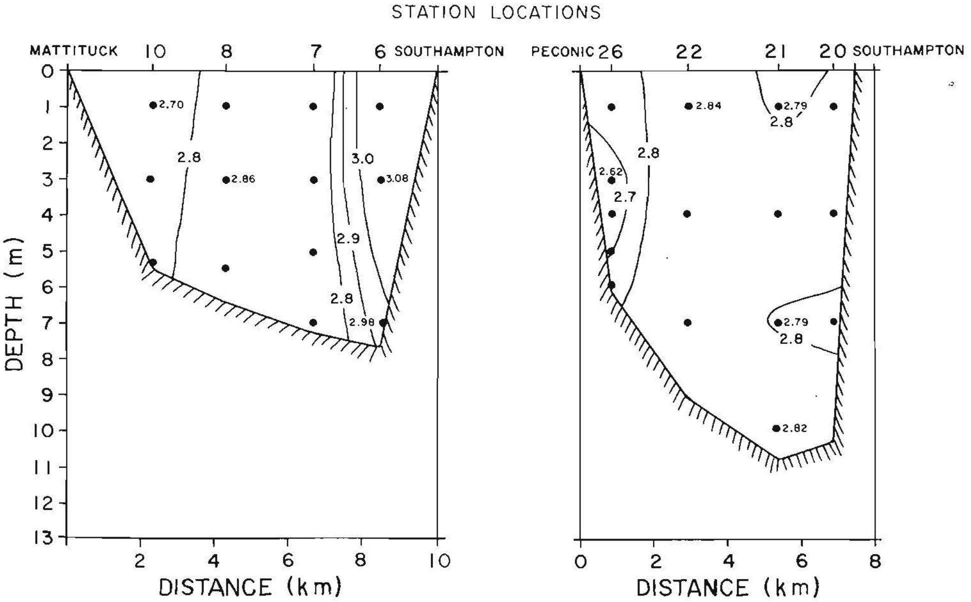

Figure B12. Temperature Profile (°C)
Cross Section - Great Peconic Bay
14 March 1975

Cross Section - Little Peconic
15-16 March 1975

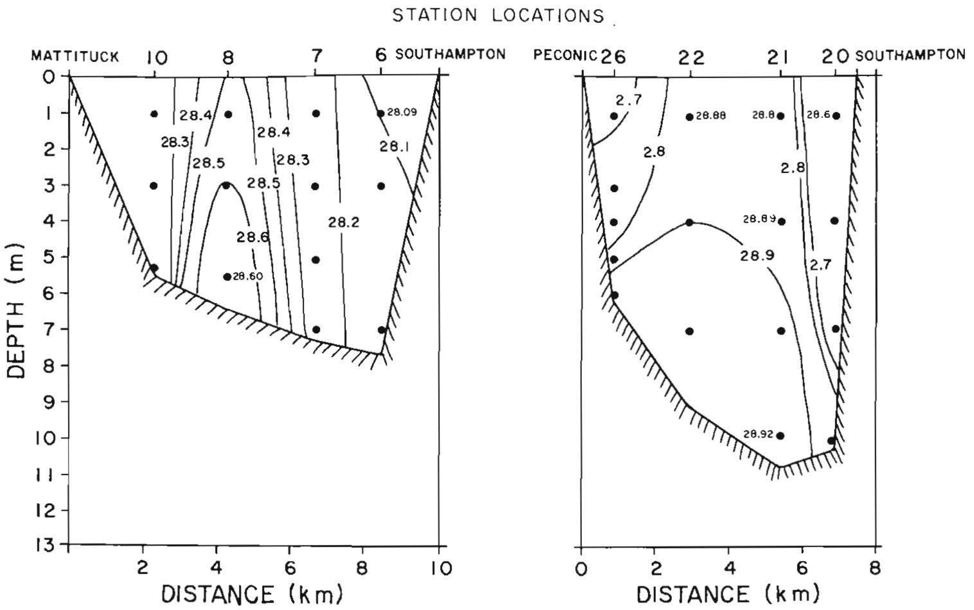

Figure B13. Salinity Profile (ppt)
Cross Section - Great Peconic Bay
14 March 1975

Cross Section - Little Peconic
15-16 March 1975

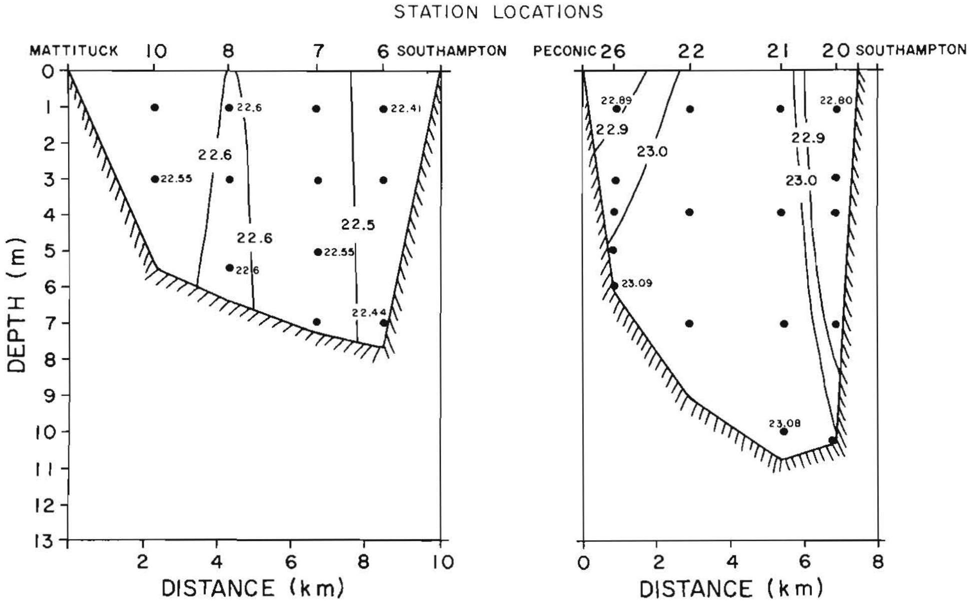

Figure B14. Sigma-t Profile
Cross Section - Great Peconic Bay
14 March 1975

Cross Section - Little Peconic
15-16 March 1975

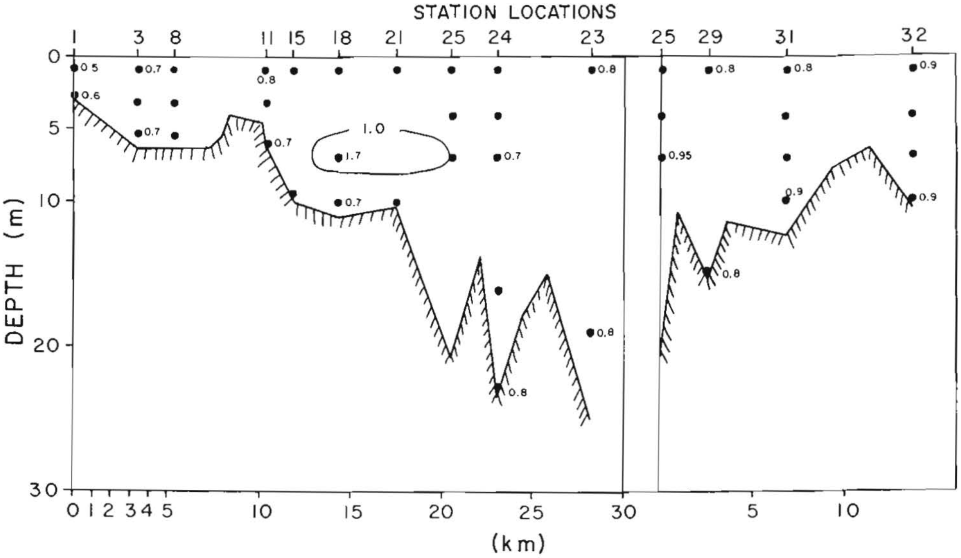

Figure B15. Total Phosphate Profile (PO_4-PµM/L)
Longitudinal Section - Peconic Bays
South Jamesport - Greenport
14-16 March 1975

Jessups Neck - Cedar Point
16 March 1975

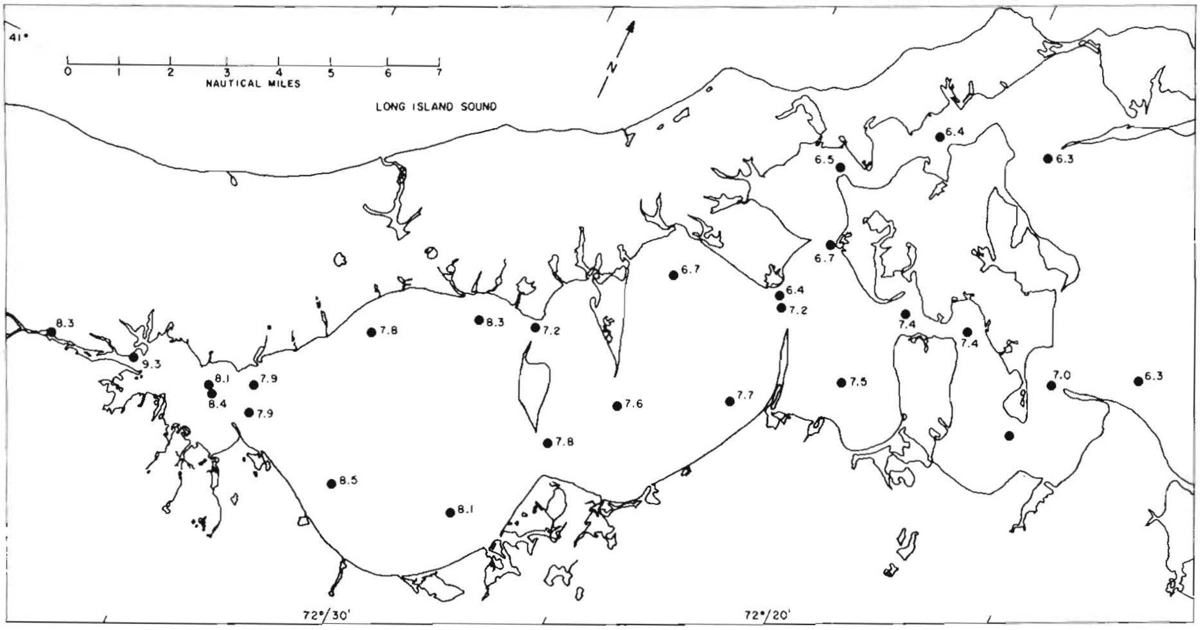

Figure B16. Surface Temperature (°C at 0.1 Meter) Peconic Bay Cruise No. 1, New York Ocean Science Laboratory 17 April 1971.

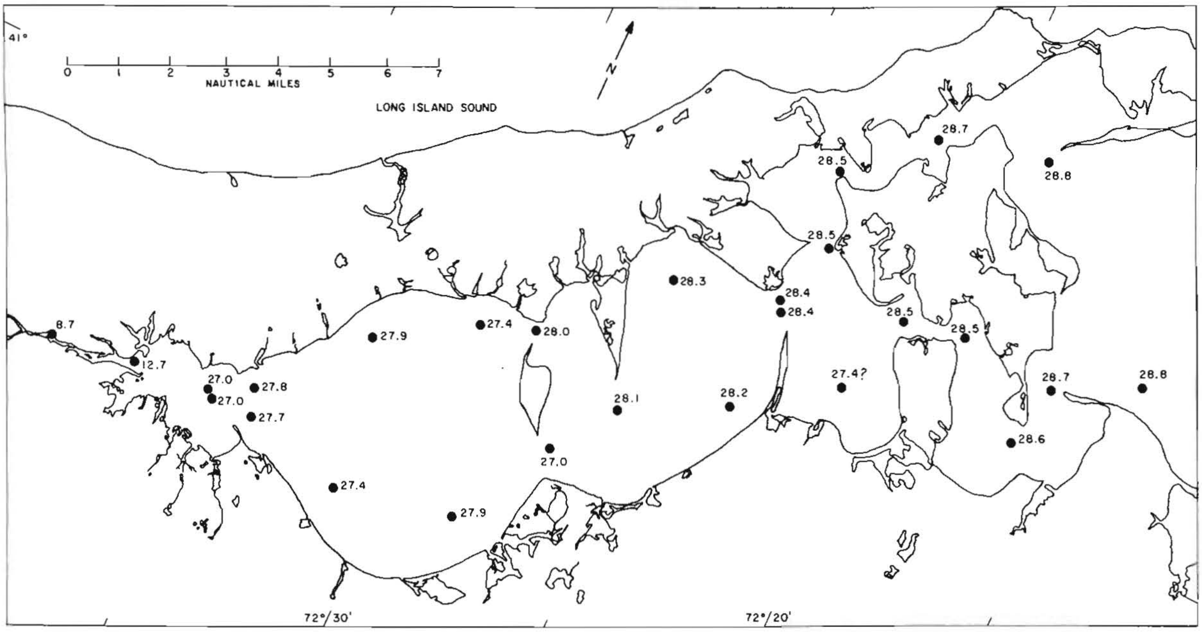

Figure B17. Surface Salinity (ppt at 0.1 Meters) Peconic Bay Cruise No. 1, New York Ocean Science Laboratory 17 April 1971.

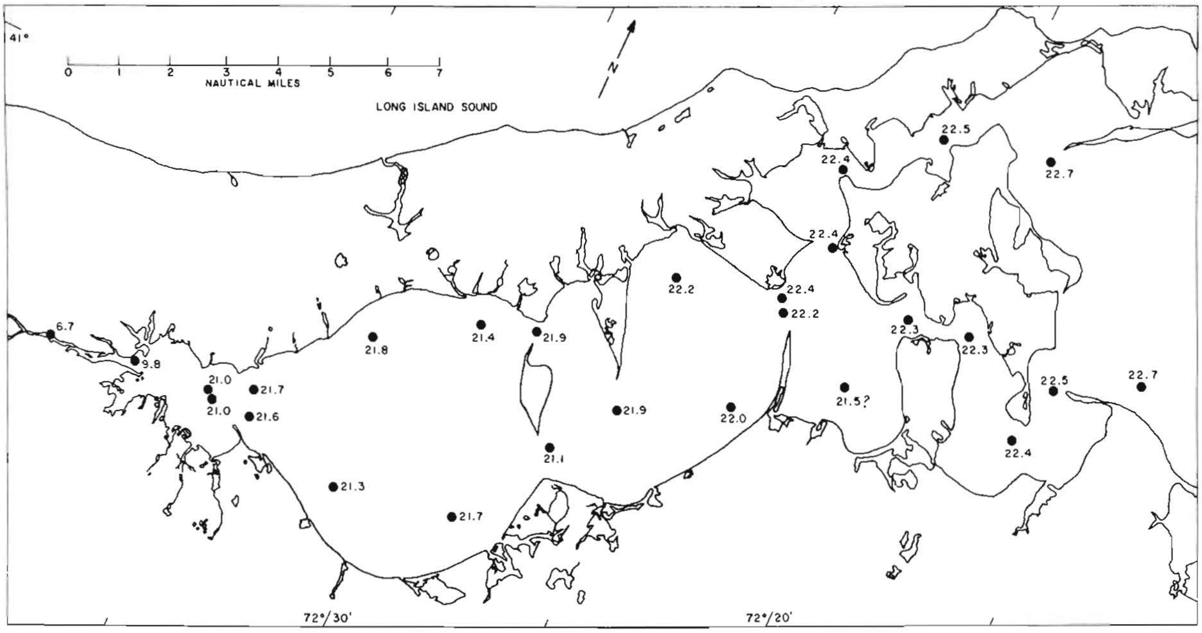

Figure B18. Surface Sigma-t (0.1 Meters) Peconic Bay Cruise No. 1, New York Ocean Science Laboratory 17 April 1971.

