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# TEXTURAL CHARACTERISTICS AND SURFICIAL SEDIMENT DISTRIBUTION MAP OF THE LOWER GREAT BAY/PISCATAQUA RIVER ESTUARY

FINAL REPORT

APRIL 1994

PREPARED BY:

LARRY G. WARD
DEPARTMENT OF EARTH SCIENCES
JACKSON ESTUARINE LABORATORY
UNIVERSITY OF NEW HAMPSHIRE
85 ADAMS POINT ROAD
DURHAM, NH 03824

JEL CONTRIBUTION #

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## ABSTRACT

Central to the overall goals of the ecological risk assessment study for the Portsmouth Naval Shipyard, Kittery, Maine are a description of the textural characteristics of the bottom sediments and a knowledge of the sedimentary environments in the lower Great Bay/Piscataqua River Estuary. Many types of contaminants are absorbed onto or are deposited in similar locations as fine grained sediments. Therefore, fine grained depositional areas of the lower estuary in the vicinity of the Portsmouth Naval Shipyard were targeted as the main sampling sites for measuring sediment chemistry, toxicity and benthic organisms. The University of New Hampshire was tasked to determine the textural characteristics of the bottom sediments in and around Portsmouth Harbor (see Task 3.1 in Johnston et al. in press). This report summarizes the results of the surficial sediment grain size and total organic matter analyses and presents a surficial sediment distribution map of the lower estuary.

## INTRODUCTION

A description of the sedimentary environments in the lower Great Bay/Piscataqua River Estuary was needed in order to help understand and predict contaminant distributions, benthic organisms distributions and possible exchanges of materials between the substrate and water column. A number of chemical contaminants tend to become absorbed on fine grained sediments or settle from the water column in areas were fine grained sediments are deposited. Therefore, it is important in all ecological assessments of marine systems, especially estuarine, to identify bottom sediment types and to determine likely fine grained depositional environments. A review of the literature and other data sources available to the investigators of this project indicated the previously collected bottom sediment information (e.g. Mills 1977) was inadequate to describe, even in general terms, the sediment distribution of the Portsmouth Naval Shipyard (PNS) area. Consequently, prior to the research undertaken during the present study, very little was known concerning the surficial sediment distribution in the lower estuary and no synthesis of the limited amount of data that was accessible was available.

The objectives of the present study were to determine the textural characteristics of the sediments of the lower Great Bay/Piscataqua River Estuary for the PNS Ecological Risk Assessment and to develop a surficial sediment distribution map (Fig. 1). To accomplish these objectives, various tasks were undertaken between approximately August 1991 to Marsh 1994, including collecting and analyzing sediment samples from approximately 218 locations, conducting a side scan sonar survey, and reviewing all available data sources. To date, over 406 sediment samples have been collected and analyzed from the 218 stations, the seismic survey has been conducted and the records reviewed, and color infrared photographs of the lower estuary (available through UNH JEL) reviewed. This information has been synthesized and incorporated into a surficial sediment distribution map of the harbor area.

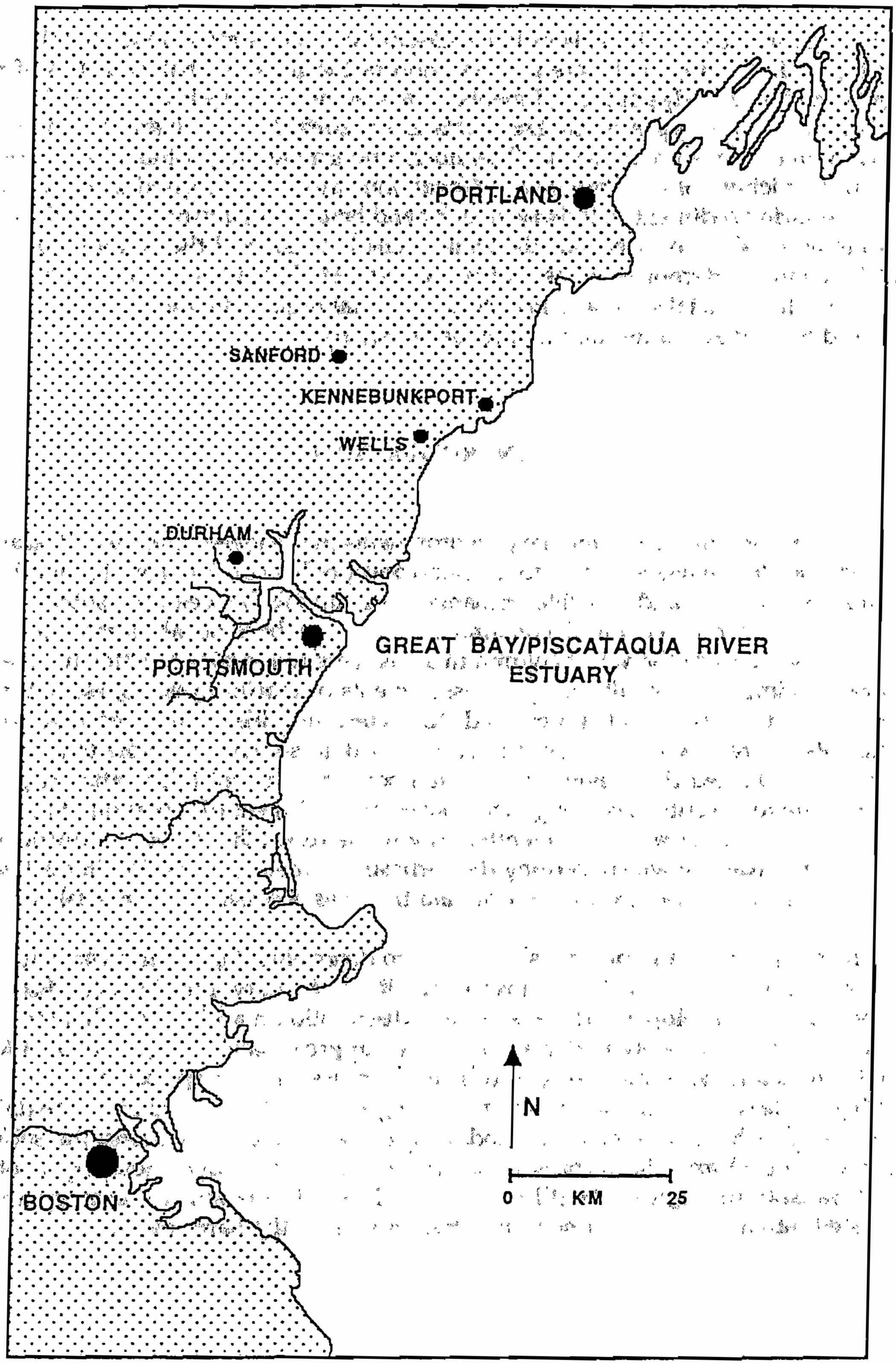



Figure 1. Location map of the Great Bay/Piscataqua River Estuary.

## METHODS

### BOTTOM SEDIMENT SAMPLING

During the initial phases of the project, Normadeau Associates Inc. collected replica (4) surficial sediment samples at 21 station in lower Portsmouth Harbor designated PH 1 - PH 21 and two stations in York River, YR 22 and YR 23 (Fig. 2). Splits of these samples, which were collected with a Shipex Grab Sampler, were obtained for textural analysis which included grain size, water content and loss on ignition (LOI) content (analytical methods described in the following section). These samples provided textural information for the primary bottom sediment sampling sites for Phase 1 of the project (which was provided to all the appropriate investigators). The PH stations were chosen to represent depositional sites in and around the PNS. Consequently, the stations were limited in their areal distribution. In order to provide adequate coverage of the lower estuary, bottom sediments were collected at an additional 197 stations (designated SS series, NHPA series and MS series) utilizing the R/V Jere A. Chase and smaller boats. Positioning was determined with Loran and surficial sediment samples were collected with a Shipex Grab Sampler. The additional samples provide a greater density of stations and covers all of the sedimentary environments in the lower estuary. The NHPA series was collected as part of a study funded by the New Hampshire Port Authority, but are included here to improve the coverage of the surficial sediment map. Most of the sampling stations which were used to construct the latest edition of the surficial sediment distribution map are shown in Figure 3. The locations (longitude and latitude) of the stations are given in Appendix 1.

### TEXTURAL ANALYSIS

Textural analyses were conducted on ~100 to ~150 g (wet weight) of sediment. Immediately after removing the sediment from the sample bag, a ~1 to ~3 cc subsample was placed in an aluminum drying dish and the moisture and loss on ignition (LOI) content determined by weight loss on drying at less than 50° C and ignition at 450° C, respectively (UNH-JEL SOP 1.11, in Mueller et al. 1992). The % LOI is a simple measure of the total organic matter content. However, the method only provides an estimate of the total organic carbon (TOC) content of the sample. In order to be able to predict more accurately the TOC content based on the LOI, the % total organic carbon and % LOI were determined on 43 subsamples that were representative of the sediment types encountered in the lower estuary. TOC was determined by gas chromatography with a Carlo Erba Nitrogen Analyzer. A least squares regression was then established between the LOI and the TOC.