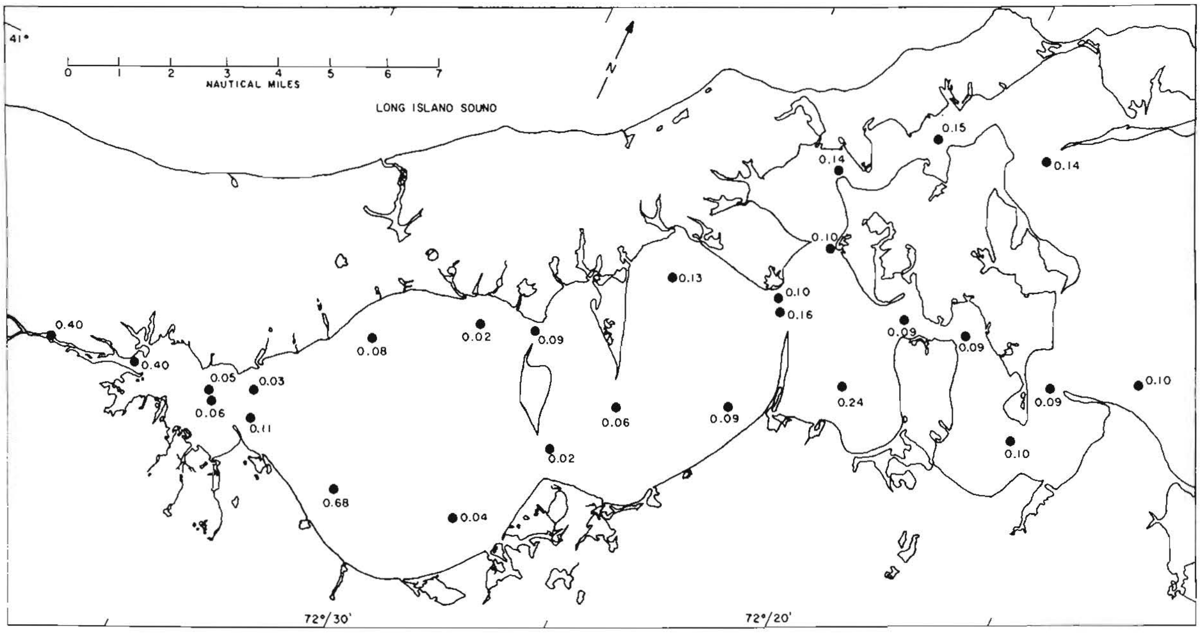

Figure B19. Surface Orthophosphate (μm/ℓ at 0.1 m) Peconic Bay Cruise No. 1, New York Ocean Science Laboratory 17 April 1971.

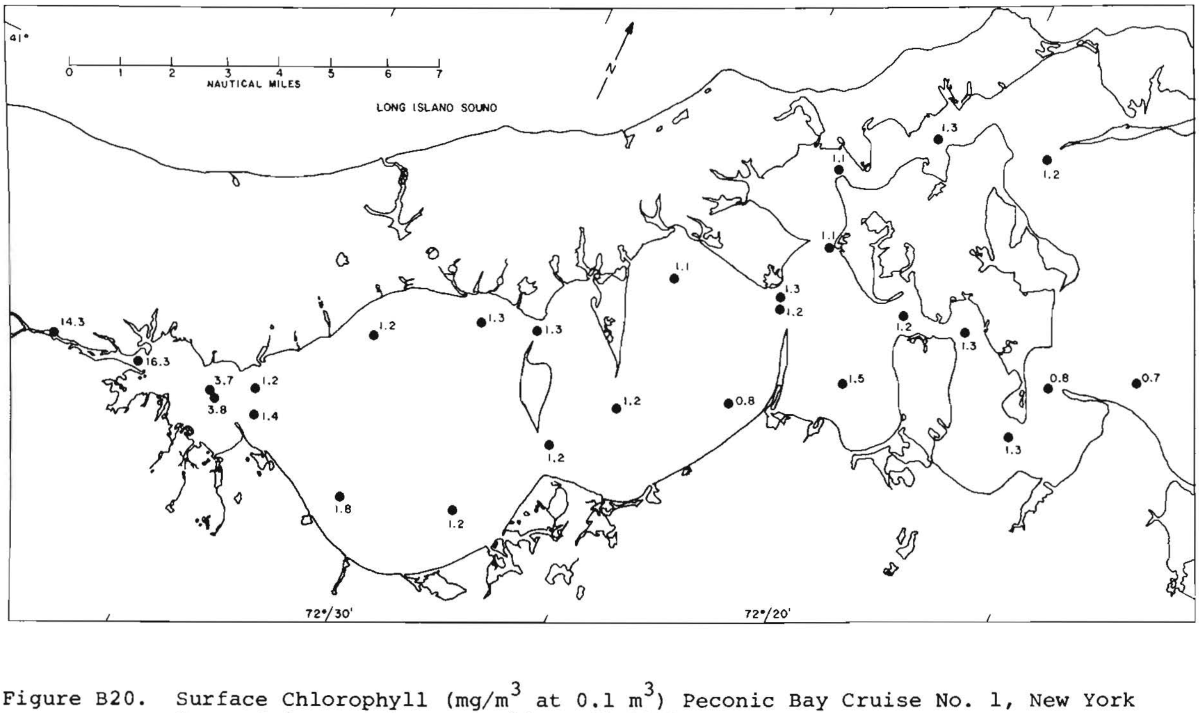

Figure B20. Surface Chlorophyll (mg/m^3 at 0.1 m^3) Peconic Bay Cruise No. 1, New York Ocean Science Laboratory 17 April 1971.

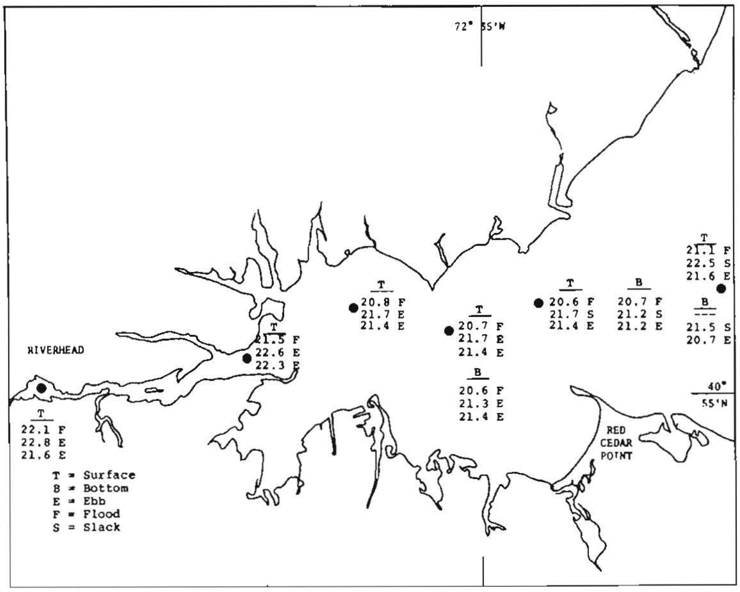

Figure B21. Water Temperature (°C) Variations Over a Nine Hour Period, Chain of Bays Project: Flanders Bay, New York Ocean Science Laboratory 12 September 1972.

SCALE: 1:40,000

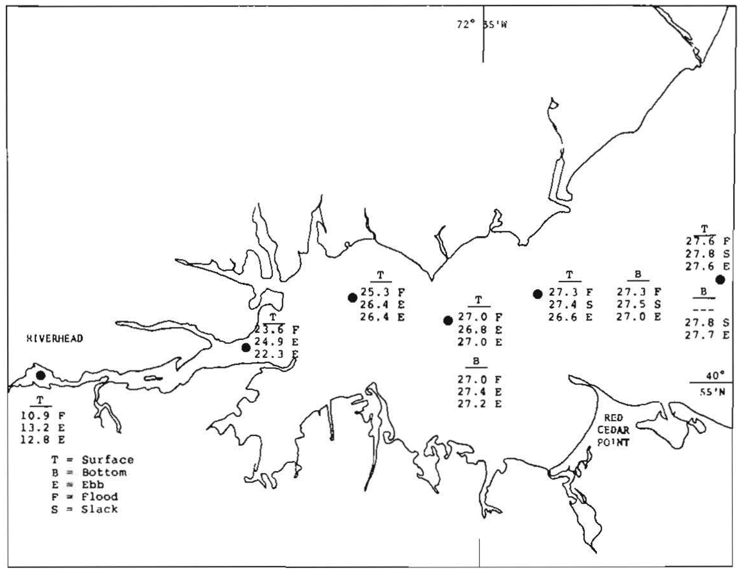

Figure B22. Salinity Variations Over a Nine Hour Period, Chain of Bays Project: Flanders Bay, New York Ocean Science Laboratory 12 September 1972.

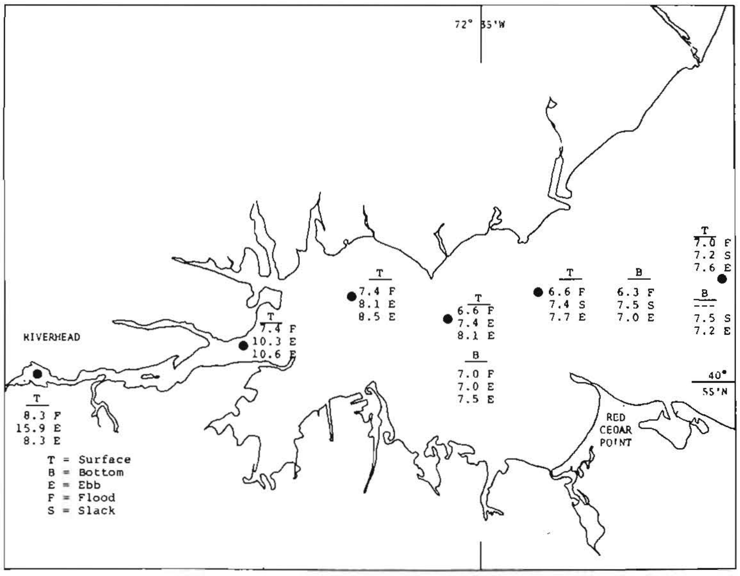

Figure B23. Dissolved Oxygen (PPM) Variations Over a Nine Hour Period, Chain of Bays Project: Flanders Bay, New York Ocean Science Laboratory 12 September 1972.

SCALE: 1:40,000

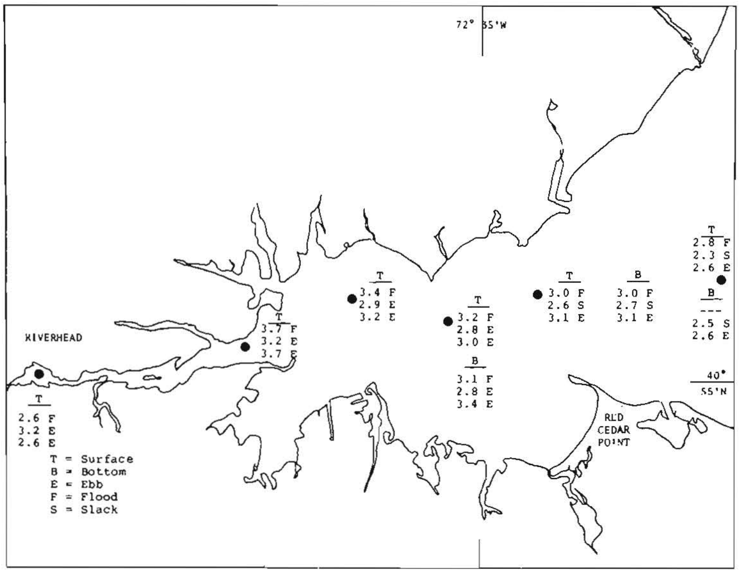

Figure B24. Dissolved Orthophosphate (μm/ℓ) Variations Over a Nine Hour Period, Chain of Bays Project: Flanders Bay, New York Ocean Science Laboratory 12 September 1972.

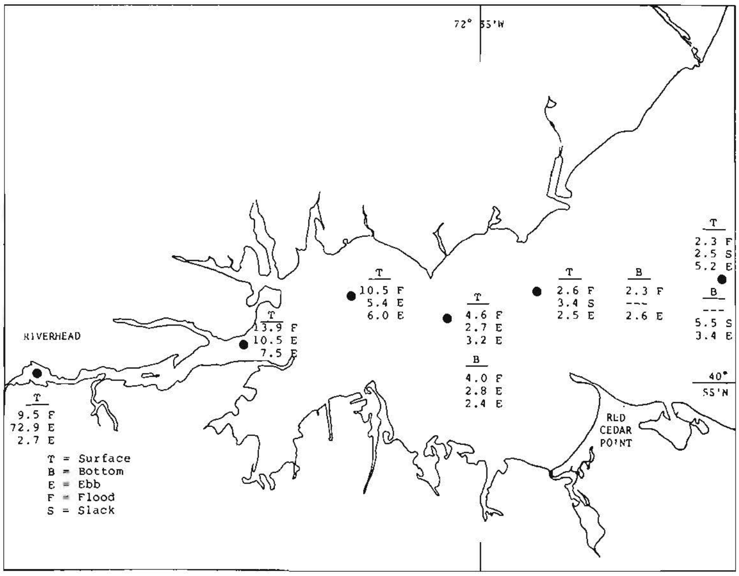

Figure B25. Chlorophyll a (mg/m^2) Variations Over a Nine Hour Period, Chain of Bays Project: Flanders Bay, New York Ocean Science Laboratory 12 September 1972.

SCALE: 1:40,000

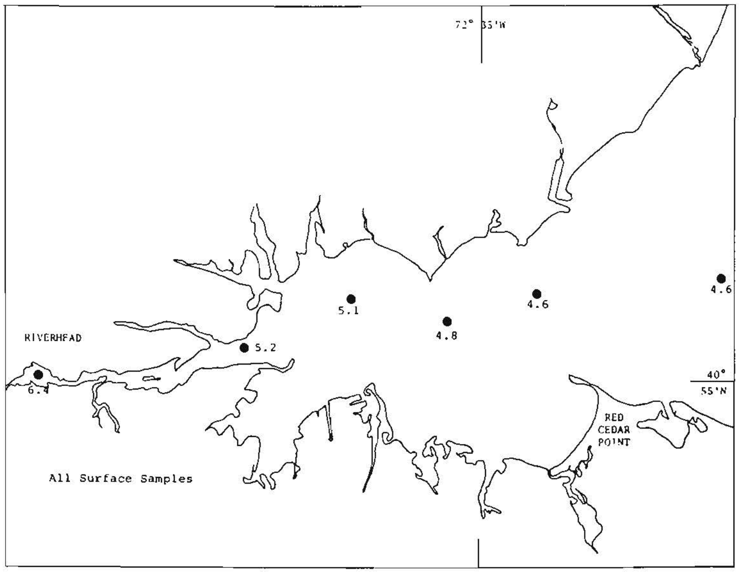

Figure B26. Water Temperature (°C) Chain of Bays Project: Flanders Bay, New York Ocean Science Laboratory 30 November 1972.

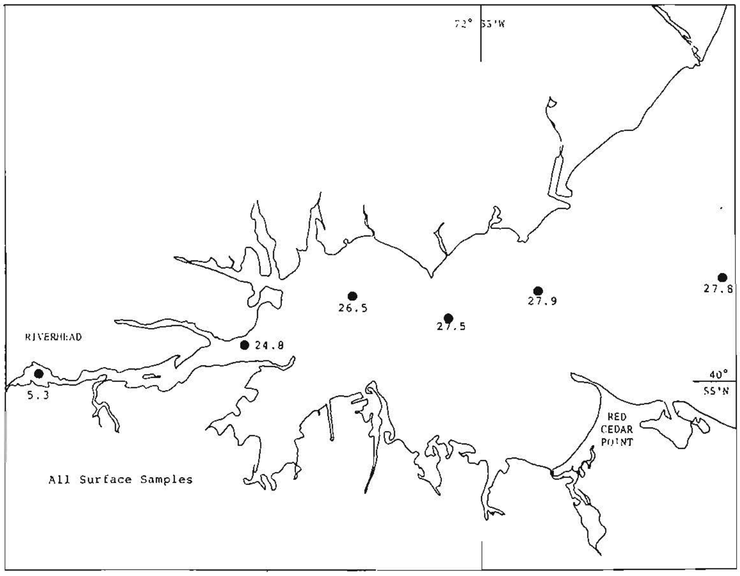

Figure B27. Salinity (ppt) Chain of Bays Project: Flanders Bay, New York Ocean Science Laboratory 30 November 1972.