The grain size analysis followed the well established methodology outlined in Folk 1980 and described in detail in UNH JEL SOP 1.11 in Mueller et al. (1992). Briefly, the sediment sample being analyzed was normally placed in a large beaker and treated with $H_2O_2$ to remove the readily oxidizable organics, washed in deionized water to remove any salts, placed in a dispersant and subsequently wet sieved through a 63 micron sieve. Some samples were analyzed using modifications of this procedure. The sand and gravel fractions (>63 microns and 2.00 mm, respectively) were removed, dried and the weight determined. If the sand or gravel fraction (by weight) was greater than 5% of the total sample, then the grain size of this fraction was determined via standard sieve analysis. If the weight of the sand and gravel fraction was less than 5%, then sieve analysis was not done. The grain size of the mud fraction (silt and clay) was determined via complete pipette analysis if it composed more than 5% of the sample. The results of the two analysis were merged together to determine the grain size statistics (% gravel,

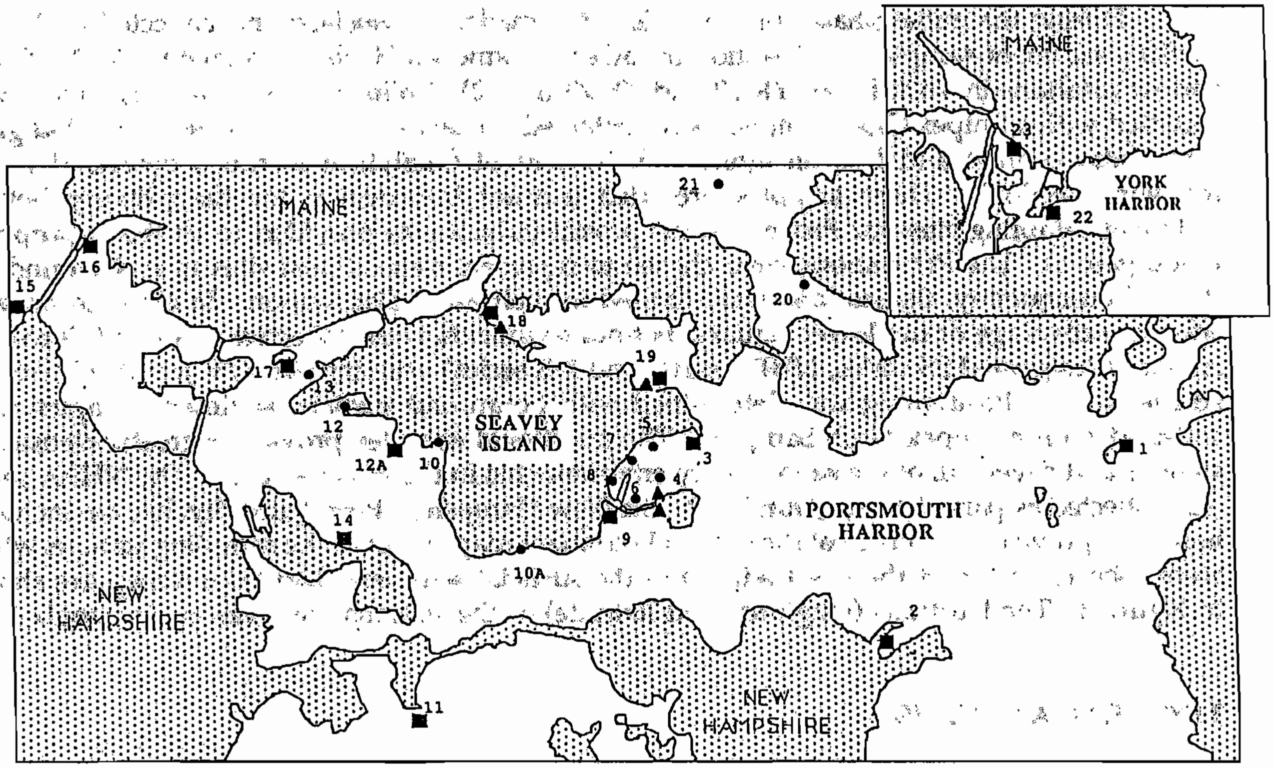



Figure 2. Location map of PH (in Portsmouth Harbor) and YR (in York Harbor) stations.

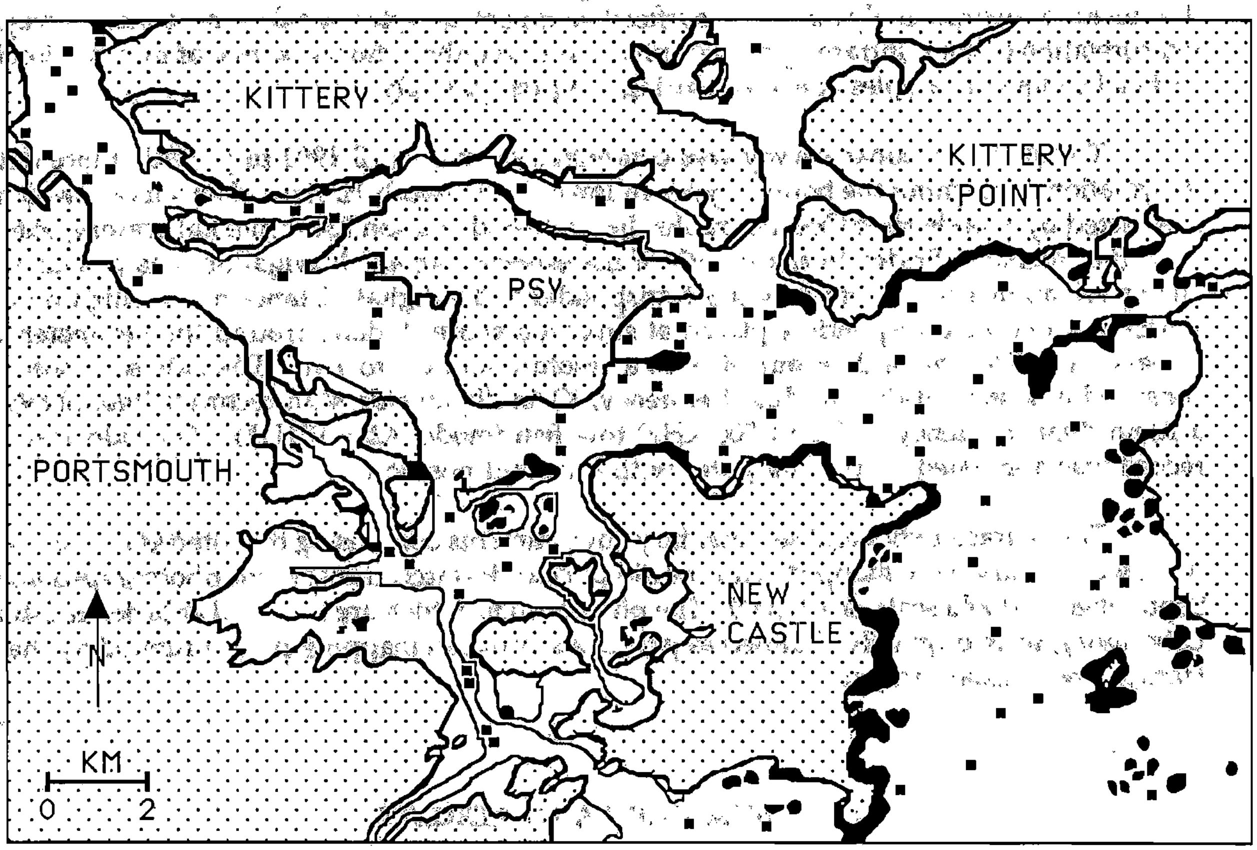



Figure 3. Location map of most of the sampling stations in the lower Great Bay/Piscataqua River Estuary.

% sand, % silt, % clay, mean size, sorting, skewness, and kurtosis) of the entire sample.

## SURFICIAL SEDIMENT DISTRIBUTION MAP

The surficial sediment distribution map is based on the synthesis of several data bases that include textural analyses of the surficial sediment samples, a side scan sonar survey, and interpretation of color infrared photographs. However, the primary source of information is the surficial sediment samples collected during the present study.

The side scan sonar survey was conducted during April 1992 to provide more detailed information concerning the bottom types in lower Portsmouth Harbor. The survey, which was conducted by Woods Hole Oceanographic Institute and Jackson Estuarine Laboratory, extended from the Interstate Bridge to the mouth of the estuary (Fig 4). Navigation was provided by a UHF navigation system with a master transponder and a digital distance measuring unit on the vessel and remote transponders placed at surveyed shore stations around the perimeter of the estuary. Positions were determined with a resolution of 0.5 to 1 m. The side scan sonar unit consisted of a state-of-the-art, dual frequency, Klein digital side scan recorder (model 595) and a Klein dual frequency (100 and 500 kHz) tow fish (model 4225-101HF). The side scan sonar record was annotated by the computer with time and position.