SCALE: 1:40,000

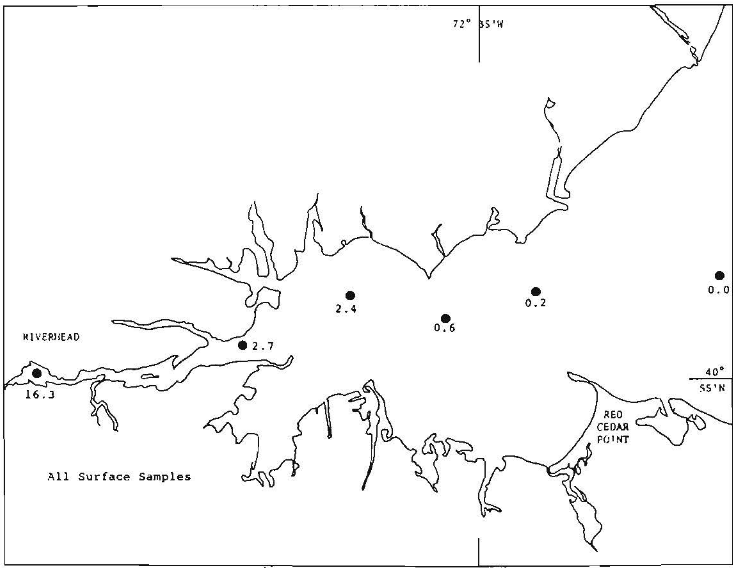

Figure B28. Inorganic Nitrate (NO_3-NµM/L) Chain of Bays Project: Flanders Bay, New York Ocean Science Laboratory 30 November 1972.

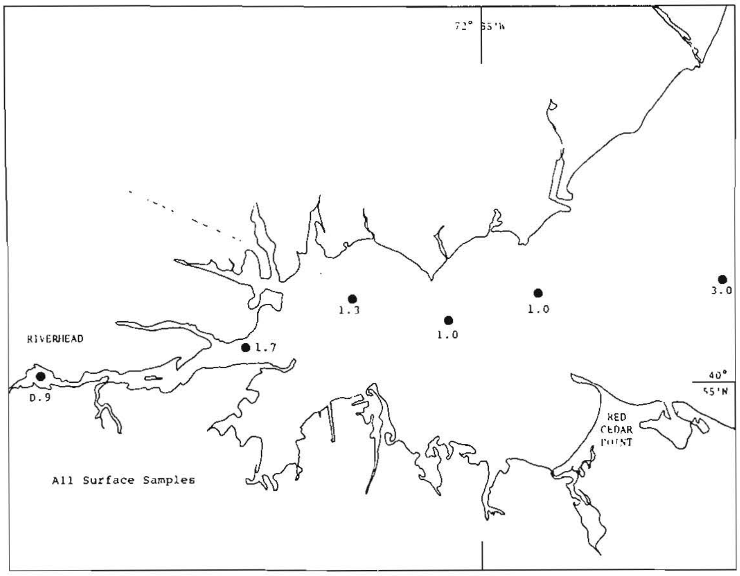

Figure B29. Orthophosphate (PO_4-PμM/L) Chain of Bays Project: Flanders Bay, New York Ocean Science Laboratory 30 November 1972.

SCALE: 1:40,000

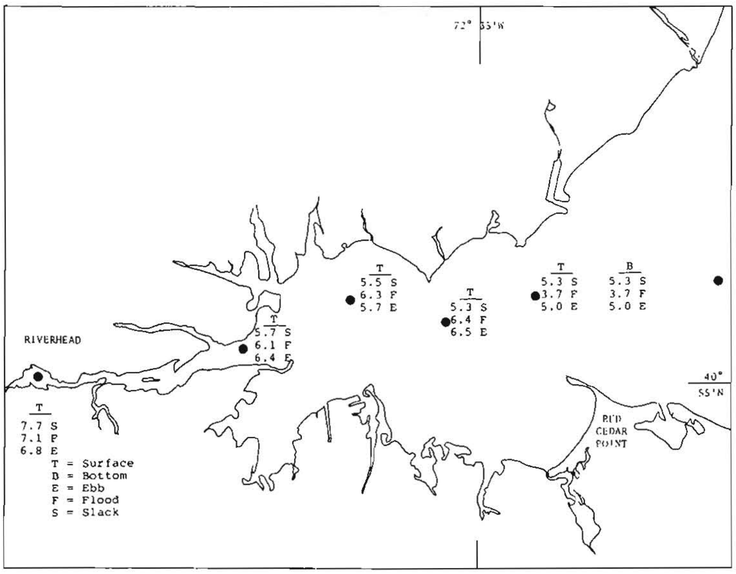

Figure B30. Water Temperature (°C) Variations Over a Six Hour Period, Chain of Bays Project: Flanders Bay, New York Ocean Science Laboratory 8 March 1973.

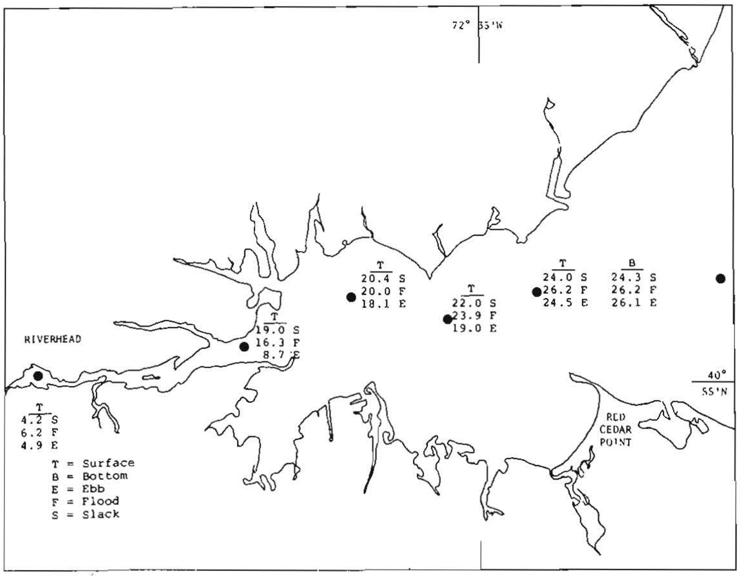

Figure B31. Salinity (ppt) Variations Over a Six Hour Period, Chain of Bays Project: Flanders Bay, New York Ocean Science Laboratory 8 March 1973.

SCALE: 1:40,000

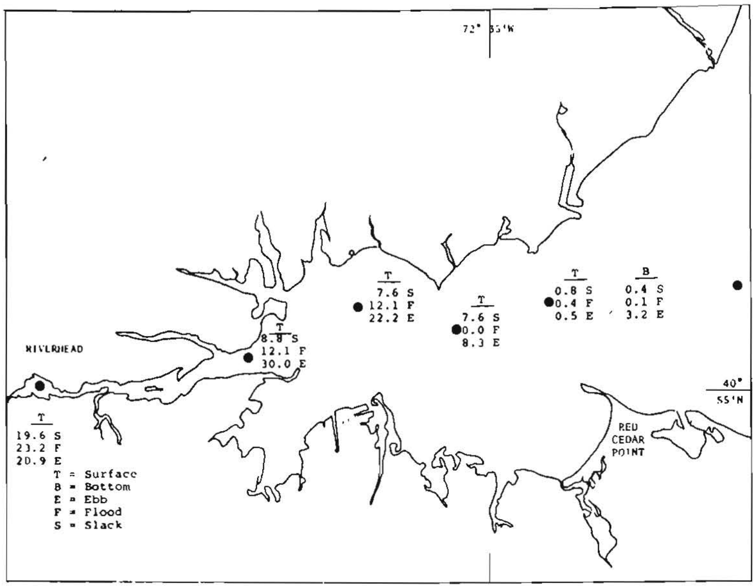

Figure B32. Inorganic Nitrate (NO_3-NμM/L) Variations Over a Six Hour Period, Chain of Bays Project: Flanders Bay, New York Ocean Science Laboratory 8 March 1973.

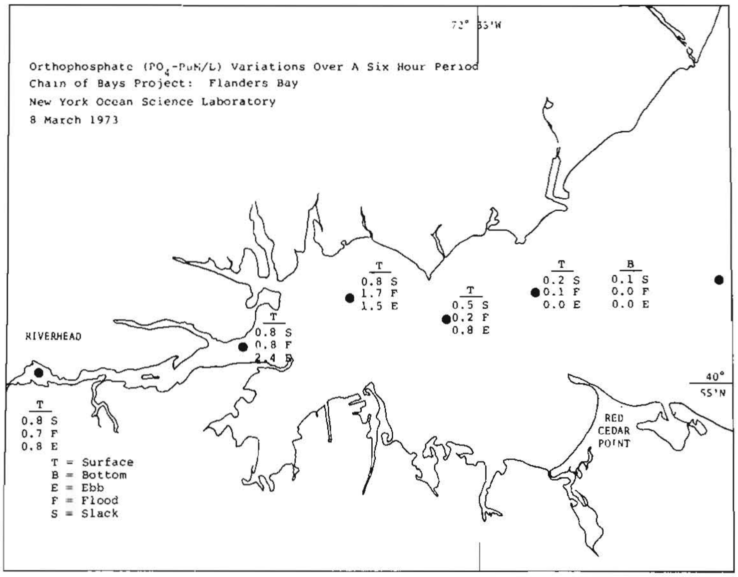

Figure B33. Orthophosphate (PO_4-PμM/L) Variations Over a Six Hour Period, Chain of Bays Project: Flanders Bay, New York Ocean Science Laboratory 8 March 1973.

SCALE: 1:40,000

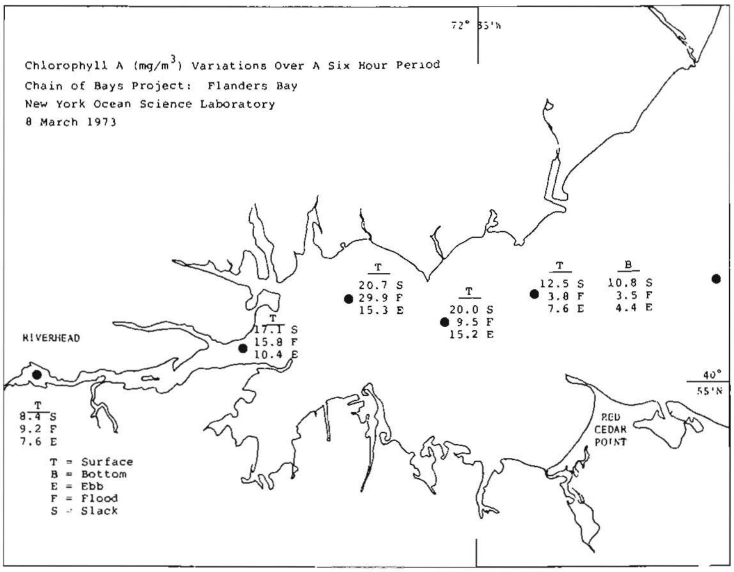

Figure B34. Chlorophyll a (mg/m^3) Variations Over a Six Hour Period, Chain of Bays Project: Flanders Bay, New York Ocean Science Laboratory 8 March 1973.

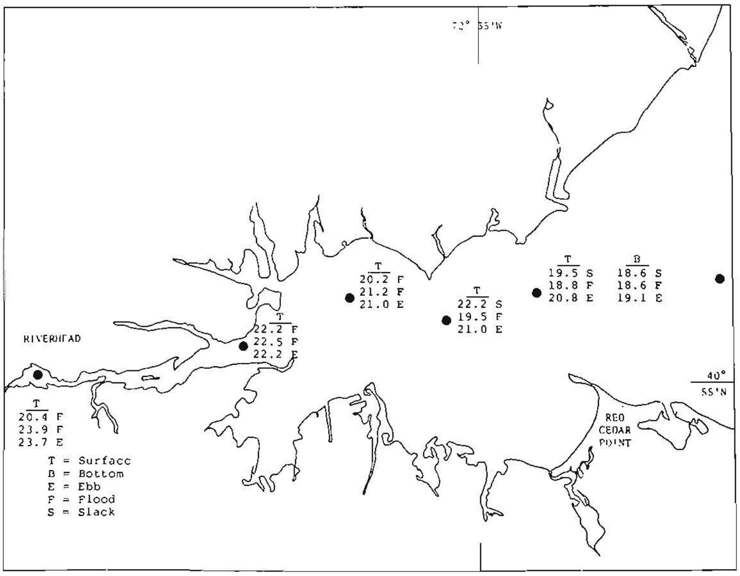

Figure B35. Water Temperature (°C) Variations Over a Six Hour Period, Chain of Bays Project: Flanders Bay, New York Ocean Science Laboratory 5 June 1973.

SCALE: 1:40,000

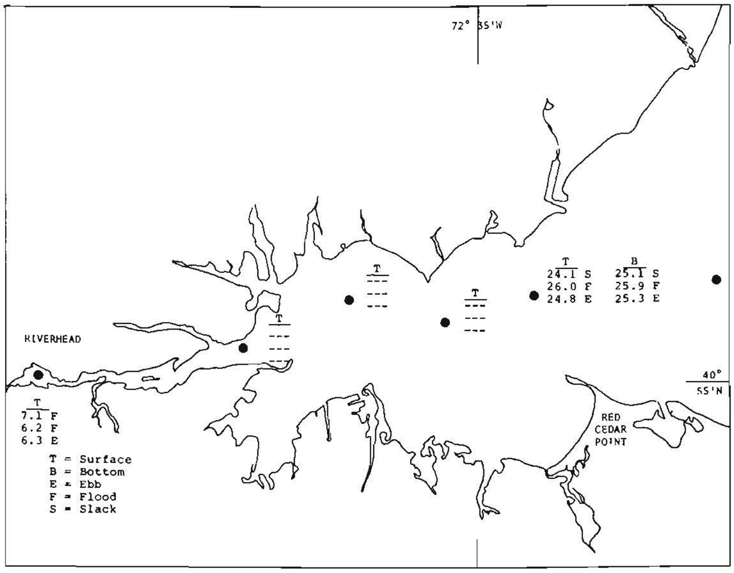

Figure B36. Salinity (ppt) Variations Over a Five Hour Period, Chain of Bays Project: Flanders Bay, New York Ocean Science Laboratory 5 June 1973.

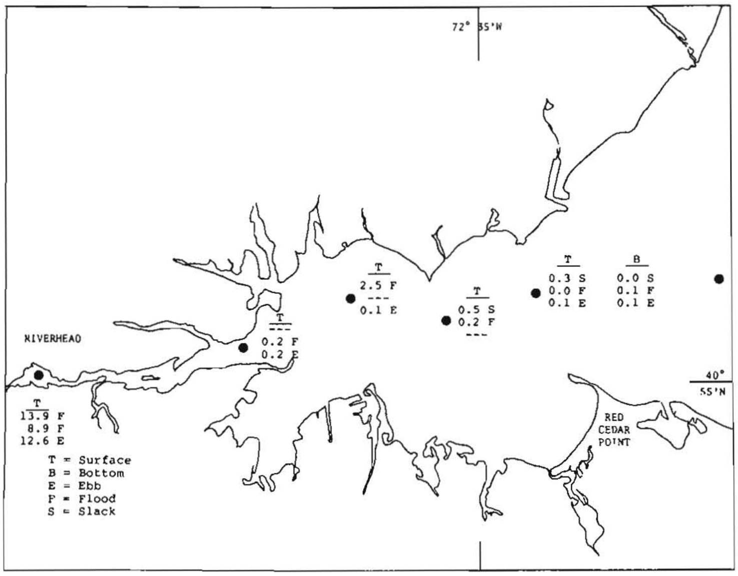

Figure B37. Inorganic Nitrate (NO_3-NμM/L) Variations Over a Five Hour Period, Chain of Bays Project: Flanders Bay, New York Ocean Science Laboratory 5 June 1973.

SCALE: 1:40,000

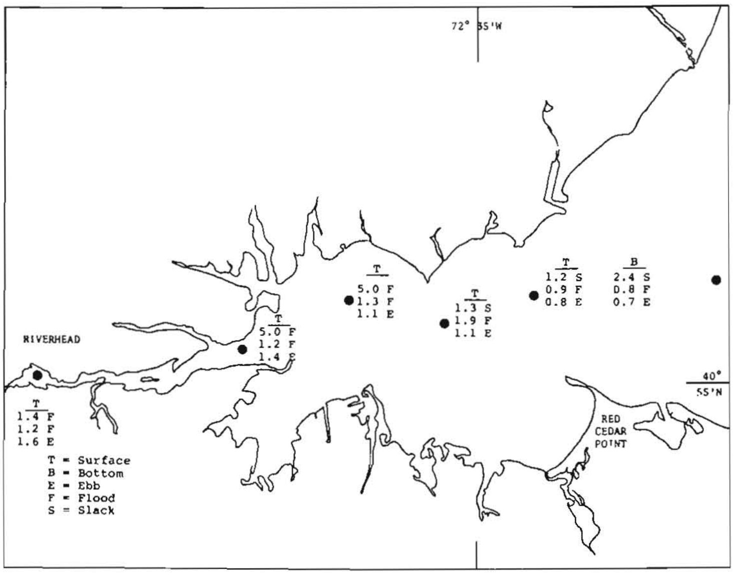

Figure B38. Orthophosphate (PO_4-PμM/L) Variations Over a Five Hour Period, Chain of Bays Project: Flanders Bay, New York Ocean Science Laboratory 5 June 1973.