The characteristics and sedimentary environments composing the intertidal areas around the lower estuary were mapped with the aid of color infrared transparent photographs taken in September 1991 at a scale of 1:12,000. The photographs, which are archived at Jackson Estuarine Laboratory, were originally obtained as part of a salt marsh mapping project funded by the New Hampshire Coastal Program.

# SUMMARY AND RESULTS

## TEXTURAL CHARACTERISTICS OF SURFICIAL SEDIMENTS

<u>Grain Size.</u> Typical of glacial environments, the grain size of the bottom sediments range from large gravel size clasts to very fine grained clays. The mean grain sizes (Fig. 5) of the sediment samples range from -4.87 phi (gravel) from a channel deposit to 8.58 phi (clay) from a marsh in Spruce Creek. Appendix 2 contains the grain size statistics and moisture and LOI content of all samples analyzed. The definition of phi units, the conversions to millimeters, and the associated sediment sizes are given in Table 1. The sorting of the surficial sediments (Fig. 5) is extremely variable ranging from 0.20 (very well sorted) to 5.41 phi (extremely poorly sorted). Some of the best sorted sediments are the sandy deposits found in Pepperrell Cove, Little Harbor and in York River; conversely, some of the poorest sorted sediments are from the gravelly or sandy gravelly deposits in the Back Channel behind the PNS or from the main channel in front of PNS. Skewness values range from strongly fine-skewed (0.95) to strongly coarse-skewed (-0.71). The coarser sediments (larger than -2 phi) and the finer sediments (smaller than 3 phi) tend to be positively skewed, indicating the poor sorting of these sediments is due to finer-grained sediments. Conversely, the sediments in the intermediate sizes (-3 phi to 3 phi) tend to be negatively skewed or close to zero. The negative skewness indicates that

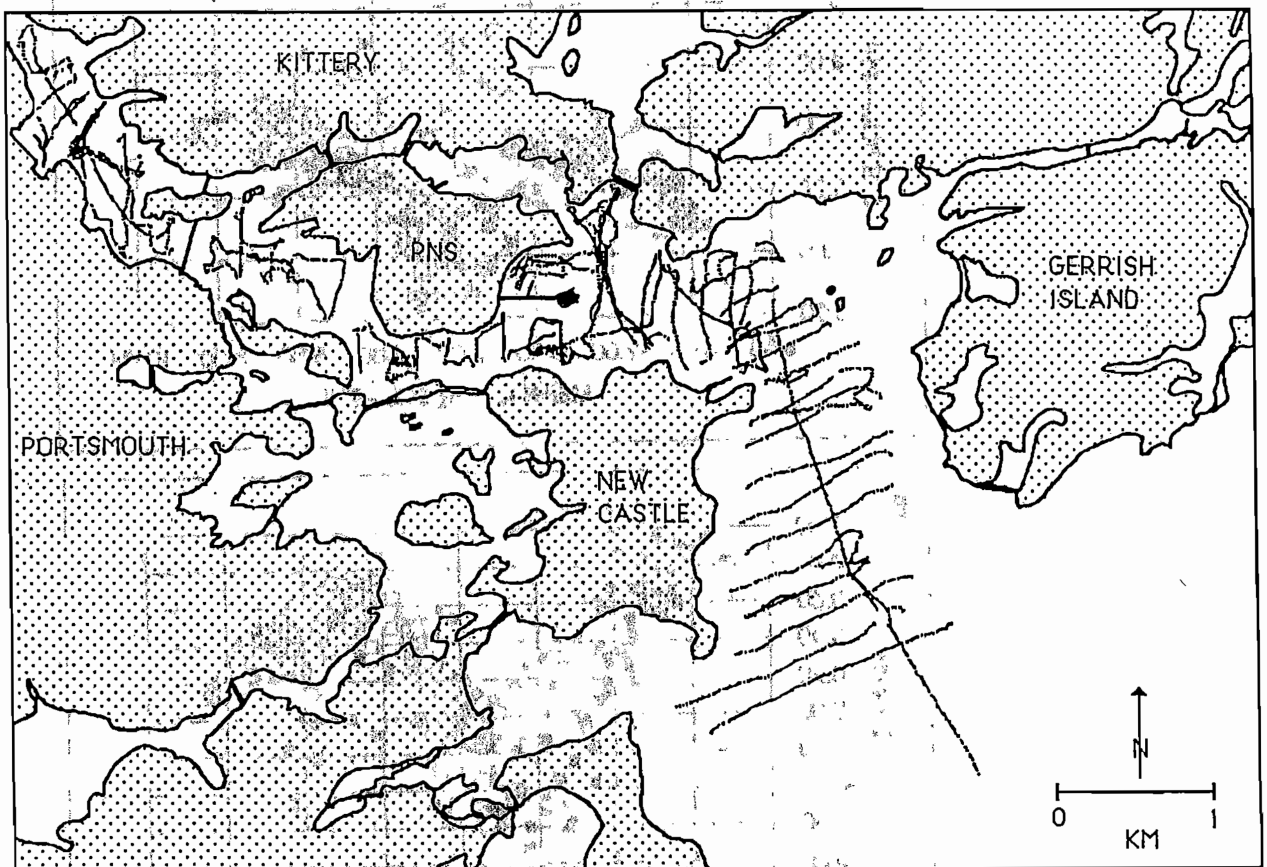



Figure 4. Shiptracks of the seismic survey.

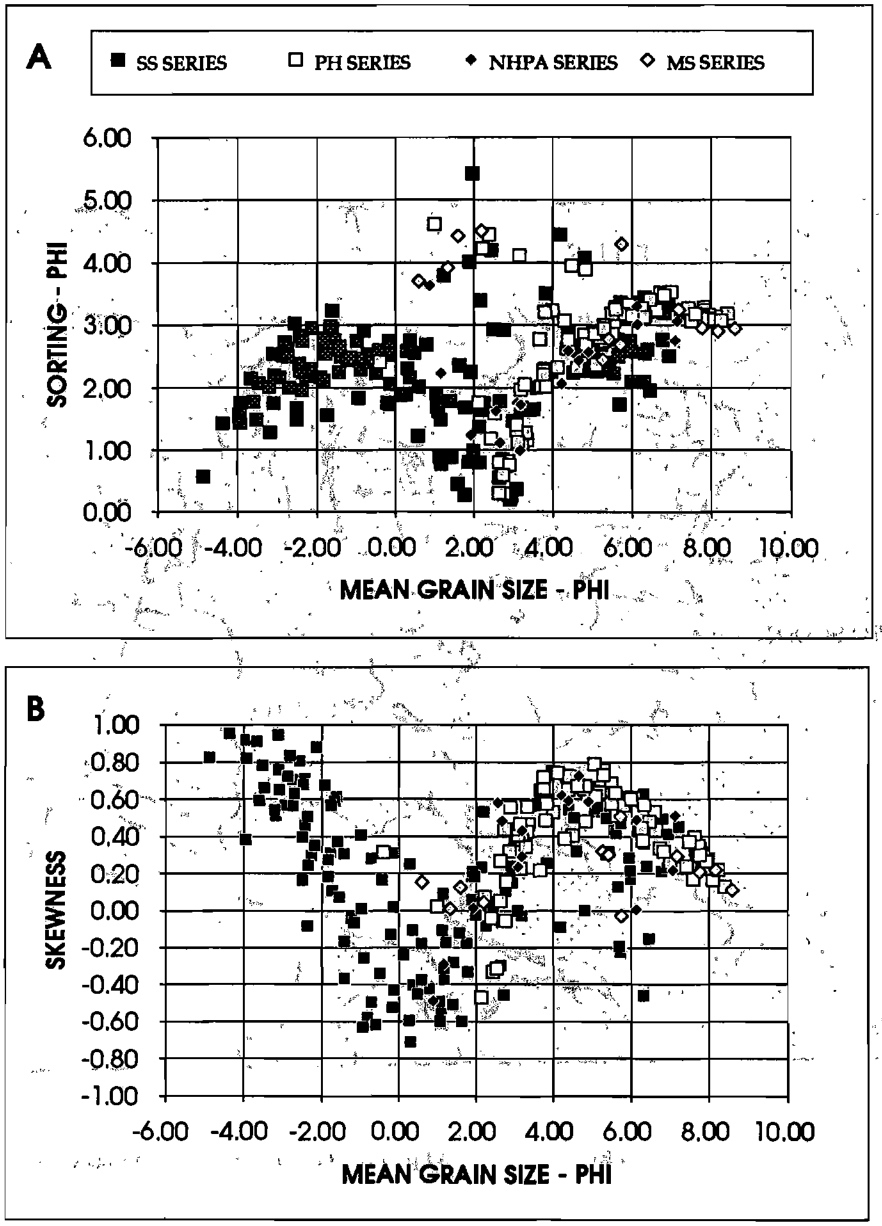



Figure 5. Binary plots of mean grain size and sorting (A) and mean grain size and skewness (B) of surficial sediment samples from the lower Great Bay/Piscataqua River Estuary.

## TABLE 1. GRAIN SIZE SCALES

| Size - PHI* | Size - Millimeters | Wentworth size class |
|---|---|---|
| -6.0 | 64 | Gravel (cobble) |
| -4.0 | 16 | Gravel (cobble) |
| -2.0 | 4 | Gravel (pebble) |
| -1.0 | 2 | Gravel (granule) |
| 0.0 | 1 | Sand (very coarse) |
| 1.0 | 0.5 | Sand (coarse) |
| 2.0 | 0.25 | Sand (medium) |
| 3.0 | 0.125 | Sand (fine) |
| 4.0 | 0.0625 | Sand (very fine) |
| 5.0 | 0.031 | Silt (coarse) |
| 6.0 | 0.0156 | Silt (medium) |
| 7.0 | 0.0078 | Silt (fine) |
| 8.0 | 0.0039 | Silt (very fine) |
| 9.0 | 0.0020 | Clay |
| 10.0 | 0.0098 | Clay |
| 11.0 | 0.00049 | Clay |
| 12.0 | 0.00024 | Clay |

* PHI = $-\log_2$ (diameter of the particle in millimeters)

any poor sorting is due to the inclusion of coarser-grained sediments.

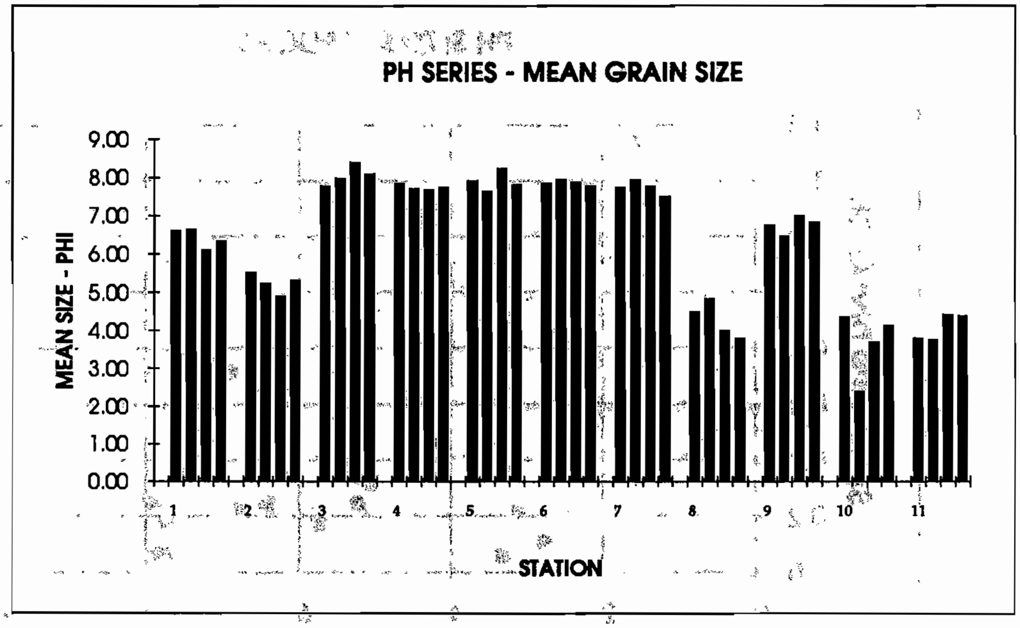
The binary plot of mean grain size versus sorting has a sinusoidal pattern which is characteristic of environments which have three main sizes of sediments composing the deposits (Fig. 5). Folk (1980) indicated that most natural sediment particles fall within three size groupings: gravel between -3 to -5 phi, fine sand between 2 to 3 phi, and clay around 10 phi. Sediment populations tend to be composed of one of these size groupings or are a mixture of the sizes. Although this natural grouping of sediments is debated (Royse 1970), it is interesting to note that the sediments of the lower estuary indicate the existence of three main populations of sediments. The size analyses of the surficial sediment samples from the lower estuary show that the sorting (standard deviation) improves for mean grain sizes around -3 to -5 phi and around 2 to 3 phi. Although no samples to date have plotted around 10 phi, it appears that very-fine grained sediments in that range are contributing to the samples as indicated by the positive skewness for samples with means from 6 to 8 phi. These results indicate that the sediments in the lower estuary are composed of the three sediment populations described by Folk (1980).

The PH series of stations included four replicas (4 separate grab samples) from each site. As part of the textural analyses program, all four replicas for each station were analyzed and grain size statistics determined, allowing assessment of textural heterogeneity over very small distances (within several meters) to be made. Figure 6 shows the mean grain size for stations PH 1 to PH 21 and the two stations in York River (YR 22 and YR 23). The standard deviations of the means of the replicas indicate the variability in mean grain size within a station is relatively small, usually being less than $\pm$ 0.6 phi (Fig. 7). However, somewhat unexpectedly, there seems to be little relationship between mean grain size and standard deviation.

<u>Moisture, Total Organic Matter, and Total Organic Carbon Content.</u> Moisture and total organic matter (TOM), as measured by loss on ignition (LOI), were determined on all of the samples collected at the PH and YR series of stations, most of the SS series, and all of the NHPA series. Unlike the PH, SS and NHPA series, the moisture and LOI content were not measured on splits of the samples taken for grain size analyses. Instead, moisture and LOI were determined at 4 cm intervals in short cores (10 to 20 cm) taken in the marshes (MS series). The samples for grain size analyses were taken from the surfaces of these cores. The means of the measurements for the entire core are used to examine the relationships among moisture, LOI and grain size in the marshes and are reported for each site (Appendix 2).

It should be noted that determinations of moisture content of coarser sediments can be problematic due to sampling techniques. Grab samplers collect both the bottom sediments and the overlying water in the sampler which often mix when removed from the grab sampler. Conversely, coarser sediments do not hold water well, allowing moisture content to be reduced while stored in the sample bag, etc. Similarly, determinations of %LOI can be difficult to measure accurately for coarser grained sediments due to the heterogeneity of the organic debris in many samples. Care was taken to avoid these problems, however, moisture and LOI results of the sediments greater than coarse silt are viewed with caution.

The moisture content of the samples ranged from 0.3 to 78.8% and varied directly with mean grain size, with the finer sediment sizes having higher moisture contents (Fig. 8). The LOI contents range from 0.3 to 42.6%, also varying directly with grain size (finer sediments having higher LOI or total organic matter). For both moisture and LOI, the highest values occur in the marshes, while the lowest in the coarse grained channels. Finer grained sediments tend to have higher moisture contents because of the ability of clay particles to hold water (Grim 1968). Finer



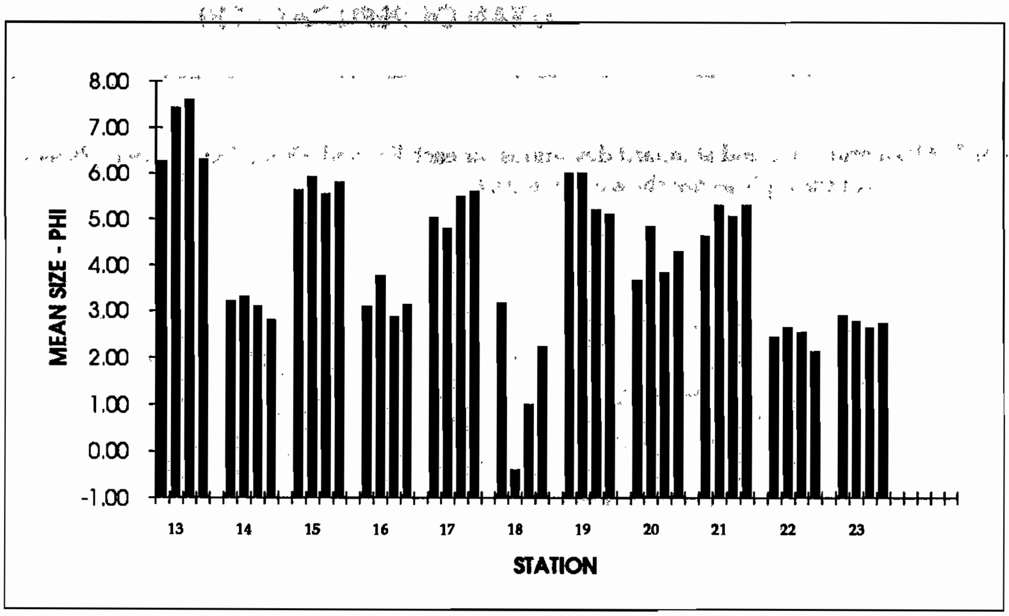




Figure 6. Grain size of replicas from stations PH 1 - 21 and YR 22 and 23.