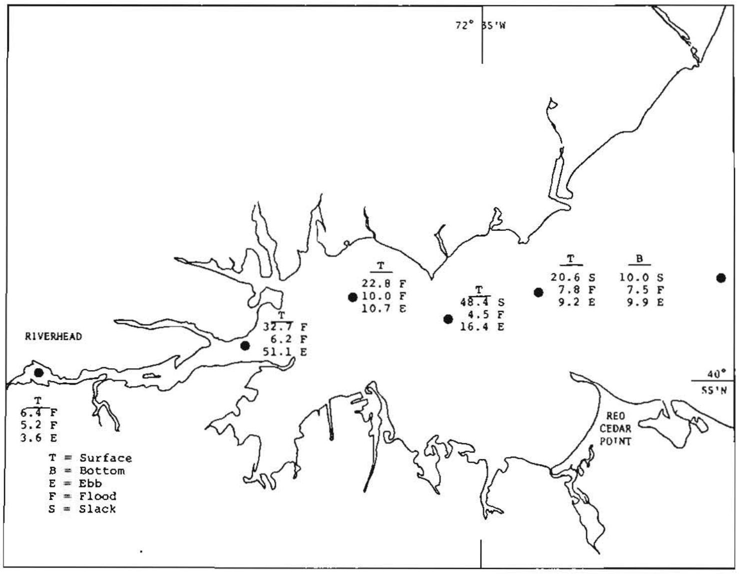

Figure B39. Chlorophyll a (mg/m^3) Variations Over a Five Hour Period, Chain of Bays Project: Flanders Bay, New York Ocean Science Laboratory 5 June 1973.

SCALE: 1:40,000

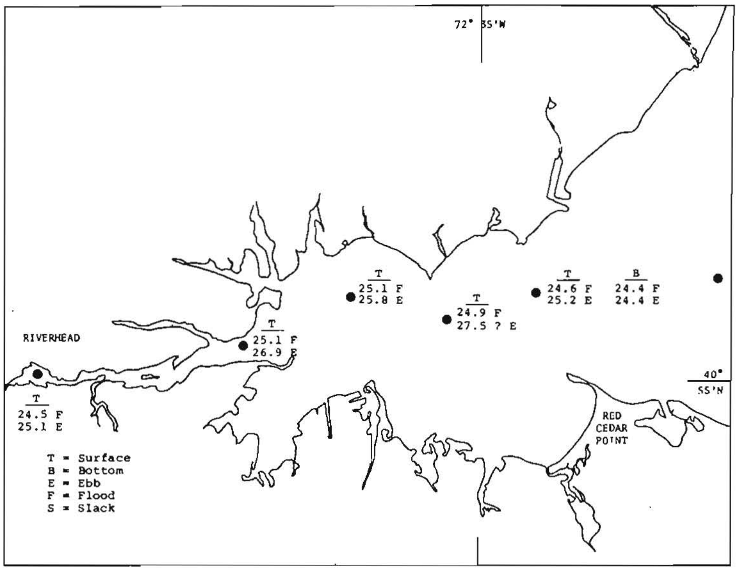

Figure B40. Water Temperature (°C) Variation Over a Four Hour Period, Chain of Bays Project: Flanders Bay, New York Ocean Science Laboratory 30 August 1973.

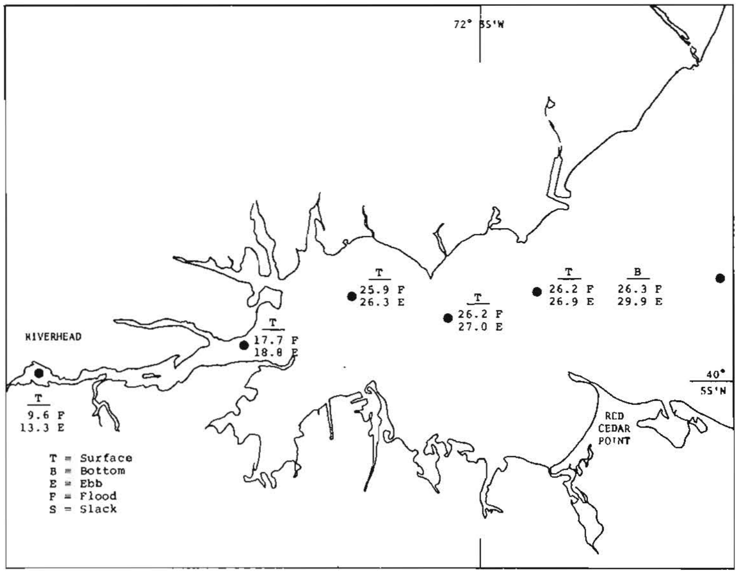

Figure B41. Salinity (ppt) Variations Over a Four Hour Period, Chain of Bays Project: Flanders Bay, New York Ocean Science Laboratory 30 August 1973.

SCALE: 1:40,000

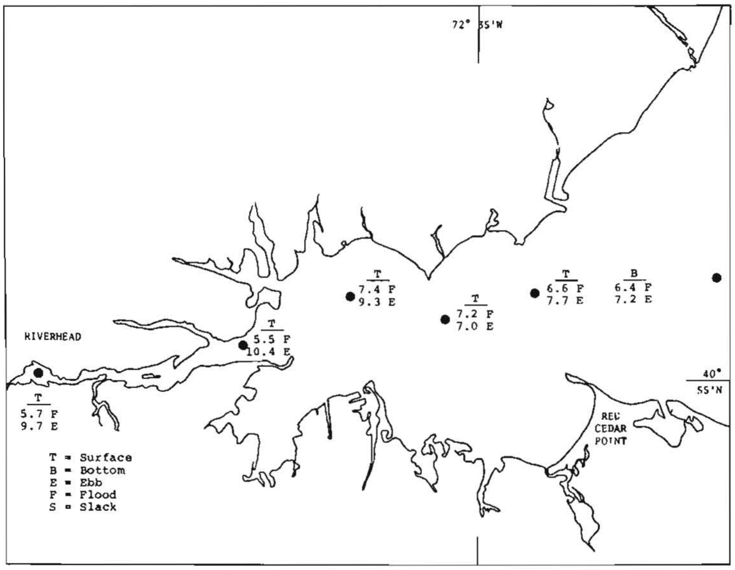

Figure B42. Dissolved Oxygen (PPM) Variations Over a Four Hour Period, Chain of Bays Project: Flanders Bay, New York Ocean Science Laboratory 30 August 1973.

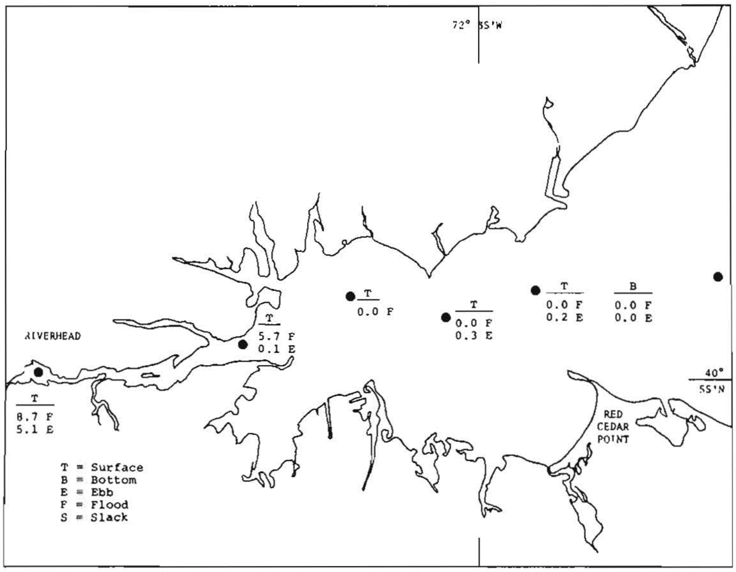

Figure B43. Inorganic Nitrate (NO_3^-NμM/L) Variations Over a Four Hour Period, Chain of Bays Project: Flanders Bay, New York Ocean Science Laboratory 30 August 1973

SCALE: 1:40,000

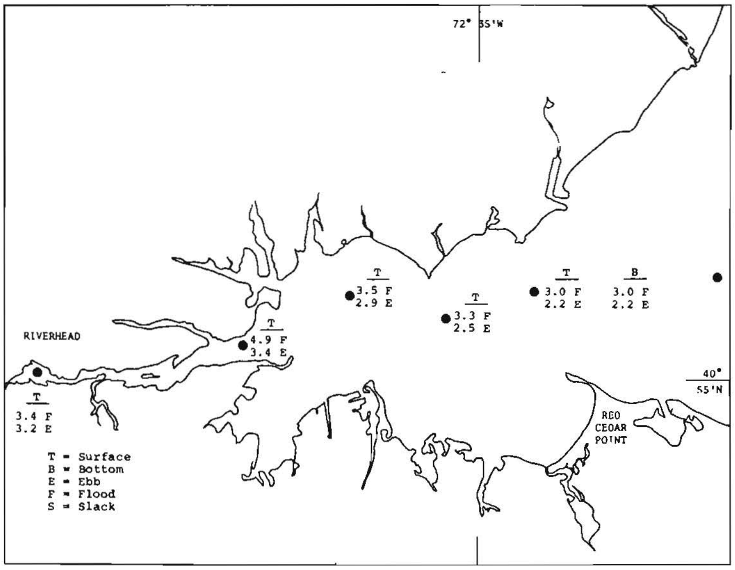

Figure B44. Orthophosphate (PO_4-P) Variations Over a Four Hour Period, Chain of Bays Project: Flanders Bay, New York Ocean Science Laboratory 30 August 1973.

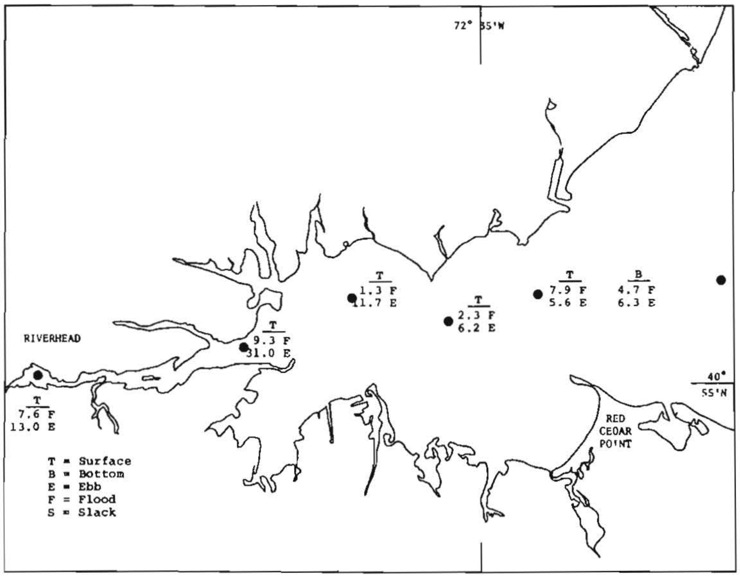

Figure B45. Chlorophyll a (mg/m^3) Variations Over a Four Hour Period, Chain of Bays Project: Flanders Bay, New York Ocean Science Laboratory 30 August 1973.

SCALE: 1:40,000

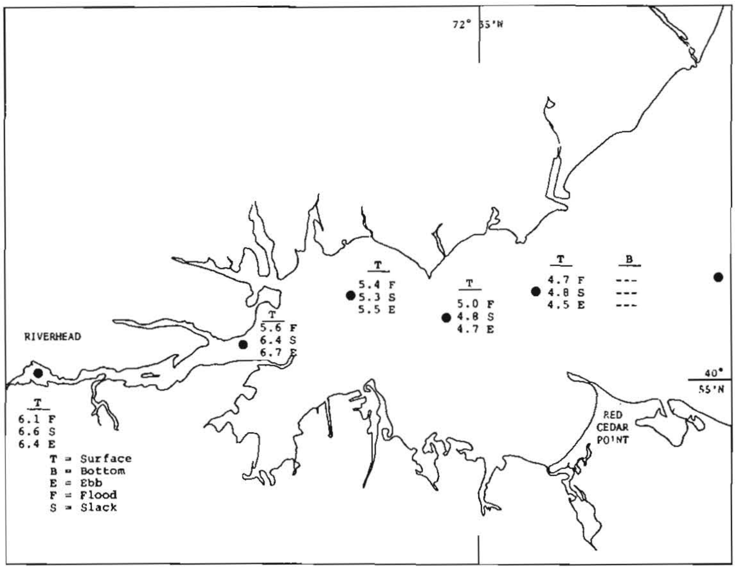

Figure B46. Water Temperature (°C) Variations Over a Six Hour Period, Chain of Bays Project: Flanders Bay, New York Ocean Science Laboratory 29 January 1974.

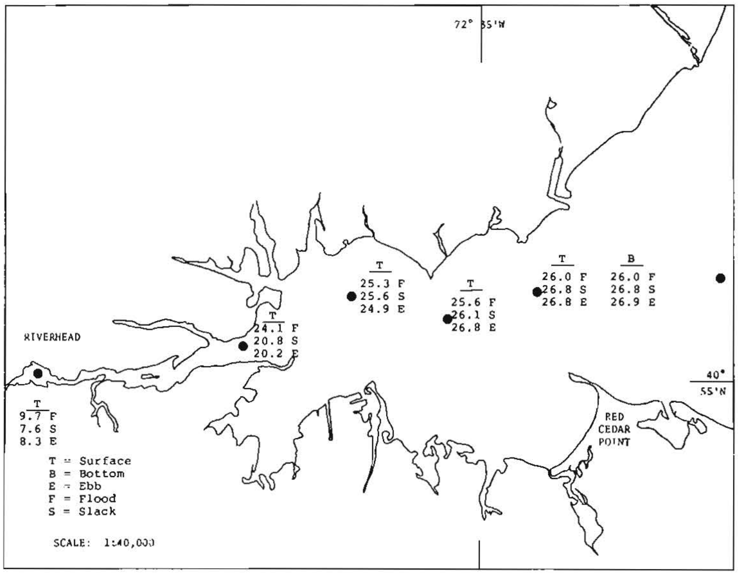

Figure B47. Salinity (ppt) Variations Over a Six Hour Period Chain of Bays Project: Flanders Bay, New York Ocean Science Laboratory 29 January 1974.

SCALE: 1:40,000

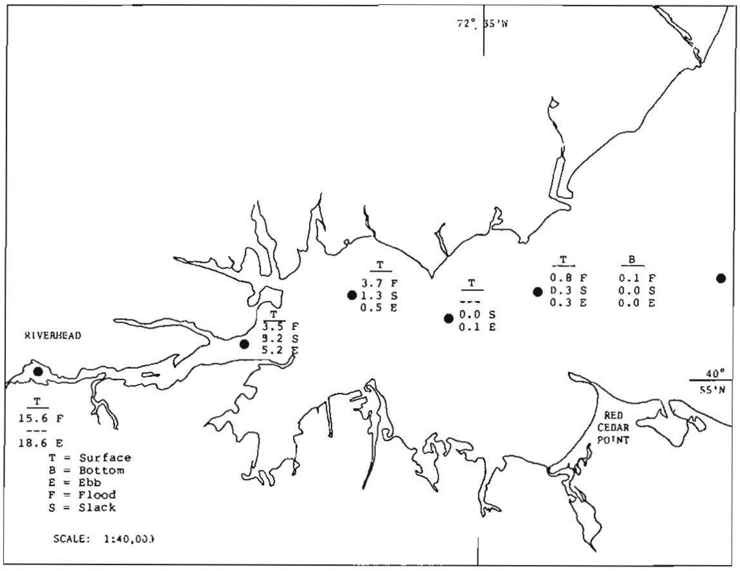

Figure B48. Inorganic Nitrate (NO_3-NμM/L) Variations Over a Six Hour Period, Chain of Bays Project: Flanders Bay, New York Ocean Science Laboratory 29 January 1974.