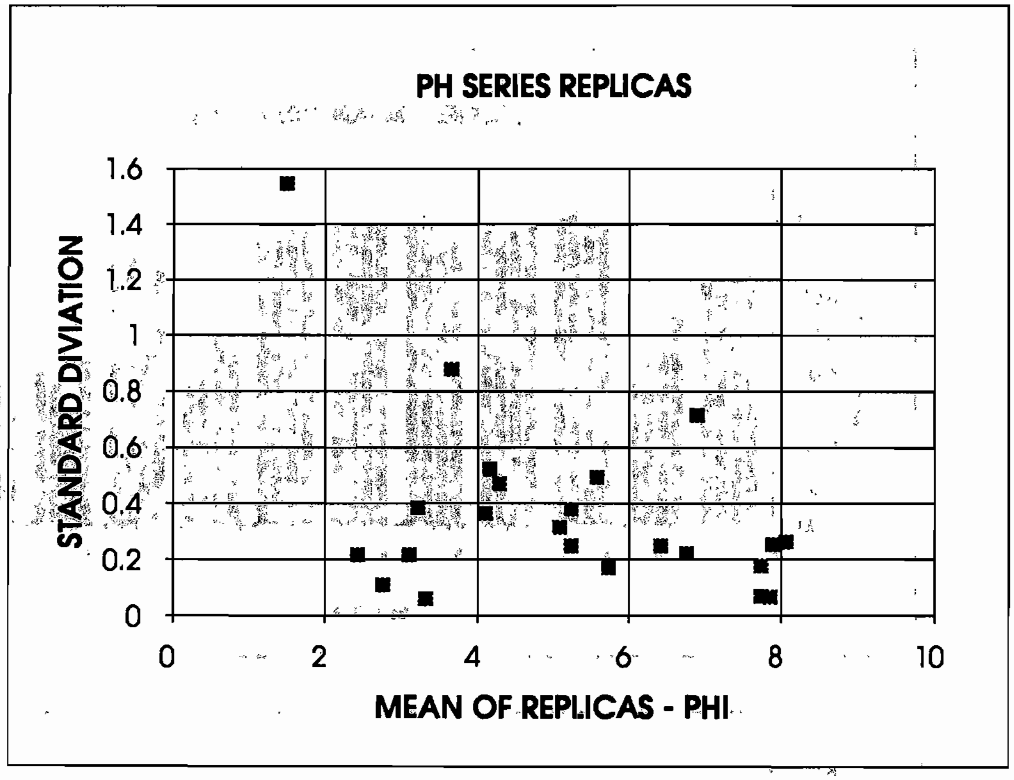



Figure 7. Mean grain size and standard deviations for each PH and YR station where replicas were taken. The grain sizes of the replicas are shown in Figure 6.

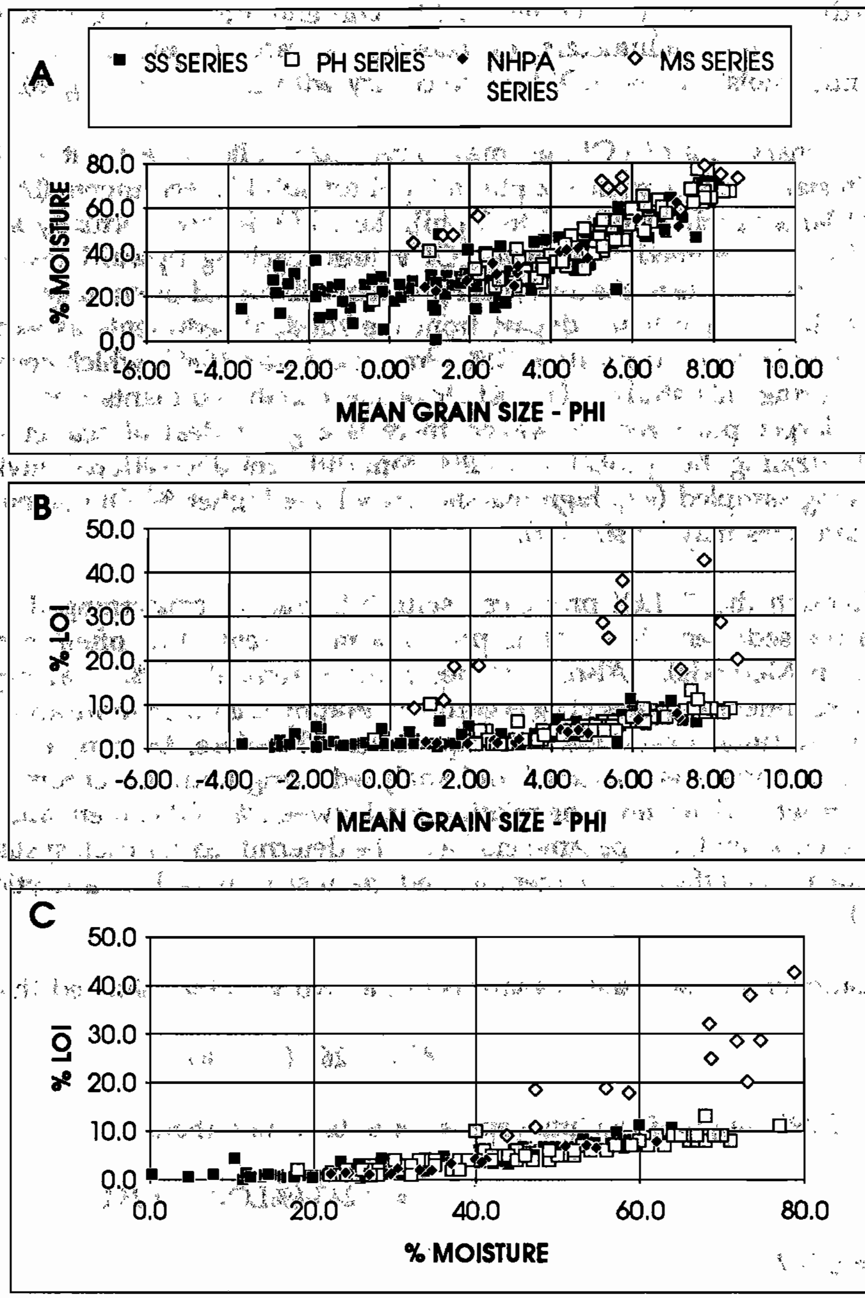



Figure 8. Binary plots of mean grain size and % moisture (A), mean grain size and % LOI, and % moisture and % LOI (C) of surficial sediment samples from the lower Great Bay/ Piscataqua River Estuary.

grained sediments tend to have higher LOI concentrations because the substrate is typically anoxic below a few millimeters, decreasing the rates of oxidation of the organic matter. Consequently, moisture and LOI tend to covary with each other (Fig. 8).

The binary plot of LOI and mean grain size indicates a positive, linear relationship at mean grain sizes greater from ~ 2 phi to 9 phi for subtidal sediments (SS, PH, and The NHPA series). At larger grain sizes (~-5 to 2 phi), the %LOI is low, normally less than 2%. A small number of coarse grained sites have LOI values reaching upward towards 5%. The higher values are probably due to the analytical problems discussed previously. The LOI values for the marshes in the lower estuary depart from the subtidal sediments as expected. Salt marshes typically range in %LOI from 10 to 50% (Frey and Basan 1985), which corresponds to the range measured during this study. The %LOI of the marsh sediments does increase with smaller sediments (larger phi sizes), however, there is a great deal of scatter in the data. This is somewhat puzzling, but probably results from different depositional environments within the marshes being sampled (e.g. high marshes may have higher %LOI contents than low marshes, but the grain sizes may be similar).

Although the % LOI provides useful information concerning the total organic matter content of the sediment, it is not as precise a measurement as often is desired (as discussed previously in Methods). Also, it is not a measurement of % total organic carbon (TOC). Analysis of sediment samples via gas chromatography is a much more accurate measure of TOC, albeit far more time consuming and expensive. Therefore, 43 samples from the PH surficial sediments and cores were selected and analyzed using both gas chromatography and simple ignition in order to determine the relationship between % LOI content and % TOC (Fig. 9). The relationship between these parameters has to be determined for each system being studied due to variations in the effects of diagenesis and grain size, as well as analytical procedures (Craft et al. 1991).

Results of a least squares analysis of the two variables showed that:

$$\% \text{ TOC} = 0.269\ (\% \text{ LOI})$$

with a $r^2 = 0.797$ (Fig 9) if the intercept is set to 0. If not, then:

$$\%\text{TOC} = 0.245\ (\%\text{LOI}) + 0.244$$

with a $r^2 = 0.807$.