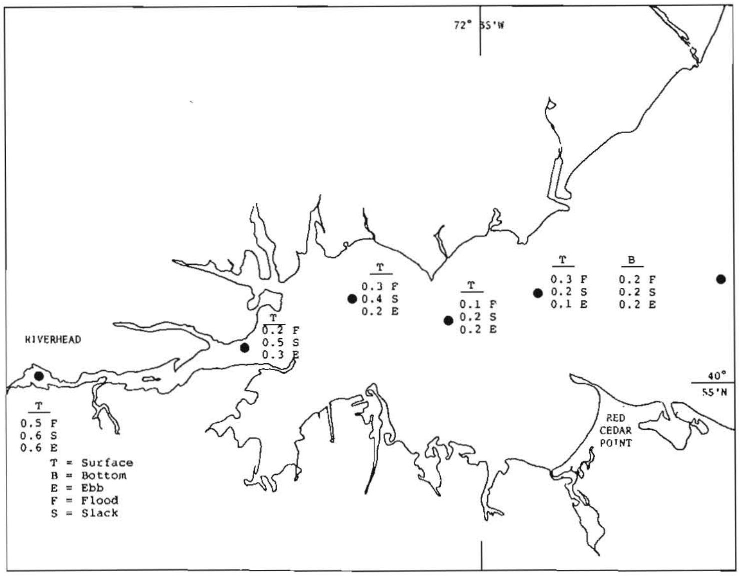

Figure B49. Orthophosphate (PO_4-PμM/L) Variations Over a Six Hour Period, Chain of Bays Project: Flanders Bay, New York Ocean Science Laboratory 29 January 1974.

SCALE: 1:40,000

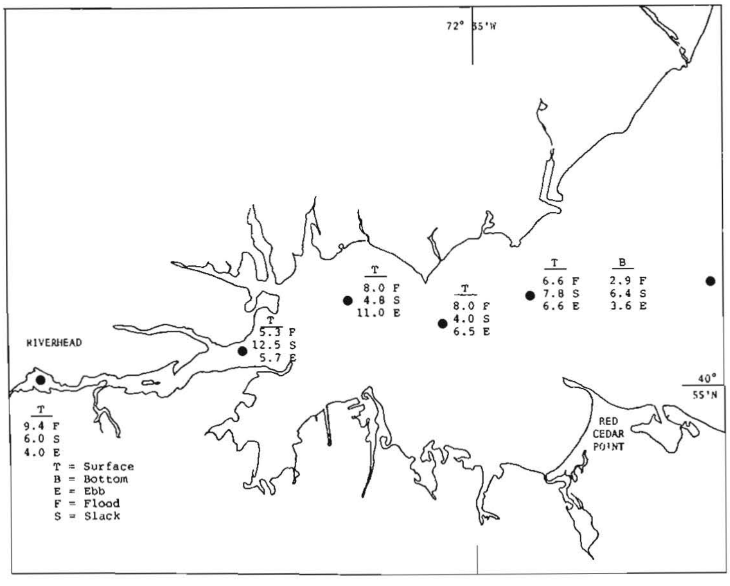

Figure B50. Chlorophyll a (mg/m^3) Variations Over a Six Hour Period, Chain of Bays Project: Flanders Bay, New York Ocean Science Laboratory 29 January 1974.

APPENDIX C

HYDROGRAPHIC STATION DATA

HYDROGRAPHIC STATION DATA UNIT LABELS AND CODE KEY

Cruise:	Year/Month/Day
Sonic Depth:	Meters
Max. Sample Depth:	Meters
Wind Velocity:	Meters/Second
Sea State Height:	Meters
Surface Temp.:	^{o}C
Visibility:	World Meteorological Organization Code 4300
Weather:	World Meteorological Organization Code 4501
Sample Depth:	Meters
Temperature:	^{o}C
Salinity:	ppt
Turbidity:	mg/l
Chlorophyll:	mg/m^3
Phaeophyton:	mg/m^3

14-16 MARCH 1975 CRUISE

MARINE SCIENCES RESEARCH CENTER

SURFACE OBSERVATIONS

CRUISE	STATION	DATE MONTH	 DAY	 YEAR	HR.EST	POSITION LATITUDE	 LONGITUDE	SONIC DEPTH	MAX. SAMPLE DEPTH	WIND VELOCITY	 DIR.FROM	AIR TEMP(C) DRY	 WET
750314	1	3	14	75	1026	40 55.50N	72 34.05W	3.0	2.8	8.9	32 TRUE	0.0	

HUMIDITY REL. (%)	OBSERVER	SEA STATE DIR.FROM	 HEIGHT	SURF TEMP	SECCHI DISK	BAR.P. MBS.HG	VISIBILITY	WEATHER	TIDE EBB	 SLACK	 FLOOD
	CDH	- TRUE	0.8	3.3	1.5 M	1023	6	7			X

PHYSICAL OBSERVATIONS

SAMPLE DEPTH	TEMP	SALINITY	SIGMA-T	OXYGEN PPM	OXYGEN UG-AT/L	OXYGEN % SAT.	PH	TURBIDITY	CHLOROPHYLL	PHAEOPHYTON
1.0	3.35	27.13	21.62	10.8	675.3	96.6	8.08	56.6	7.4	2.5
2.8	3.33	27.10	21.60	10.9	681.5	97.5	8.06	70.5		

CHEMICAL OBSERVATIONS

SAMPLE DEPTH	PART. CARBON UG/L	PART. ORG-N UG/L	NH3-N UMOLAR	NO2-N UMOLAR	NO3-N UMOLAR	TOTAL PHOS UMOLAR
1.0	710	108	0.2	0.15	0.8	0.54
2.8	370	64	0.4	0.09	0.7	0.61

SURFACE OBSERVATIONS

CRUISE	STATION	DATE MONTH	 DAY	 YEAR	HR.EST	POSITION LATITUDE	 LONGITUDE	SONIC DEPTH	MAX. SAMPLE DEPTH	WIND VELOCITY	 DIR.FROM	AIR TEMP(C) DRY	 WET
750314	2	3	14	75	1130	40 55.30N	72 33.00W	6.0	5.7	13.0	67 TRUE	0.6	

HUMIDITY REL. (%)	OBSERVER	SEA STATE DIR.FROM	 HEIGHT	SURF TEMP	SECCHI DISK	BAR.P. MBS.HG	VISIBILITY	WEATHER	TIDE EBB	 SLACK	 FLOOD
	CDH	- TRUE	1.1	3.2	1.7 M	1022	6	7			X

PHYSICAL OBSERVATIONS

SAMPLE DEPTH	TEMP	SALINITY	SIGMA-T	OXYGEN PPM	OXYGEN UG-AT/L	OXYGEN % SAT.	PH	TURBIDITY	CHLOROPHYLL	PHAEOPHYTON
1.0	3.36	27.26	21.73	10.7	669.0	95.9	8.09	53.3	5.9	1.6
3.0	3.34	27.33	21.78	10.7	669.0	95.9	8.09	32.4		
5.7	3.27	27.32	21.78	10.7	669.0	95.7	8.09	69.0		

CHEMICAL OBSERVATIONS

SAMPLE DEPTH	PART. CARBON UG/L	PART. ORG-N UG/L	NH3-N UMOLAR	NO2-N UMOLAR	NO3-N UMOLAR	TOTAL PHOS UMOLAR
1.0	1090	160	0.3	0.12	0.3	0.86
5.7	1150	64	0.6			

SURFACE OBSERVATIONS

CRUISE	STATION	DATE MONTH	 DAY	 YEAR	HR.EST	POSITION LATITUDE	 LONGITUDE	SONIC DEPTH	MAX. SAMPLE DEPTH	WIND VELOCITY	 DIR.FROM	AIR TEMP(C) DRY	 WET
750314	3	3	14	75	1148	40 56.10N	72 31.80W	6.7	6.0	13.4	87 TRUE	1.1	

HUMIDITY REL. (%)	OBSERVER	SEA STATE DIR.FROM	 HEIGHT	SURF TEMP	SECCHI DISK	BAR.P. MBS.HG	VISIBILITY	WEATHER	TIDE EBB	 SLACK	 FLOOD
	CDH	- TRUE	1.0	2.7	2.4 M	1022	6	7			

PHYSICAL OBSERVATIONS

SAMPLE DEPTH	TEMP	SALINITY	SIGMA-T	OXYGEN PPM	OXYGEN UG-AT/L	OXYGEN % SAT.	PH	TURBIDITY	CHLOROPHYLL	PHAEOPHYTON
1.0	2.76	28.16	22.49	10.7	669.0	95.0	8.06	22.4	2.0	1.6
3.0	2.75	28.16	22.49	10.6	662.8	94.1	8.07	22.4		
6.0	2.74	28.17	22.49	10.6	662.8	94.1	8.06	23.9		

CHEMICAL OBSERVATIONS

SAMPLE DEPTH	PART. CARBON UG/L	PART. ORG-N UG/L	NH3-N UMOLAR	NO2-N UMOLAR	NO3-N UMOLAR	TOTAL PHOS UMOLAR
1.0	790	99	0.5	0.07	1.0	0.67
3.0			0.1	0.17	1.0	0.64
6.0	620	83	0.3	0.18	1.0	0.66

SURFACE OBSERVATIONS

CRUISE	STATION	DATE MONTH	 DAY	 YEAR	HR.EST	POSITION LATITUDE	 LONGITUDE	SONIC DEPTH	MAX. SAMPLE DEPTH	WIND VELOCITY	 DIR.FROM	AIR TEMP(C) DRY	 WET
750314	4	3	14	75	1212	40 54.90N	72 31.50W	6.0	5.5	6.7	97 TRUE	1.1	

HUMIDITY REL. (%)	OBSERVER	SEA STATE DIR.FROM	 HEIGHT	SURF TEMP	SECCHI DISK	BAR.P. MBS.HG	VISIBILITY	WEATHER	TIDE EBB	 SLACK	 FLOOD
	CDH	110 TRUE	0.8	2.9	2.0 M	1022	6	7			X

PHYSICAL OBSERVATIONS

SAMPLE DEPTH	TEMP	SALINITY	SIGMA-T	OXYGEN PPM	OXYGEN UG-AT/L	OXYGEN % SAT.	PH	TURBIDITY	CHLOROPHYLL	PHAEOPHYTON
1.0	2.89	28.09	22.42	10.6	662.8	94.4	8.06	24.1	2.0	0.8
3.0	2.87	28.09	22.42	10.6	662.8	94.4	8.07	22.3		
5.5	2.86	28.11	22.44	10.7	669.0	95.2	8.07	23.6		

CHEMICAL OBSERVATIONS

SAMPLE DEPTH	PART. CARBON UG/L	PART. ORG-N UG/L	NH3-N UMOLAR	NO2-N UMOLAR	NO3-N UMOLAR	TOTAL PHOS UMOLAR
1.0	360	60	0.4	0.13	1.0	0.66
5.5	280	44	0.2	0.09	0.9	0.69

SURFACE OBSERVATIONS

CRUISE	STATION	DATE			HR.EST	POSITION		SONIC DEPTH	MAX. SAMPLE DEPTH	WIND		AIR TEMP(C)	
		MONTH	DAY	YEAR		LATITUDE	LONGITUDE			VELOCITY	DIR.FROM	DRY	WET
750314	5	3	14	75	1246	40 53.70N	72 30.20W	3.7	3.5	6.2	77 TRUE	1.1	

HUMIDITY REL. (%)	OBSERVER	SEA STATE		SURF TEMP	SECCHI DISK	BAR.P. MBS.HG	VISIBILITY	WEATHER	TIDE		
		DIR.FROM	HEIGHT						EBB	SLACK	FLOOD
	CDH	- TRUE	0.0	3.1	1.3 M	1021	6	7	X		

PHYSICAL OBSERVATIONS

SAMPLE DEPTH	TEMP	SALINITY	SIGMA-T	OXYGEN PPM	OXYGEN UG-AT/L	OXYGEN % SAT.	PH	TURBIDITY	CHLOROPHYLL	PHAEOPHYTON
1.0	3.14	27.90	22.25	10.5	656.5	94.0	8.05	31.6	1.8	1.1
3.5	3.15	27.90	22.25	10.5	656.5	94.0	8.05	33.7		

CHEMICAL OBSERVATIONS

SAMPLE DEPTH	PART. CARBON UG/L	PART. ORG-N UG/L	NH3-N UMOLAR	NO2-N UMOLAR	NO3-N UMOLAR	TOTAL PHOS UMOLAR
1.0	470	72	0.2	0.07	0.9	0.66
3.5			0.2	0.12	0.4	0.62

SURFACE OBSERVATIONS

CRUISE	STATION	DATE			HR.EST	POSITION		SONIC DEPTH	MAX. SAMPLE DEPTH	WIND		AIR TEMP(C)	
		MONTH	DAY	YEAR		LATITUDE	LONGITUDE			VELOCITY	DIR.FROM	DRY	WET
750314	6	3	14	75	1327	40 54.80N	72 28.90W	7.6	7.0	14.3	92 TRUE	1.7	

HUMIDITY REL. (%)	OBSERVER	SEA STATE		SURF TEMP	SECCHI DISK	BAR.P. MBS.HG	VISIBILITY	WEATHER	TIDE		
		DIR.FROM	HEIGHT						EBB	SLACK	FLOOD
	CDH	72 TRUE	0.6	3.0	2.5 M	1020	5	7			

PHYSICAL OBSERVATIONS

SAMPLE DEPTH	TEMP	SALINITY	SIGMA-T	OXYGEN PPM	OXYGEN UG-AT/L	OXYGEN % SAT.	PH	TURBIDITY	CHLOROPHYLL	PHAEOPHYTON
1.0	3.07	28.09	22.41	10.5	656.5	93.9	8.08	23.0	2.0	0.7
3.0	3.08	28.11	22.42	10.6	662.8	94.9	8.07	21.7		
7.0	2.98	28.12	22.44	10.6	662.8	94.6	8.07	21.3		

CHEMICAL OBSERVATIONS

SAMPLE DEPTH	PART. CARBON UG/L	PART. ORG-N UG/L	NH3-N UMOLAR	NO2-N UMOLAR	NO3-N UMOLAR	TOTAL PHOS UMOLAR
1.0	800	86	0.3	0.14	0.4	0.62
0.0			0.3	0.00	0.8	0.59
7.0	840	94	0.4	0.11	0.8	0.73

SURFACE OBSERVATIONS

CRUISE	STATION	DATE			HR.EST	POSITION		SONIC DEPTH	MAX. SAMPLE DEPTH	WIND		AIR TEMP(C)	
		MONTH	DAY	YEAR		LATITUDE	LONGITUDE			VELOCITY	DIR.FROM	DRY	WET
750314	7	3	14	75	1346	40 55.70N	72 29.40W	7.2	7.0	6.7	77 TRUE	0.6	

HUMIDITY REL. (%)	OBSERVER	SEA STATE		SURF TEMP	SECCHI DISK	BAR.P. MBS.HG	VISIBILITY	WEATHER	TIDE		
		DIR.FROM	HEIGHT						EBB	SLACK	FLOOD
	CDH	77 TRUE	0.6	2.8	2.5 M	1020	5	7	X		

PHYSICAL OBSERVATIONS

SAMPLE DEPTH	TEMP	SALINITY	SIGMA-T	OXYGEN PPM	OXYGEN UG-AT/L	OXYGEN % SAT.	PH	TURBIDITY	CHLOROPHYLL	PHAEOPHYTON
1.0	2.80	28.24	22.55	10.7	669.0	95.2	8.07	15.9	1.5	0.6
3.0	2.80	28.24	22.55	10.7	669.0	95.2	8.07	16.3		
5.0	2.81	28.24	22.55	10.7	669.0	95.2	8.07	17.7		
7.0	2.82	28.24	22.54	10.7	669.0	95.2	8.07	17.2		

CHEMICAL OBSERVATIONS

SAMPLE DEPTH	PART. CARBON UG/L	PART. ORG-N UG/L	NH3-N UMOLAR	NO2-N UMOLAR	NO3-N UMOLAR	TOTAL PHOS UMOLAR
1.0	420	52	0.4	0.11	0.8	0.66
7.0	420	62	0.9	0.06	0.8	0.64

SURFACE OBSERVATIONS

CRUISE	STATION	DATE			HR.EST	POSITION		SONIC DEPTH	MAX. SAMPLE DEPTH	WIND		AIR TEMP(C)	
		MONTH	DAY	YEAR		LATITUDE	LONGITUDE			VELOCITY	DIR.FROM	DRY	WET
750314	8	3	14	75	1408	40 56.60N	72 30.30W	6.7	5.5	11.6	87 TRUE	1.1	

HUMIDITY REL. (%)	OBSERVER	SEA STATE		SURF TEMP	SECCHI DISK	BAR.P. MBS.HG	VISIBILITY	WEATHER	TIDE		
		DIR.FROM	HEIGHT						EBB	SLACK	FLOOD
	CDH	87 TRUE	0.6	2.8	3.0 M	1020	5	7	X		

PHYSICAL OBSERVATIONS

SAMPLE DEPTH	TEMP	SALINITY	SIGMA-T	OXYGEN PPM	OXYGEN UG-AT/L	OXYGEN % SAT.	PH	TURBIDITY	CHLOROPHYLL	PHAEOPHYTON
1.0	2.85	28.31	22.60	10.7	669.0	95.3	8.07	18.2	1.7	0.6
3.0	2.86	28.31	22.60	10.7	669.0	95.4	8.07	21.2		
5.5	2.86	28.31	22.60	10.7	669.0	95.4	8.07	39.8		

CHEMICAL OBSERVATIONS

SAMPLE DEPTH	PART. CARBON UG/L	PART. ORG-N UG/L	NH3-N UMOLAR	NO2-N UMOLAR	NO3-N UMOLAR	TOTAL PHOS UMOLAR
1.0	650	75	0.4	0.13	0.8	0.67
3.0			0.6	0.10	0.3	0.66
5.5	670	70	0.0	0.07	1.0	0.68

SURFACE OBSERVATIONS

CRUISE	STATION	DATE MONTH	DATE DAY	DATE YEAR	HR.EST	POSITION LATITUDE	POSITION LONGITUDE	SONIC DEPTH	MAX. SAMPLE DEPTH	WIND VELOCITY	WIND DIR.FROM	AIR TEMP(C) DRY	AIR TEMP(C) WET
750314	9	3	14	75	1456	40 56.80N	72 32.00W	3.0	2.5	14.3	77 TRUE	0.6	

HUMIDITY REL. (%)	OBSERVER	SEA STATE DIR.FROM	SEA STATE HEIGHT	SURF TEMP	SECCHI DISK	BAR.P. MBS.HG	VISIBILITY	WEATHER	TIDE EBB	TIDE SLACK	TIDE FLOOD
	CDH	77 TRUE	1.0	2.7	1.0 M	1017	5	7	X		

PHYSICAL OBSERVATIONS

SAMPLE DEPTH	TEMP	SALINITY	SIGMA-T	OXYGEN PPM	OXYGEN UG-AT/L	OXYGEN % SAT.	PH	TURBIDITY	CHLOROPHYLL	PHAEOPHYTON
1.0	2.71	28.08	22.43	10.8	675.3	95.8	8.07	40.8	2.2	1.0
2.5	2.71	28.10	22.44	10.8	675.3	95.8	8.08	37.0		

CHEMICAL OBSERVATIONS

SAMPLE DEPTH	PART. CARBON UG/L	PART. ORG-N UG/L	NH3-N UMOLAR	NO2-N UMOLAR	NO3-N UMOLAR	TOTAL PHOS UMOLAR
1.0	890	123	0.6	0.11	0.4	0.60
2.5	630	73	0.5	0.11	1.0	0.62

SURFACE OBSERVATIONS

CRUISE	STATION	DATE MONTH	DATE DAY	DATE YEAR	HR.EST	POSITION LATITUDE	POSITION LONGITUDE	SONIC DEPTH	MAX. SAMPLE DEPTH	WIND VELOCITY	WIND DIR.FROM	AIR TEMP(C) DRY	AIR TEMP(C) WET
750314	10	3	14	75	1518	40 57.70N	72 30.70W	6.1	5.5	11.6	72 TRUE	0.6	

HUMIDITY REL. (%)	OBSERVER	SEA STATE DIR.FROM	SEA STATE HEIGHT	SURF TEMP	SECCHI DISK	BAR.P. MBS.HG	VISIBILITY	WEATHER	TIDE EBB	TIDE SLACK	TIDE FLOOD
	CDH	77 TRUE	0.8	2.7	2.8 M	1016	5	7	X		

PHYSICAL OBSERVATIONS

SAMPLE DEPTH	TEMP	SALINITY	SIGMA-T	OXYGEN PPM	OXYGEN UG-AT/L	OXYGEN % SAT.	PH	TURBIDITY	CHLOROPHYLL	PHAEOPHYTON
1.0	2.70	28.21	22.53	10.7	669.0	94.9	8.06	21.0	1.5	0.6
3.0	2.71	28.24	22.55	10.7	669.0	95.0	8.06	20.6		
5.5	2.73	28.25	22.56	10.8	675.3	95.9	8.06	20.0		

CHEMICAL OBSERVATIONS

SAMPLE DEPTH	PART. CARBON UG/L	PART. ORG-N UG/L	NH3-N UMOLAR	NO2-N UMOLAR	NO3-N UMOLAR	TOTAL PHOS UMOLAR
1.0	180	65	0.4	0.12	1.0	0.69
5.5			0.5	0.06	0.8	0.65

SURFACE OBSERVATIONS

CRUISE	STATION	DATE MONTH	DATE DAY	DATE YEAR	HR.EST	POSITION LATITUDE	POSITION LONGITUDE	SONIC DEPTH	MAX. SAMPLE DEPTH	WIND VELOCITY	WIND DIR.FROM	AIR TEMP(C) DRY	AIR TEMP(C) WET
750315	11	3	15	75	0933	40 57.20N	72 27.00W	6.1	6.0	6.7	337 TRUE	0.0	

HUMIDITY REL. (%)	OBSERVER	SEA STATE DIR.FROM	SEA STATE HEIGHT	SURF TEMP	SECCHI DISK	BAR.P. MBS.HG	VISIBILITY	WEATHER	TIDE EBB	TIDE SLACK	TIDE FLOOD
	CDH	327 TRUE	0.3	2.4	1.5 M	1015	8	1			X

PHYSICAL OBSERVATIONS

SAMPLE DEPTH	TEMP	SALINITY	SIGMA-T	OXYGEN PPM	OXYGEN UG-AT/L	OXYGEN % SAT.	PH	TURBIDITY	CHLOROPHYLL	PHAEOPHYTON
1.0	2.56	28.53	22.79	10.2	637.8	90.4	7.55	35.5	2.1	0.8
3.0	2.53	28.50	22.77	10.4	650.3	92.1	7.45	40.7		
6.0	2.56	28.33	22.63	10.2	637.8	90.3	7.87	52.4	1.8	0.7

CHEMICAL OBSERVATIONS

SAMPLE DEPTH	PART. CARBON UG/L	PART. ORG-N UG/L	NH3-N UMOLAR	NO2-N UMOLAR	NO3-N UMOLAR	TOTAL PHOS UMOLAR
1.0			0.6	0.28	0.6	0.75
3.0				0.07	0.9	0.70
6.0	500	93	0.3	0.09	0.7	0.65

SURFACE OBSERVATIONS

CRUISE	STATION	DATE MONTH	DATE DAY	DATE YEAR	HR.EST	POSITION LATITUDE	POSITION LONGITUDE	SONIC DEPTH	MAX. SAMPLE DEPTH	WIND VELOCITY	WIND DIR.FROM	AIR TEMP(C) DRY	AIR TEMP(C) WET
750315	12	3	15	75	1010	40 55.70N	72 29.50W	6.1	6.0	8.9	337 TRUE	0.0	

HUMIDITY REL. (%)	OBSERVER	SEA STATE DIR.FROM	SEA STATE HEIGHT	SURF TEMP	SECCHI DISK	BAR.P. MBS.HG	VISIBILITY	WEATHER	TIDE EBB	TIDE SLACK	TIDE FLOOD
	CDH	337 TRUE	0.5		1.1 M	1016	8	1			X

PHYSICAL OBSERVATIONS

SAMPLE DEPTH	TEMP	SALINITY	SIGMA-T	OXYGEN PPM	OXYGEN UG-AT/L	OXYGEN % SAT.	PH	TURBIDITY	CHLOROPHYLL	PHAEOPHYTON
1.0	2.56	27.81	22.22	10.8	675.3	95.2	7.91	84.6	4.7	2.3
3.0	2.50	27.88	22.28	10.5	656.5	92.5	7.88	85.9		
6.0	2.46	27.90	22.30	10.3	644.0	90.7	7.88	92.0	4.0	2.5

CHEMICAL OBSERVATIONS

SAMPLE DEPTH	PART. CARBON UG/L	PART. ORG-N UG/L	NH3-N UMOLAR	NO2-N UMOLAR	NO3-N UMOLAR	TOTAL PHOS UMOLAR
1.0	810	148	0.4	0.06	0.9	0.60
6.0	920	128	0.4	0.00	0.8	0.73

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                                                  SURFACE OBSERVATIONS
                                DATE                         POSITION            SONIC    MAX. SAMPLE              WIND            AIR TEMP(C)
  CRUISE     STATION      MONTH DAY YEAR    HR.EST    LATITUDE    LONGITUDE      DEPTH       DEPTH         VELOCITY  DIR.FROM     DRY     WET
  750315        13           3   15   75     1039     40 57.30N   72 28.50W       4.0         3.9             8.0    307 TRUE     0.6
      HUMIDITY                          SEA  STATE          SURF       SECCHI      BAR.P.                                           TIDE
      REL. (%)       OBSERVER       DIR.FROM  HEIGHT        TEMP        DISK       MBS.HG        VISIBILITY       WEATHER      EBB SLACK FLOOD
                        CDH         307 TRUE    0.3          2.5        2.9 M       1016             8               1                    X
                                                  PHYSICAL OBSERVATIONS
SAMPLE                                                OXYGEN        OXYGEN      OXYGEN
DEPTH       TEMP      SALINITY       SIGMA-T            PPM        UG-AT/L      % SAT.      PH       TURBIDITY      CHLOROPHYLL      PHAEOPHYTON
  1.0       2.61       28.35          22.65            10.7         669.0        94.8      7.95        31.2             2.1              0.7
  3.9       2.61       28.35          22.65            10.0         625.3        88.6      7.94        35.5             2.1              0.8
                                                  CHEMICAL OBSERVATIONS
                      PART.             PART.                                                                      TOTAL
SAMPLE                CARBON            ORG-N               NH3-N              NO2-N              NO3-N            PHOS
DEPTH                 UG/L              UG/L                UMOLAR             UMOLAR             UMOLAR           UMOLAR
  1.0                                                        0.2                0.15               0.9              0.71
  3.9                 1140               138                 0.4                0.15               0.5              0.64


                                                  SURFACE OBSERVATIONS
                                DATE                         POSITION            SONIC    MAX. SAMPLE              WIND            AIR TEMP(C)
  CRUISE     STATION      MONTH DAY YEAR    HR.EST    LATITUDE    LONGITUDE      DEPTH       DEPTH         VELOCITY  DIR.FROM     DRY     WET
  750315        14           3   15   75     1106     40 58.40N   72 29.10W       6.1         5.0             9.8    357 TRUE     0.0
      HUMIDITY                          SEA  STATE          SURF       SECCHI      BAR.P.                                           TIDE
      REL. (%)       OBSERVER       DIR.FROM  HEIGHT        TEMP        DISK       MBS.HG        VISIBILITY       WEATHER      EBB SLACK FLOOD
                        CDH         337 TRUE    0.5          2.4        1.8 M       1016             8               1                    X
                                                  PHYSICAL OBSERVATIONS
SAMPLE                                                OXYGEN        OXYGEN      OXYGEN
DEPTH       TEMP      SALINITY       SIGMA-T            PPM        UG-AT/L      % SAT.      PH       TURBIDITY      CHLOROPHYLL      PHAEOPHYTON
  1.0       2.52       28.28          22.60            10.3         644.0        91.0      7.96        37.2             2.1              0.9
  3.0       2.51       28.28          22.60            10.3         644.0        91.0      7.95        92.2
  5.0       2.51       28.28          22.60            10.3         644.0        91.0      7.95        92.2             1.9              0.8
                                                  CHEMICAL OBSERVATIONS
                      PART.             PART.                                                                      TOTAL
SAMPLE                CARBON            ORG-N               NH3-N              NO2-N              NO3-N            PHOS
DEPTH                 UG/L              UG/L                UMOLAR             UMOLAR             UMOLAR           UMOLAR
  1.0                                                        0.4                0.10               0.3              0.72
  5.0                                                        0.3                0.14               1.1              0.74


                                                  SURFACE OBSERVATIONS
                                DATE                         POSITION            SONIC    MAX. SAMPLE              WIND            AIR TEMP(C)
  CRUISE     STATION      MONTH DAY YEAR    HR.EST    LATITUDE    LONGITUDE      DEPTH       DEPTH         VELOCITY  DIR.FROM     DRY     WET
  750315        15           3   15   75     1146     40 57.70N   72 25.80W      10.7        10.0            10.7    327 TRUE     2.2
      HUMIDITY                          SEA  STATE          SURF       SECCHI      BAR.P.                                           TIDE
      REL. (%)       OBSERVER       DIR.FROM  HEIGHT        TEMP        DISK       MBS.HG        VISIBILITY       WEATHER      EBB SLACK FLOOD
                        CDH         337 TRUE    0.5          2.6        1.5 M       1017             8               1
                                                  PHYSICAL OBSERVATIONS
SAMPLE                                                OXYGEN        OXYGEN      OXYGEN
DEPTH       TEMP      SALINITY       SIGMA-T            PPM        UG-AT/L      % SAT.      PH       TURBIDITY      CHLOROPHYLL      PHAEOPHYTON
  1.0       2.65       28.04          22.40            10.2         637.8        90.3      7.98        62.0             3.2              1.7
  4.0       2.51       28.39          22.69            10.2         637.8        90.2      8.00        40.9             2.6              1.1
  7.0       2.51       28.43          22.72            10.2         637.8        90.2      8.01        40.8             2.6              1.1
 10.0       2.60       28.70          22.93            10.2         637.8        90.6      8.03        33.4             2.9              1.0
                                                  CHEMICAL OBSERVATIONS
                      PART.             PART.                                                                      TOTAL
SAMPLE                CARBON            ORG-N               NH3-N              NO2-N              NO3-N            PHOS
DEPTH                 UG/L              UG/L                UMOLAR             UMOLAR             UMOLAR           UMOLAR
  1.0                                                        0.8                0.12               1.0              0.68
  4.0                                                        0.6                0.07               0.8              0.68
  7.0                                                        0.5                0.11               0.9              0.71
 10.0                  660               107                 0.4                0.12               0.8              0.68