## SURFICIAL SEDIMENT DISTRIBUTION MAP

The Great Bay/Piscataqua River Estuary was carved out during the glacial advances associated with the Quaternary (geologic time period covering the last two to three million years), which left extensive till deposits behind as the ice retreated. Bottom sediments in glaciated embayments are typically extremely heterogeneous due to the primary source of sediments being till deposits. In addition to the impact of the glaciation, the region has undergone a complex sea level history with a transgression of the sea, a drop in sea level and another marine transgression since the end of the Wisconsin Glaciation (last major glacial period). During the last several thousand years, since the rate of sea level dramatically slowed (1.5 to 2.0 mm/yr for Portsmouth Harbor, Hicks et al. 1983), the sedimentary deposits in the Great Bay/Piscataqua River Estuary have been influenced by tidal action and wave effects. Due

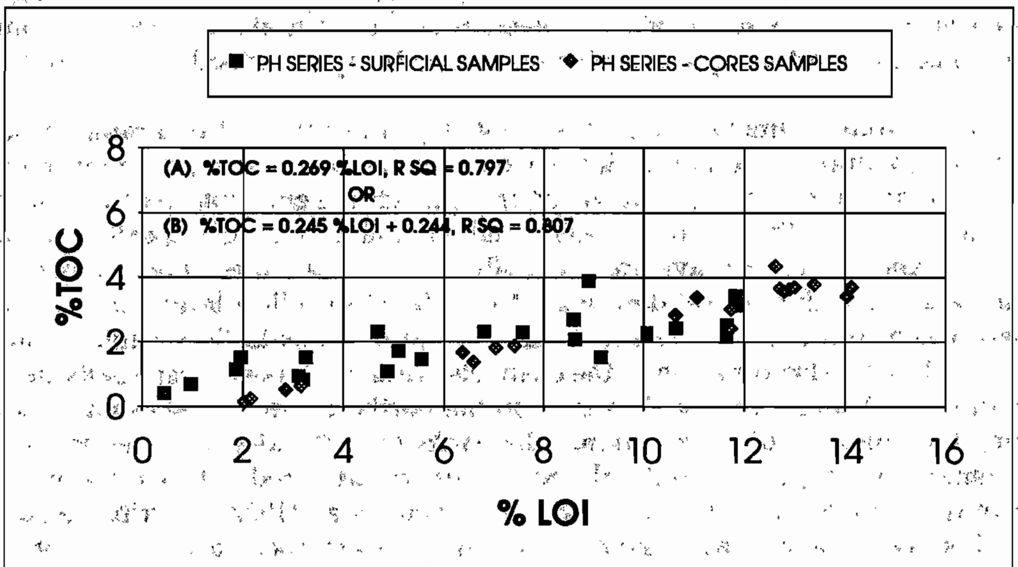



Figure 9. Total organic carbon (TOC) and % LOI content of surficial sediment samples and of cores taken in the lower Great Bay/Piscataqua River Estuary. The linear regression equation was determined by setting the intercept to 0 in (A) and also by allowing the intercept to be computed (B).

to the combination of these processes, the sedimentary environments within the estuary are extremely complex.

The sedimentary deposits in the lower estuary have been classified using the tertiary classifications described in Folk (1954), which use the ratios (or %) of the gravel, sand and mud (silt and clay) content or the ratios of the sand, silt or clay content. Other classifications were reviewed such as Shepard (1954), however, Folk's classification, which is commonly used, appears to be the most adequate for the sediments being described (Fig. 10 and 11).

The bottom sediments on the lower estuary are composed of a range of sediment types from gravels to muds, which grade into each other. The dominant sediment type in the deeper channel areas are sandy gravels. However, true gravels are encountered attesting to the strength of the tidal currents in the Piscataqua River and the influence of till deposits as a major sediment source. The abundance of gravel may actually be underestimated due to inherent problems in sampling and analyzing gravel deposits. It is difficult to collect large clasts with the standard samplers and to retrieve adequate material to conduct statistically reliable grain size analyses (Kelly et al. 1987). Also common to the channels are sand deposits, especially near the entrance of the estuary. A large sand shelf occurs on the northern side of the estuary, near the mouth, reflecting the influence of wave action. The flanks of both sides of the entrance to the estuary are dominated by exposed intertidal bedrock or subtidal bedrock, with scattered patches of sediment (presumably sand to gravel veneers). Kelly et al. (1987) described a subparallel band of gravel between the landward sandy areas and seaward rocky areas north of the entrance to the Piscataqua River on the inner shelf. It appears from Kelly et al. (their Figure 10) that the northern side of the region just outside the estuary on the inner shelf is composed of dominantly rock, with patches of sandy gravel, gravelly sand and muddy sand. Mills (1977) indicated the inner shelf directly seaward of the mouth of the Piscataqua River was composed of sand, while gravel occurred just to the north. Results of the present research agree with these trends for the offshore.

Finer grained sediments are found in the shallow embayments and tidal flats which flank the deeper channel areas. The very finest sediments were encountered in Clark Cove (the embayment between Clark Island and Jamaica Point), in a cove in Spruce Creek and a cove in the northern part of Pepperrell Cove (just to the west of the entrance to Chauncey Creek). Most notable to the present study are the very fine sediments in Clark Cove. Here, a belt of mud forms the perimeter of the embayment, while the more central area is composed of sandy mud. However, the more common fine grained deposits mapped during the present study are the sandy muds to muddy sands, which compose many of the shallow regions. Numerous intertidal flats, mapped from the existing NOS bathymetric chart and color infrared photographs, are located around most of the lower estuary, especially in the back channel area that lies between Portsmouth and New Castle and connects the Piscataqua River with the Atlantic Ocean through Little Harbor. These sediments are dominated by sandy muds to muddy sands. In addition, a few scattered salt marsh deposits are found. These marsh sediments range from very fine muds to gravelly muddy sand deposits. The coarse sediments are found in the smaller fringing marshes which are adjacent to eroding bedrock or lie on cobble shorelines.

Despite the large data base incorporated into the map, boundaries between sedimentary units (as defined by grain size) are somewhat subjective, although based on the best information available. In some locations the boundaries between sedimentary units are placed within narrow constraints provided by the density of the surficial sediment sampling stations. At other locations, where the density of the sampling stations is lower, boundary locations are estimated. However, the boundaries are considered reasonably accurate. Also, the surficial sediment map