                                                  SURFACE OBSERVATIONS
                                DATE                         POSITION            SONIC    MAX. SAMPLE              WIND            AIR TEMP(C)
  CRUISE     STATION      MONTH DAY YEAR    HR.EST    LATITUDE    LONGITUDE      DEPTH       DEPTH         VELOCITY  DIR.FROM     DRY     WET
  750315        16           3   15   75     1210     40 57.50N   72 24.70W       6.2         6.0             8.0    322 TRUE     3.9
      HUMIDITY                          SEA  STATE          SURF       SECCHI      BAR.P.                                           TIDE
      REL. (%)       OBSERVER       DIR.FROM  HEIGHT        TEMP        DISK       MBS.HG        VISIBILITY       WEATHER      EBB SLACK FLOOD
                        CDH         327 TRUE    0.7          2.6        2.0 M       1017             8               1
                                                  PHYSICAL OBSERVATIONS
SAMPLE                                                OXYGEN        OXYGEN      OXYGEN
DEPTH       TEMP      SALINITY       SIGMA-T            PPM        UG-AT/L      % SAT.      PH       TURBIDITY      CHLOROPHYLL      PHAEOPHYTON
  1.0       2.67       28.30          22.60            10.2         637.8        90.5      8.01        34.0             2.1              0.7
  3.0       2.66       28.32          22.62            10.2         637.8        90.5      8.01        33.9
  6.0       2.64       28.33          22.63            10.2         637.8        90.4      8.01        36.3             2.3              0.7
                                                  CHEMICAL OBSERVATIONS
                      PART.             PART.                                                                      TOTAL
SAMPLE                CARBON            ORG-N               NH3-N              NO2-N              NO3-N            PHOS
DEPTH                 UG/L              UG/L                UMOLAR             UMOLAR             UMOLAR           UMOLAR
  1.0                  620                99                 0.6                0.22               0.4              0.66
  6.0                  640                74                 0.6                0.11               1.0              0.69
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                                                   SURFACE OBSERVATTONS
                          CATE                          POSITION           SONTC   MAX. SAMPLE              WIND           AIR TEMP(C)
  CRUISE    STATION  MONTH DAY YEAR   HR.EST    LATITUDE    LONGITUDE     CEPTH       DEPTH        VELOCTTY  DIR.FROM     DRY     WET
  750315       17       3   15   75     1243    40 59.20N   72 26.80W       7.3        6.8            11.6    357 TRUE     1.1
     HUMIDITY                        SEA  STATE        SURF       SECCHI      BAR.P.                                             TIDE
     REL. (%)     ORSERVER       CIR.FROM  HEIGHT      TEMP        OISK       MBS.HG      VISIRILITY      WEATHER     EBB SLACK FLOOD
                     CDH         337 TRUE    0.6        2.5        1.5 M       1018            8             1
                                                   PHYSICAL OBSERVATIONS
SAMPLE                                                CXYGEN       OXYGEN      OXYGEN
DEPTH        TEMP      SALINITY      SIGMA-T           PPM       UG-AT/L      % SAT.       PH       TURRIDITY      CHLOROPHYLL       PHAEOPHYTON
  1.0        2.65       28.66         22.89           10.2        637.8        9C.7       8.04        36.6            2.7                0.8
  3.0        2.64       28.67         22.90           10.2        637.8        90.7       8.04        38.2            2.8                1.0
  6.8        2.57       23.77         22.98           10.2        637.8        90.6       8.04        73.4            4.4                2.5
                                                   CHEMICAL OBSERVATIONS
                      PART.            PART.                                                                      TOTAL
SAMPLE               CARRON            ORG-N             NH3-N              NO2-N              NO3-N               PHOS
DEPTH                 UG/L             UG/L              UMOLAR             UMOLAR             UMOLAR             UMOLAR
  1.0                 1030              114               0.3                0.09               0.7                0.68
  3.0                                                     0.9
  6.8                  890              144               0.4                0.10               0.7                0.69


                                                   SURFACE ORSERVATIONS
                          CATE                          POSITION           SONIC   MAX. SAMPLE              WIND           AIR TEMP(C)
  CRUISF    STATION  MONTH DAY YEAR   HR.EST    LATITUDE    LONGITUDE     CEPTH       DEPTH        VELOCITY  OIR.FROM     DRY     WET
  750315       18       3   15   75     1320    40 58.70N   72 25.00W      10.7       10.0            11.6    292 TRUE     2.8
     HUMIDITY                        SEA  STATE        SURF       SECCHI      BAR.P.                                             TIDE
     REL. (%)     OBSERVER       CIR.FROM  HEIGHT      TEMP        DISK       MBS.HG      VISIBILITY      WEATHER     EBB SLACK FLOOD
                     CDH         317 TRUE    0.8        2.7        2.9 M       1018            8             1
                                                   PHYSICAL OBSERVATIONS
SAMPLE                                                CXYGEN       OXYGEN      OXYGEN
DEPTH        TEMP      SALINITY      SIGMA-T           PPM       UG-AT/L      % SAT.       PH       TURRIDITY      CHLOROPHYLL       PHAEOPHYTON
  1.0        2.72       28.48         22.74           10.2        637.8        9C.7       8.04        30.5            2.3                0.8
  4.0        2.70       28.49         22.75           10.2        637.8        9C.7       8.04        31.3            2.3                0.7
  7.0        2.67       28.50         22.76           10.2        637.8        90.6       8.04        32.4            2.3                0.8
 10.0        2.63       28.65         22.88           10.1        631.5        89.7       8.06        32.8            2.6                0.9
                                                   CHEMICAL OBSERVATIONS
                      PART.            PART.                                                                      TOTAL
SAMPLF               CARRON            ORG-N             NH3-N              NO2-N              NO3-N               PHOS
DEPTH                 UG/L             UG/L              UMOLAR             UMOLAR             UMOLAR             UMOLAR
  1.0                  500              102               0.2                0.22               1.0                0.71
  3.0                                                     0.5                0.13               1.0                0.70
  7.0                                                     0.3                0.39               1.0                1.66
 10.0                  460               62               0.6                0.05               0.9                0.69


                                                   SURFACE OBSERVATIONS
                          CATE                          POSITION           SONIC   MAX. SAMPLE              WIND           AIR TEMP(C)
  CRUISE    STATION  MONTH DAY YEAR   HR.EST    LATITUDE    LONGITUDE     CEPTH       DEPTH        VELOCITY  DIR.FROM     DRY     WET
  750315       19       3   15   75     1409    40 58.20N   72 23.80W       5.5        5.0             7.9    307 TRUE     2.8
     HUMIDITY                        SEA  STATE        SURF       SECCHI      BAR.P.                                             TIDE
     REL. (%)     ORSERVER       DIR.FROM  HEIGHT      TEMP        DISK       MBS.HG      VISIBILITY      WEATHER     EBB SLACK FLOOD
                     CDH         327 TRUE    0.8        2.8        2.8 M       1019            8             1          X
                                                   PHYSICAL OBSERVATIONS
SAMPLE                                                CXYGEN       OXYGEN      OXYGEN
DEPTH        TEMP      SALINITY      SIGMA-T           PPM       UG-AT/L      % SAT.       PH       TURRIDITY      CHLOROPHYLL       PHAEOPHYTON
  1.0        2.71       28.45         22.72           10.2        637.8        9C.7       8.C6        32.3            2.1                0.5
  3.0        2.71       28.46         22.73           10.2        637.8        9C.7       8.07        31.6
  5.0        2.70       28.47         22.74           10.2        637.8        9C.7       8.04        30.6            2.0                0.8
                                                   CHEMICAL OBSERVATIONS
                      PART.            PART.                                                                      TOTAL
SAMPLE               CARRON            ORG-N             NH3-N              NO2-N              NO3-N               PHOS
DEPTH                 UG/L             UG/L              UMOLAR             UMOLAR             UMOLAR             UMOLAR
  1.0                                                     0.8                0.06               0.9                0.68
  5.0                  660               77               0.8                0.08               0.9                0.87


                                                   SURFACE OBSERVATIONS
                          CATE                          POSITION           SONIC   MAX. SAMPLE              WIND           AIR TEMP(C)
  CRUISE    STATION  MONTH DAY YEAR   HR.EST    LATITUDE    LONGITUDE     CEPTH       DEPTH        VELOCITY  DIR.FPOM     DRY     WET
  750315       20       3   15   75     1442    40 59.80N   72 22.60W      12.2       11.0             7.3    307 TRUE     2.8
     HUMIDITY                        SEA  STATE        SURF       SECCHI      BAR.P.                                             TIDE
     REL. (%)     OBSERVER       CIR.FROM  HEIGHT      TEMP        DISK       MBS.HG      VISIBILITY      WEATHER     EBB SLACK FLOOD
                     CDH         317 TRUE    1.0        2.8        2.3 M       1019            8             1          X
                                                   PHYSICAL OBSERVATIONS
SAMPLE                                                CXYGEN       OXYGEN      OXYGEN
DEPTH        TEMP      SALINITY      SIGMA-T           PPM       UG-AT/L      % SAT.       PH       TURBIDITY      CHLOROPHYLL       PHAEOPHYTON
  1.0        2.83       28.64         22.86           10.2        637.8        91.1       8.07        74.3            2.3                0.6
  4.0        2.83       28.64         22.86           10.2        637.8        91.1       8.07        88.8            2.4                0.6
  7.0        2.79       28.63         22.86           10.2        637.8        91.0       8.07        92.2            2.2                0.7
 11.0        2.78       28.82         23.01           10.2        637.8        91.1       8.07        92.2            2.7                1.8
                                                   CHEMICAL OBSERVATIONS
                      PART.            PART.                                                                      TOTAL
SAMPLE               CARRON            ORG-N             NH3-N              NO2-N              NO3-N               PHOS
OEPTH                 UG/L             UG/L              UMOLAR             UMOLAR             UMOLAR             UMOLAR
  1.0                  57D               93               0.6                0.14               1.1                0.71
 11.0                  540               99               0.6                0.05               0.9                0.67
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SURFACE OBSERVATIONS

CRUISE	STATION	DATE MONTH	DATE DAY	DATE YEAR	HR.EST	POSITION LATITUDE	POSITION LONGITUDE	SONIC DEPTH	MAX. SAMPLE DEPTH	WIND VELOCITY	WIND DIR.FROM	AIR TEMP(C) DRY	AIR TEMP(C) WET
750315	21	3	15	75	1503	41 00.05N	72 23.70W	10.3	10.0	11.2	277 TRUE	1.7	

HUMIDITY REL. (%)	OBSERVER	SEA STATE DIR.FROM	SEA STATE HEIGHT	SURF TEMP	SECCHI DISK	BAR.P. MBS.HG	VISIBILITY	WEATHER	TIDE EBB	TIDE SLACK	TIDE FLOOD
	CDH	297 TRUE	0.8	2.9	2.1 M	1019	8	1	X		

PHYSICAL OBSERVATIONS

SAMPLE DEPTH	TEMP	SALINITY	SIGMA-T	OXYGEN PPM	OXYGEN UG-AT/L	OXYGEN % SAT.	PH	TURBIDITY	CHLOROPHYLL	PHAEOPHYTON
1.0	2.79	28.88	23.06	10.2	637.8	91.1	8.10	92.2	3.2	1.0
4.0	2.80	28.89	23.06	10.2	637.8	91.1	8.10	92.2	3.2	0.9
7.0	2.79	28.91	23.08	10.2	637.8	91.1	8.10	92.2		
10.0	2.82	28.92	23.08	10.2	637.8	91.2	8.10	92.2	3.0	0.9

CHEMICAL OBSERVATIONS

SAMPLE DEPTH	PART. CARBON UG/L	PART. ORG-N UG/L	NH3-N UMOLAR	NO2-N UMOLAR	NO3-N UMOLAR	TOTAL PHOS UMOLAR
1.0			0.2	0.10	0.9	0.75
10.0	820	102	0.3	0.07	0.9	0.70

SURFACE OBSERVATIONS

CRUISE	STATION	DATE MONTH	DATE DAY	DATE YEAR	HR.EST	POSITION LATITUDE	POSITION LONGITUDE	SONIC DEPTH	MAX. SAMPLE DEPTH	WIND VELOCITY	WIND DIR.FROM	AIR TEMP(C) DRY	AIR TEMP(C) WET
750315	22	3	15	75	1535	41 00.30N	72 25.40W	8.5	7.5	8.9	327 TRUE	2.8	

HUMIDITY REL. (%)	OBSERVER	SEA STATE DIR.FROM	SEA STATE HEIGHT	SURF TEMP	SECCHI DISK	BAR.P. MBS.HG	VISIBILITY	WEATHER	TIDE EBB	TIDE SLACK	TIDE FLOOD
	CDH	327 TRUE	0.7	2.9	2.6 M	1020	8	1	X		

PHYSICAL OBSERVATIONS

SAMPLE DEPTH	TEMP	SALINITY	SIGMA-T	OXYGEN PPM	OXYGEN UG-AT/L	OXYGEN % SAT.	PH	TURBIDITY	CHLOROPHYLL	PHAEOPHYTON
1.0	2.84	28.88	23.05	10.2	637.8	91.2	8.10	82.7	2.5	0.7
4.0	2.83	28.90	23.07	10.2	637.8	91.2	8.11	92.2	2.8	0.8
7.5	2.82	28.92	23.08	10.2	637.8	91.2	8.11	92.2	3.0	0.8

CHEMICAL OBSERVATIONS

SAMPLE DEPTH	PART. CARBON UG/L	PART. ORG-N UG/L	NH3-N UMOLAR	NO2-N UMOLAR	NO3-N UMOLAR	TOTAL PHOS UMOLAR
1.0	440	93	0.5	0.13	1.1	0.81
7.5	620	87	0.6	0.18	0.9	0.75

SURFACE OBSERVATIONS

CRUISE	STATION	DATE MONTH	DATE DAY	DATE YEAR	HR.EST	POSITION LATITUDE	POSITION LONGITUDE	SONIC DEPTH	MAX. SAMPLE DEPTH	WIND VELOCITY	WIND DIR.FROM	AIR TEMP(C) DRY	AIR TEMP(C) WET
750316	23	3	16	75	0814	41 4.50N	72 22.30W	22.3	19.0	2.7	293 TRUE	1.7	

HUMIDITY REL. (%)	OBSERVER	SEA STATE DIR.FROM	SEA STATE HEIGHT	SURF TEMP	SECCHI DISK	BAR.P. MBS.HG	VISIBILITY	WEATHER	TIDE EBB	TIDE SLACK	TIDE FLOOD
	CDH	- TRUE	0.0	2.7	2.9 M	1030	8	1		X	

PHYSICAL OBSERVATIONS

SAMPLE DEPTH	TEMP	SALINITY	SIGMA-T	OXYGEN PPM	OXYGEN UG-AT/L	OXYGEN % SAT.	PH	TURBIDITY	CHLOROPHYLL	PHAEOPHYTON
1.0	2.80	29.02	23.17	10.5	656.5	93.9	8.05	21.2	4.3	1.6
4.0	2.76	29.04	23.18	10.5	656.5	93.8	8.06	21.5		
7.0	2.76	29.05	23.19	10.5	656.5	93.8	8.06	23.0	4.5	1.6
10.0	2.76	29.12	23.25	10.5	656.5	93.9	8.06	23.6		
13.0	2.76	29.04	23.18	10.6	662.8	94.7	8.07	21.2		
16.0	2.83	29.13	23.25	10.6	662.8	94.9	8.07	22.9	5.5	1.5
19.0	2.85	29.15	23.27	10.8	675.3	96.8	8.10	29.3		

CHEMICAL OBSERVATIONS

SAMPLE DEPTH	PART. CARBON UG/L	PART. ORG-N UG/L	NH3-N UMOLAR	NO2-N UMOLAR	NO3-N UMOLAR	TOTAL PHOS UMOLAR
1.0	860	109	0.3	0.09	0.5	0.85
19.0	760	82	0.6	0.13	1.0	0.85

SURFACE OBSERVATIONS

CRUISE	STATION	DATE MONTH	DATE DAY	DATE YEAR	HR.EST	POSITION LATITUDE	POSITION LONGITUDE	SONIC DEPTH	MAX. SAMPLE DEPTH	WIND VELOCITY	WIND DIR.FROM	AIR TEMP(C) DRY	AIR TEMP(C) WET
750316	24	3	16	75	0908	41 3.00N	72 22.60W	22.9	21.0	3.6	307 TRUE	3.3	

HUMIDITY REL. (%)	OBSERVER	SEA STATE DIR.FROM	SEA STATE HEIGHT	SURF TEMP	SECCHI DISK	BAR.P. MBS.HG	VISIBILITY	WEATHER	TIDE EBB	TIDE SLACK	TIDE FLOOD
	CDH	- TRUE	0.0	2.8	3.2 M	1031	8	1		X	

PHYSICAL OBSERVATIONS

SAMPLE DEPTH	TEMP	SALINITY	SIGMA-T	OXYGEN PPM	OXYGEN UG-AT/L	OXYGEN % SAT.	PH	TURBIDITY	CHLOROPHYLL	PHAEOPHYTON
1.0	2.76	28.94	23.11	10.5	656.5	93.8	8.03	65.8	3.6	0.7
4.0	2.75	28.98	23.14	10.5	656.5	93.8	8.03	65.7	3.5	1.1
7.0	2.74	28.91	23.08	10.5	656.5	93.7	8.02	68.5	3.1	1.0
10.0	2.77	28.92	23.09	10.5	656.5	93.8	8.03	45.3	2.8	0.7
13.0	2.83	28.92	23.08	10.4	650.3	93.0	8.03	34.9	3.2	1.1
16.0	2.81	28.93	23.09	10.4	650.3	93.0	8.02	30.8	3.4	0.9
19.0	2.83	28.93	23.09	10.3	644.0	92.1	8.02	29.0	3.1	0.7
21.0	2.83	28.94	23.10	10.3	644.0	92.1	8.02	31.4	3.1	1.0