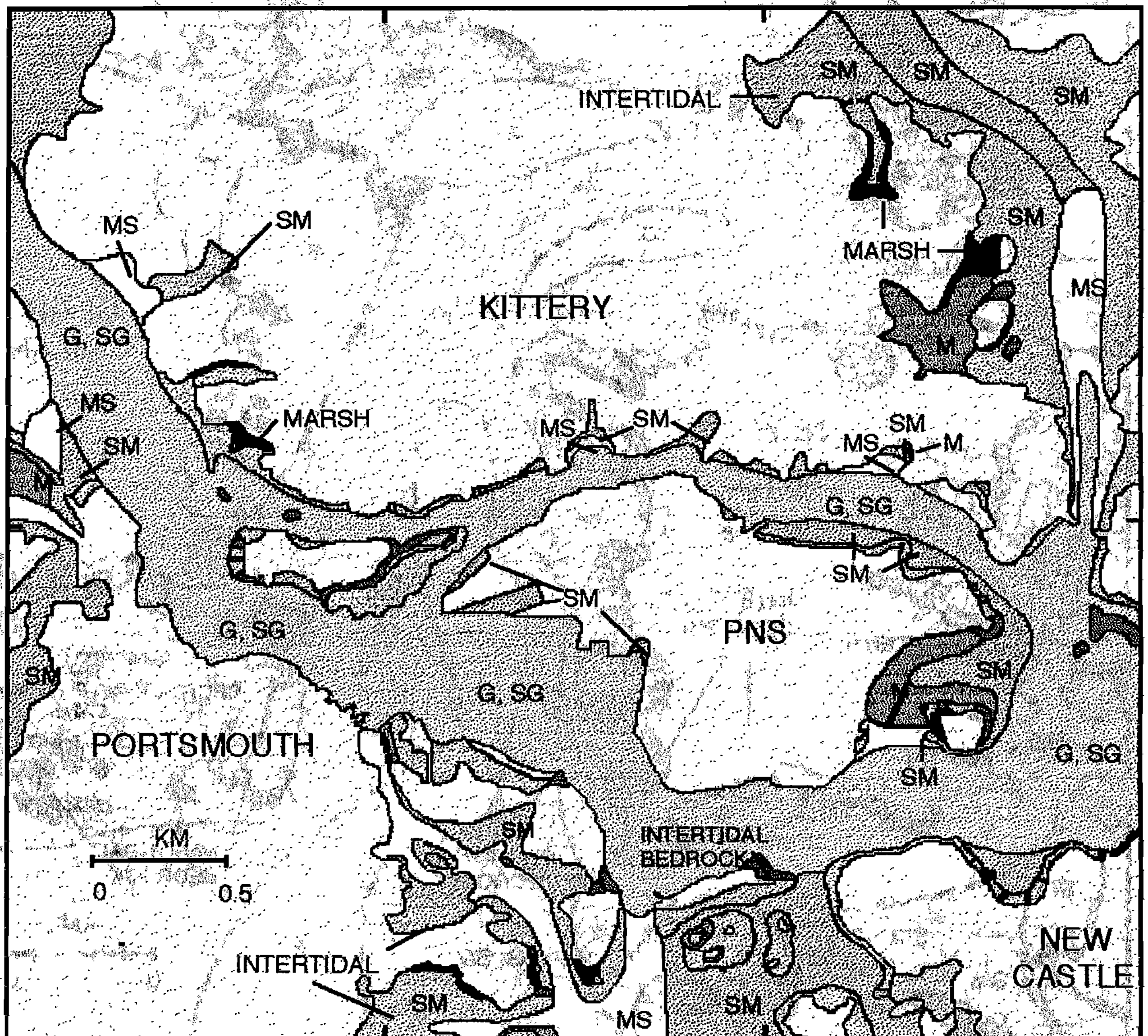



Figure 10. Surficial sediment distribution map for the lower Great Bay/Piscataqua River Estuary. The grain size classification is based on Folk (1954). Abbreviations used on the map include G (gravel), SG (sandy gravel), MS (muddy sand), SM (sandy mud), and M (mud). Marshes are shown in green. Intertidal areas are slightly lighter in color or have more texture than adjacent colors. The seaward boundaries of the intertidal areas are shown by solid black lines.

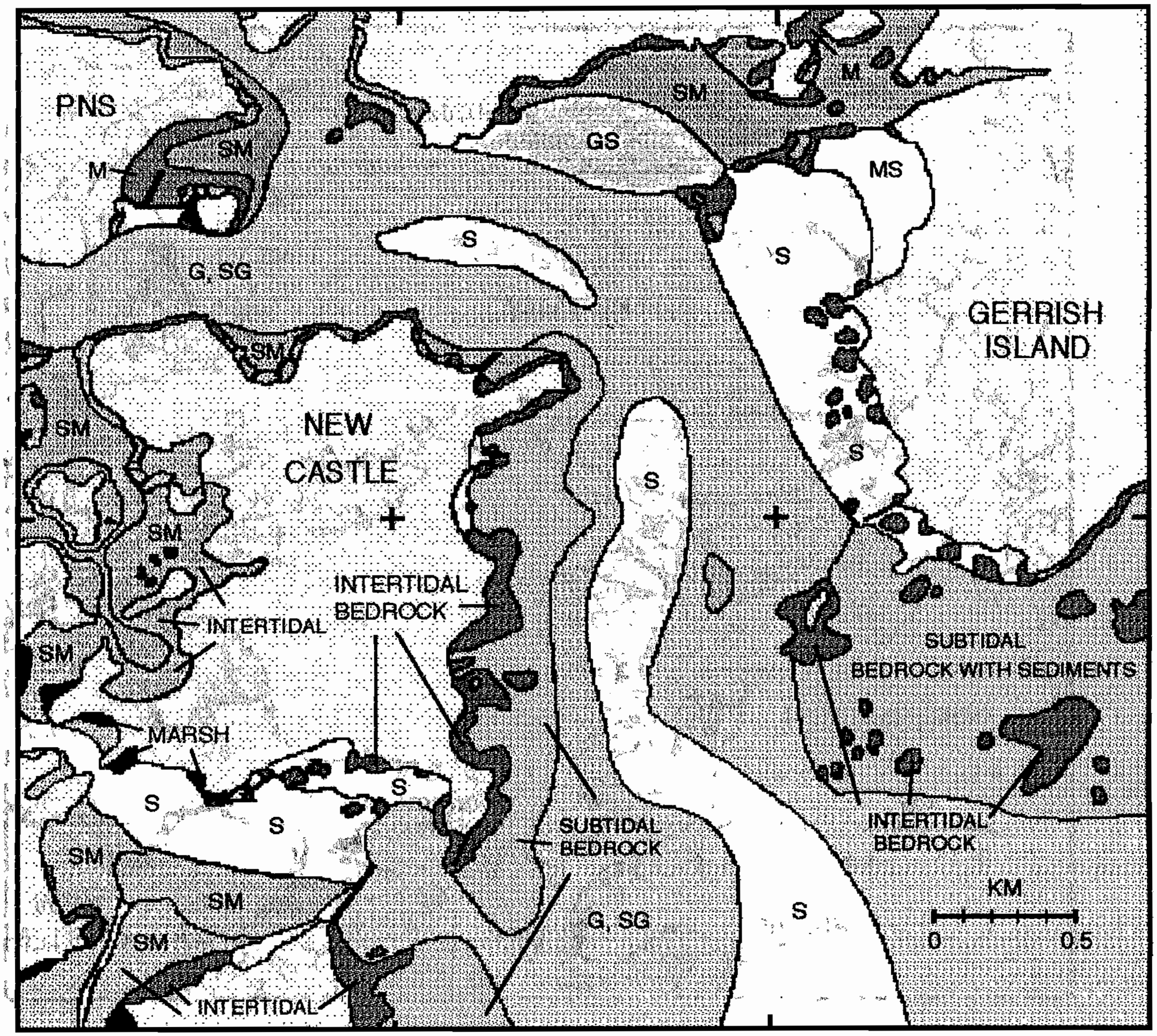



Figure 11. Surficial sediment distribution map for the lower Great Bay/Piscataqua River Estuary. The grain size classification is based on Folk (1954). Abbreviations used on the map include G (gravel), SG (sandy gravel), S (sand), MS (muddy sand), SM (sandy mud), and M (mud). Marshes are shown in green. Most intertidal areas are slightly lighter in color or have more texture than adjacent areas. The seaward boundaries of the intertidal areas are shown by solid black lines. Intertidal bedrock is shown as black. Subtidal bedrock with a thin veneer of scattered sediment is shown as grey.

will be periodically updated as new information becomes available. It should be noted that the surficial sediment map and textural information on the sediments presented here represent a major advance in our understanding of the sedimentary environments in the lower estuary and meet the objectives outlined in the original work plan.

## DREDGING ACTIVITIES IN THE LOWER ESTUARY

Portsmouth Harbor is the lone deep draft harbor in New Hampshire and processes approximately 3.5 million tons of shipping per year (US Army Corps of Engineers, in press). In addition to the commercial uses, Portsmouth Harbor handles submarines and other military vessels associated with the PNS or other industries in the area. Finally, the lower estuary is utilized by numerous fishing vessels and private pleasure craft. Consequently, the lower harbor has been modified by dredging a number of times during the last century to insure adequate channel size and depth, anchorage and turning basins. This includes removal of sediments, as well as ledge, that has obstructed waterways. Most of these modifications were completed prior to the development of the surficial sediment map. Dredging that has recently or will occur in the near future probably will not dramatically effect the results presented here. It is likely that areas that are dredged will be covered by a veneer of sediments similar to what was removed unless the hydrodynamic conditions (tidal range and currents) change. The exception to this is in the area of Cutts Cove, where extensive modifications are planned associated with the expansion of the New Hampshire Port Authority piers and facilities. However, it is useful to keep in mind the dredging activities and realize that some impacts may have occurred.

Dredging activities in lower Portsmouth Harbor have been documented in some detail in a report entitled "New Hampshire Dredged Material Management Study" (U.S. Army Corps of Engineers, in press). The information provided here is based on this report. Early modifications of the Harbor date back to the 1800's when Federal sponsorship built the 1000' causeway between New Castle and Goat Island and two ledge areas were removed (Gangway Rock located opposite of the western end of PNS and a ledge at the southwestern end of Badgers Island). A second major modification occurred in the 1960's with the creation of the ≈6.2 mile, 35' deep, 400 to 600' wide channel from New Castle to Newington. This included removing ledge at Henderson Point (southern end of PNS), Gangway Rock, Badgers Island (island just to the west of PNS), the US Route 95 Bridge (between Portsmouth and Kittery) and Boiling Rock (in Newington upstream from the study area) and forming two turning basins (near Boiling Rock and at the end of the channel in Newington). Most recent Federal activities include maintenance of the main channel including the removal of rock adjacent to Goat Island (opposite side of channel across from southern extent of PNS) in 1991 and periodic dredging of sand and gravel from Badgers Island to the Simplex facility in Newington. In addition to the Federal dredging projects (e.g. U.S. Army Corps of Engineers), a number of smaller efforts have been undertaken by the Navy for the PNS, the State of New Hampshire and Maine, and private businesses. This includes the dredging of channels around the PNS, as well as in Clark Cove.