CHEMICAL OBSERVATIONS

SAMPLE DEPTH	PART. CARBON UG/L	PART. ORG-N UG/L	NH3-N UMOLAR	NO2-N UMOLAR	NO3-N UMOLAR	TOTAL PHOS UMOLAR
1.0	370	68	0.4	0.02	0.7	0.69
4.0	640	71	0.2	0.13	1.0	0.77
7.0	440	65	0.1	0.09	0.7	0.73
10.0	820	118	0.4	0.11	0.4	0.74
13.0	580	50	0.4	0.11	0.4	0.74
16.0	650	74	0.4	0.07	1.1	0.80
19.0	540	74	0.1	0.07	0.7	0.71
21.0	730	65	0.4	0.11	1.0	0.76

SURFACE OBSERVATIONS

CRUISE	STATION	DATE			HR.EST	POSITION		SONIC	MAX. SAMPLE	WIND		AIR TEMP(C)	
		MONTH	DAY	YEAR		LATITUDE	LONGITUDE	DEPTH	DEPTH	VELOCITY	DIR.FROM	DRY	WET
750316	25	3	16	75	1029	41 1.60N	72 23.00W	8.5	7.0	4.9	287 TRUE	7.8	

HUMIDITY REL. (%)	OBSERVER	SEA STATE		SURF	SECCHI	BAR.P.	VISIBILITY	WEATHER	TIDE		
		DIR.FROM	HEIGHT	TEMP	DISK	MBS.HG			EBB	SLACK	FLOOD
	CDH	287 TRUE	1.0	2.7	M	1030	8	1			X

PHYSICAL OBSERVATIONS

SAMPLE DEPTH	TEMP	SALINITY	SIGMA-T	OXYGEN PPM	OXYGEN UG-AT/L	OXYGEN % SAT.	PH	TURBIDITY	CHLOROPHYLL	PHAEOPHYTON
1.0	2.79	28.96	23.12	10.7	669.0	95.6	8.07	24.0	1.4	0.5
4.0	2.76	28.99	23.14	10.7	669.0	95.6	8.08	29.2	3.5	0.9
7.0	2.76	29.02	23.17	10.7	669.0	95.6	8.07	29.0	3.6	1.0

CHEMICAL OBSERVATIONS

SAMPLE DEPTH	PART. CARBON UG/L	PART. ORG-N UG/L	NH3-N UMOLAR	NO2-N UMOLAR	NO3-N UMOLAR	TOTAL PHOS UMOLAR
1.0	540	59	0.6	0.13	0.9	0.75
4.0	620	86	0.2	0.11	0.8	0.73
7.0			0.3	0.12	1.2	0.95

SURFACE OBSERVATIONS

CRUISE	STATION	DATE			HR.EST	POSITION		SONIC	MAX. SAMPLE	WIND		AIR TEMP(C)	
		MONTH	DAY	YEAR		LATITUDE	LONGITUDE	DEPTH	DEPTH	VELOCITY	DIR.FROM	DRY	WET
750316	26	3	16	75	1108	41 1.40N	72 26.20W	6.2	6.0	2.2	312 TRUE	11.7	

HUMIDITY REL. (%)	OBSERVER	SEA STATE		SURF	SECCHI	BAR.P.	VISIBILITY	WEATHER	TIDE		
		DIR.FROM	HEIGHT	TEMP	DISK	MBS.HG			EBB	SLACK	FLOOD
	CDH	- TRUE	0.0	2.9	4.0 M	1030	8	1			X

PHYSICAL OBSERVATIONS

SAMPLE DEPTH	TEMP	SALINITY	SIGMA-T	OXYGEN PPM	OXYGEN UG-AT/L	OXYGEN % SAT.	PH	TURBIDITY	CHLOROPHYLL	PHAEOPHYTON
1.0	2.77	28.67	22.89	10.7	669.0	95.4	8.06	18.5	1.4	0.3
3.0	2.62	28.74	22.96	10.7	669.0	95.1	8.07	18.5	1.5	0.4
4.0	2.66	28.74	22.95	10.7	669.0	95.2	8.07	19.8		
5.0	2.67	28.89	23.07	10.7	669.0	95.3	8.08	20.3		
6.0	2.78	28.92	23.09	10.7	669.0	95.6	8.08	19.7	2.1	0.5

CHEMICAL OBSERVATIONS

SAMPLE DEPTH	PART. CARBON UG/L	PART. ORG-N UG/L	NH3-N UMOLAR	NO2-N UMOLAR	NO3-N UMOLAR	TOTAL PHOS UMOLAR
1.0	710	90	0.5	0.24	1.0	0.76
3.0	190	52	0.3	0.04	1.4	0.86
6.0	450	76	0.6	0.17	1.8	0.90

SURFACE OBSERVATIONS

CRUISE	STATION	DATE			HR.EST	POSITION		SONIC	MAX. SAMPLE	WIND		AIR TEMP(C)	
		MONTH	DAY	YEAR		LATITUDE	LONGITUDE	DEPTH	DEPTH	VELOCITY	DIR.FROM	DRY	WET
750316	27	3	16	75	1155	41 1.30N	72 24.60W	3.2	3.0	2.7	332 TRUE	7.8	

HUMIDITY REL. (%)	OBSERVER	SEA STATE		SURF	SECCHI	BAR.P.	VISIBILITY	WEATHER	TIDE		
		DIR.FROM	HEIGHT	TEMP	DISK	MBS.HG			EBB	SLACK	FLOOD
	CDH	- TRUE	0.0	2.5	4.0 M	1030	8	1			X

PHYSICAL OBSERVATIONS

SAMPLE DEPTH	TEMP	SALINITY	SIGMA-T	OXYGEN PPM	OXYGEN UG-AT/L	OXYGEN % SAT.	PH	TURBIDITY	CHLOROPHYLL	PHAEOPHYTON
1.0	2.90	28.96	23.11	10.8	675.3	96.8	8.0	19.4	2.2	0.5
3.0	2.86	28.96	23.11	10.8	675.3	96.7	8.0	19.8	2.1	0.5

CHEMICAL OBSERVATIONS

SAMPLE DEPTH	PART. CARBON UG/L	PART. ORG-N UG/L	NH3-N UMOLAR	NO2-N UMOLAR	NO3-N UMOLAR	TOTAL PHOS UMOLAR
1.0	320	40	0.5	0.00	0.9	0.83
3.0	340	64	0.9	0.12	1.2	0.88

SURFACE OBSERVATIONS

CRUISE	STATION	DATE			HR.EST	POSITION		SONIC	MAX. SAMPLE	WIND		AIR TEMP(C)	
		MONTH	DAY	YEAR		LATITUDE	LONGITUDE	DEPTH	DEPTH	VELOCITY	DIR.FROM	DRY	WET
750316	28	3	16	75	1245	41 0.90N	72 21.90W	7.0	6.8	2.2	252 TRUE	8.3	

HUMIDITY REL. (%)	OBSERVER	SEA STATE		SURF	SECCHI	BAR.P.	VISIBILITY	WEATHER	TIDE		
		DIR.FROM	HEIGHT	TEMP	DISK	MBS.HG			EBB	SLACK	FLOOD
	CDH	- TRUE	0.0	2.9	4.0 M	1030	8	1			X

PHYSICAL OBSERVATIONS

SAMPLE DEPTH	TEMP	SALINITY	SIGMA-T	OXYGEN PPM	OXYGEN UG-AT/L	OXYGEN % SAT.	PH	TURBIDITY	CHLOROPHYLL	PHAEOPHYTON
1.0	2.82	29.00	23.15	10.7	669.0	95.7	8.12	22.0	2.8	0.4
4.0	2.81	29.01	23.16	10.7	669.0	95.7	8.12	22.2	2.7	0.7
6.8	2.81	29.02	23.17	10.7	669.0	95.7	8.12	21.3	2.7	0.5

CHEMICAL OBSERVATIONS

SAMPLE DEPTH	PART. CARBON UG/L	PART. ORG-N UG/L	NH3-N UMOLAR	NO2-N UMOLAR	NO3-N UMOLAR	TOTAL PHOS UMOLAR
1.0	350	43	0.2	0.15	0.8	0.71
4.0	370	59	0.1	0.10	1.1	0.78
7.0	530	94	0.5	0.03	0.9	0.84

SURFACE OBSERVATIONS

CRUISE	STATION	DATE MONTH	DAY	YEAR	HR.EST	POSITION LATITUDE	LONGITUDE	SONIC DEPTH	MAX. SAMPLE DEPTH	WIND VELOCITY	DIR.FROM	AIR TEMP(C) DRY	WET
750316	29	3	16	75	1316	41 1.70N	72 21.20W	15.5	15.0	3.6	262 TRUE	7.2	

HUMIDITY REL. (%)	OBSERVER	SEA STATE DIR.FROM	HEIGHT	SURF TEMP	SECCHI DISK	BAR.P. MBS.HG	VISIBILITY	WEATHER	TIDE EBB	SLACK	FLOOD
	CDH	257 TRUE	0.1	3.0	3.1 M	1030	8	1			X

PHYSICAL OBSERVATIONS

SAMPLE DEPTH	TEMP	SALINITY	SIGMA-T	OXYGEN PPM	OXYGEN UG-AT/L	OXYGEN % SAT.	PH	TURBIDITY	CHLOROPHYLL	PHAEOPHYTON
1.0	2.94	29.09	23.21	10.7	669.0	96.1	8.15	39.5	4.3	1.7
4.0	2.94	29.09	23.21	10.7	669.0	96.1	8.15	38.1	4.0	1.5
7.0	2.90	29.11	23.23	10.7	669.0	96.0	8.15	35.4	4.0	1.4
10.0	2.91	29.11	23.23	10.7	669.0	96.0	8.15	36.8	4.2	1.4
13.0	2.92	29.11	23.23	10.7	669.0	96.0	8.15	36.8		
15.0	2.90	29.12	23.24	10.7	669.0	96.0	8.15	38.1	4.9	1.2

CHEMICAL OBSERVATIONS

SAMPLE DEPTH	PART. CARBON UG/L	PART. ORG-N UG/L	NH3-N UMOLAR	NO2-N UMOLAR	NO3-N UMOLAR	TOTAL PHOS UMOLAR
1.0	820	90	0.6	0.14	1.0	0.80
4.0	680	84	0.4	0.06	1.0	0.76
7.0	830	87	0.5	0.11	0.8	0.75
10.0	810	59	0.4	0.11	1.1	0.80
13.0	820	77	0.7	0.00	1.1	0.79
15.0	950	124	0.2	0.08	0.7	0.80

SURFACE OBSERVATIONS

CRUISE	STATION	DATE MONTH	DAY	YEAR	HR.EST	POSITION LATITUDE	LONGITUDE	SONIC DEPTH	MAX. SAMPLE DEPTH	WIND VELOCITY	DIR.FROM	AIR TEMP(C) DRY	WET
750316	30	3	16	75	1405	41 0.80N	72 19.90W	7.0	6.5	1.3	317 TRUE		

HUMIDITY REL. (%)	OBSERVER	SEA STATE DIR.FROM	HEIGHT	SURF TEMP	SECCHI DISK	BAR.P. MBS.HG	VISIBILITY	WEATHER	TIDE EBB	SLACK	FLOOD
	CDH	297 TRUE	0.1	3.1	5.5 M	1030	8	1			X

PHYSICAL OBSERVATIONS

SAMPLE DEPTH	TEMP	SALINITY	SIGMA-T	OXYGEN PPM	OXYGEN UG-AT/L	OXYGEN % SAT.	PH	TURBIDITY	CHLOROPHYLL	PHAEOPHYTON
1.0	2.92	29.02	23.16	10.8	675.3	96.9	8.14	18.7	1.4	0.3
3.0	2.88	29.05	23.18	10.8	675.3	96.8	8.16	16.9	1.7	0.3
6.5	2.77	29.06	23.20	10.8	675.3	96.5	8.15	17.6	2.1	0.4

CHEMICAL OBSERVATIONS

SAMPLE DEPTH	PART. CARBON UG/L	PART. ORG-N UG/L	NH3-N UMOLAR	NO2-N UMOLAR	NO3-N UMOLAR	TOTAL PHOS UMOLAR
1.0	450	94		0.10	1.1	0.79
3.0	350	46	0.1	0.00	0.8	0.73
6.5	370	46	0.1	0.18	1.0	0.78

SURFACE OBSERVATIONS

CRUISE	STATION	DATE MONTH	DAY	YEAR	HR.EST	POSITION LATITUDE	LONGITUDE	SONIC DEPTH	MAX. SAMPLE DEPTH	WIND VELOCITY	DIR.FROM	AIR TEMP(C) DRY	WET
750316	31	3	16	75	1522	41 2.70N	72 18.50W	11.6	9.5	4.0	242 TRUE	7.2	

HUMIDITY REL. (%)	OBSERVER	SEA STATE DIR.FROM	HEIGHT	SURF TEMP	SECCHI DISK	BAR.P. MBS.HG	VISIBILITY	WEATHER	TIDE EBB	SLACK	FLOOD
	CDH	257 TRUE	0.1	3.1	2.3 M	1028	8	1	X		

PHYSICAL OBSERVATIONS

SAMPLE DEPTH	TEMP	SALINITY	SIGMA-T	OXYGEN PPM	OXYGEN UG-AT/L	OXYGEN % SAT.	PH	TURBIDITY	CHLOROPHYLL	PHAEOPHYTON
1.0	3.04	29.19	23.28	10.8	675.3	97.3	8.18	42.1	5.8	1.0
4.0	3.04	29.19	23.28	10.8	675.3	97.3	8.18	45.7	5.5	1.5
7.0	3.02	29.21	23.30	10.8	675.3	97.2	8.18	48.8	5.6	1.6
9.5	2.98	29.24	23.33	10.8	675.3	97.2	8.18	49.3	7.3	2.0

CHEMICAL OBSERVATIONS

SAMPLE DEPTH	PART. CARBON UG/L	PART. ORG-N UG/L	NH3-N UMOLAR	NO2-N UMOLAR	NO3-N UMOLAR	TOTAL PHOS UMOLAR
1.0	900	90	0.5	0.15	1.0	0.80
4.0	660	18	0.6	0.06	1.0	0.75
7.0	740	102	0.4	0.14	0.9	0.84
9.5	990	136	0.6	0.18	1.2	0.92

SURFACE OBSERVATIONS

CRUISE	STATION	DATE MONTH	DAY	YEAR	HR.EST	POSITION LATITUDE	LONGITUDE	SONIC DEPTH	MAX. SAMPLE DEPTH	WIND VELOCITY	DIR.FROM	AIR TEMP(C) DRY	WET
750316	32	3	16	75	1624	41 2.40N	72 16.00W	9.4	9.0	3.6	257 TRUE	8.3	

HUMIDITY REL. (%)	OBSERVER	SEA STATE DIR.FROM	HEIGHT	SURF TEMP	SECCHI DISK	BAR.P. MBS.HG	VISIBILITY	WEATHER	TIDE EBB	SLACK	FLOOD
	CDH	267 TRUE	0.1	3.1	2.1 M	1027	8	1	X		

PHYSICAL OBSERVATIONS

SAMPLE DEPTH	TEMP	SALINITY	SIGMA-T	OXYGEN PPM	OXYGEN UG-AT/L	OXYGEN % SAT.	PH	TURBIDITY	CHLOROPHYLL	PHAEOPHYTON
1.0	3.17	29.37	23.42	10.9	681.5	98.6	8.21	47.5	7.1	1.3
4.0	3.14	29.40	23.44	10.9	681.5	98.6	8.21	47.1	7.7	1.6
7.0	3.13	29.40	23.44	10.9	681.5	98.5	8.21	45.4	7.1	1.4
9.0	3.13	29.40	23.44	10.9	681.5	98.5	8.20	46.2	6.9	1.4

CHEMICAL OBSERVATIONS

SAMPLE DEPTH	PART. CARBON UG/L	PART. ORG-N UG/L	NH3-N UMOLAR	NO2-N UMOLAR	NO3-N UMOLAR	TOTAL PHOS UMOLAR
1.0			0.5	0.12	1.2	0.86
4.0	990	105	0.6	0.15	1.2	0.80
7.0	900	111	0.3	0.13	1.1	0.60
9.0	740	115	0.8	0.14	1.2	0.91