Little Harbor was originally modified in the late 1800's to early 1900's by the construction of the two stone breakwaters at the entrance to the harbor (a 550' northern jetty and a 900' southern jetty completed in 1894), dredging an 3000' long, 12' deep, 100' wide entrance channel extending to the Route 1B bridge, and an anchorage basin (700' by 300' just south of the entrance). The original purpose of these modifications by the U.S. Army Corps of Engineers which were completed in 1903 was to provide anchorage for sailing schooners while waiting to go into Portsmouth Harbor. Today the primary use is for recreational and fishing boats. The accommodate these needs, a small channel (6' deep, 75 to 100' wide) from the Route 1B bridge between New Castle and Rye into Sagamore Creek and continuing on to Shapleigh and Goat Islands was created by the U.S. Army Corps of Engineers. A private business (Wentworth -By-The-Sea) sponsored the removal of ~216,000 cubic yards in the 1980's. The removal of ~ 270,000 yards of material is presently being considered by the New Hampshire Port Authority.

Noteworthy for the development of the surficial sediment map of Portsmouth Harbor is the extent of dredging activities and other modifications to the lower estuary. Since the late 1800"s, many of the main channels have been dredged or had ledge removed. Therefore, alterations due to dredging is almost the normal circumstance, rather than the exception. However, as stated previously, with the exception of the early changes to the channel, the overall characteristics of the estuary are basically the same (in terms of tidal range, currents, etc.). Consequently, the surficial sediments found in the lower estuary may be altered over short periods, but the physical processes that dictate the composition of the bottom likely remain unchanged. Therefore, the characteristics of the bottom shown in the surficial sediment distribution map are probably representative of equilibrium conditions since only one major dredging project (removal of ledge from near Goat Island in 1991) occurred during the period the samples were collected for this study.

## CONCLUSIONS

Based on the analyses of over 400 sediment samples from ~218 stations in lower Great Bay/Piscataqua River Estuary (Portsmouth Harbor including Little Harbor), a side scan sonar survey, color infrared photographs, and the development of a surficial sediment distribution map, the following conclusions are made:

1. The bottom sediments (including subtidal, intertidal flats and intertidal salt marshes) are extremely heterogeneous ranging from gravels to muds.

2. The bottom sediments are composed of three main grain size populations or mixtures of these populations which include gravels (-5 phi to -3 phi), fine sands (2 phi to 3 phi) and muds from (8 phi to 10 phi).

3. The variability in grain size characteristics over small distances (several meters) is small (normally less than 0.6 phi), indicating a single point sample represents the sampling station.

4. Moisture and total organic matter contents of the bottom sediments covary with each other and with mean grain size. The finest grained sediments have the highest moisture and total organic matter contents.

5. The total organic carbon and total organic matter (as measured by loss on ignition) of the bottom sediment covaries. The total organic carbon content constitutes ~ 25 to 30% of the total organic matter.

6. The channels in the lower estuary are dominantly sandy gravels to gravels. Most shallow subtidal or intertidal flats are sandy muds to muddy sands; however some shallow sand flats occur. Mud deposits are less common and usually occur in the upper reaches of coves. One of the finest grained sediment deposit encountered during this study occurred in Clark Cove, adjacent to the PNS.

## ACKNOWLEDGEMENTS

This project was funded by the U.S. Navy (Northern Division of Naval Facilities Engineering Command, Philadelphia, PA through NCCOSC and the U.S. EPA-ERLN) to the University of New Hampshire. The author gratefully acknowledges the Navy's support. The continuing interest, input and support from Robert Johnston and Jeff Grovhoug of NCCOSC, and Lt. James Conroy, Debbie Carlson, Simeon Hahn and Mark Liepert of the Northern Division is appreciated. The design of the study was aided by extensive discussions with Robert Johnston, Frederick Short (UNH JEL) and David Burdick (UNH JEL). James Tayon (PNS) provided logistical support for parts of the field work. Much of the field and laboratory work was carried out with the aid of James Jefferson, Philip Pope, Chris Hartman, Gwen Gengenbach (all of UNH). The field work was also aided by the captain (Paul Pelletier) and the mate (Ken Houtler) of the R/V Jere A. Chase and the R/V Gulf Challenger. Wayne Spencer (WHOI) facilitated the seismic survey. Additional support for work study students for this project was provided by the UNH JEL.

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# APPENDIX 1. STATION LOCATIONS.

| Station | Year | Navigation method | Latitude | Longitude | Corrected Latitude | Corrected Longitude | Basic Location |
|---|---|---|---|---|---|---|---|
| **PH SERIES GRAB SAMPLES** | | | | | | | |
| Note: PH stations were located visually on the navigational chart. Coordinates were read from the chart. No instrument correction of coordinates were possible. Any corrections were done by visual examination of the location map and replotting. | | | | | | | |
| PH-1 | 1990 | Chart | | | 43 04 42.5 | 70 41 46.8 | E of Gooseberry Island, in eelgrass bed |
| PH-2 | 1990 | Chart | | | 43 04 18.8 | 70 42 40.1 | SSE of pier at USCG station; in eelgrass bed |
| PH-3 | 1990 | Chart | | | 43 04 45.5 | 70 43 22.0 | Between Jamaica Isl. and Hick Rocks, in eelgrass |
| PH-4 | 1990 | Chart | | | 43 04 41.2 | 70 43 26.9 | N of Clark Island, 11' deep mud bottom |
| PH-5 | 1990 | Chart | | | 43 04 45.5 | 70 43 28.6 | S of Jamaica Island; 13' deep mud bottom |
| PH-6 | 1990 | Chart | | | 43 04 38.0 | 70 43 35.0 | N of Clark Island causeway, 11' deep mud bottom |
| PH-7 | 1990 | Chart | | | 43 04 44.2 | 70 43 34.5 | Clark Cove, near Norway ball #17 |
| PH-8 | 1990 | Chart | | | 43 04 40.0 | 70 43 38.2 | W of Clark Island pier, 8' deep mud bottom |
| PH-9 | 1990 | Chart | | | 43 04 34.0 | 70 43 41.5 | S of Clark Island causeway, in eelgrass bed |
| PH-10 | 1990 | Chart | | | 43 04 43.5 | 70 44 17.2 | S of dry dock 2 at PNSY, 3'+ of sediment |
| PH-10A | 1990 | Chart | | | 43 04 28.7 | 70 44 06.5 | Between Henderson Point and Sullivan Point |
| PH-11 | 1990 | Chart | | | 43 04 05.5 | 70 44 29.5 | S of Shapleigh Island, in eelgrass bed |
| PH-12 | 1990 | Chart | | | 43 04 50.5 | 70 44 37.0 | SE of dry dock 1 at PNSY, 75' from pier, 3.5' of sed. |
| PH-12A | 1990 | Chart | | | 43 04 45.5 | 70 44 24.3 | SW of berth 3 at PNSY |
| PH-13 | 1990 | Chart | | | 43 04 56.3 | 70 44 42.2 | Off dry dock 3 at PNSY, 60' from pier, 40"+ of sed. |
| PH-14 | 1990 | Chart | | | 43 04 33.7 | 70 44 38.4 | N of Pierce Island, in eelgrass bed |
| PH-15 | 1990 | Chart | | | 43 05 08.1 | 70 45 50.5 | In Piscataqua R., NE of Outer Cutt's Cove, eelgrass |
| PH-16 | 1990 | Chart | | | 43 05 12.4 | 70 45 33.0 | E of Freeman's Pt., near mouth of inlet ; in eelgrass |
| PH-17 | 1990 | Chart | | | 43 04 57.6 | 70 44 49.5 | Just S of Wattlebury Island; in eelgrass bed |
| PH-18 | 1990 | Chart | | | 43 05 04.8 | 70 44 08.2 | E side of back gate entr. to PNSY, in eelgrass bed |
| PH-19 | 1990 | Chart | | | 43 04 55.4 | 70 43 29.0 | W of Jamaica Isl. in back channel of PNSY, eelgrass |
| PH-20 | 1990 | Chart | | | 43 05 10.4 | 70 43 01.2 | Near N shore of entrance to Barters Creek |
| PH-21 | 1990 | Chart | | | 43 05 28.5 | 70 43 14.0 | E of Admiralty Village |
| YR-22 | 1990 | Chart | | | 43 07 46.0 | 70 38 27.5 | York Harbor |
| YR-23 | 1990 | Chart | | | 43 08 04.7 | 70 38 46.0 | York Harbor |
| **SS SERIES GRAB SAMPLES** | | | | | | | |
| Note: SS stations were located using RV Jere Chase navigation systems (Voyager and Internav). Internav was primarily used in later sampling as it was considered more accurate. Instrument readings were used for original placement of stations on location map. However, locations were adjusted based on field notes and visually moved to what was considered a more accurate position. | | | | | | | |
| SS1 | 1991 | Voyager | | | 43 02 37.8 | 70 42 33.6 | Odlorne Point - White Island, no sample |
| SS2 | 1991 | Voyager | | | 43 02 51.0 | 70 42 17.4 | Odlorne Point - White Island |
| SS3 | 1991 | Voyager | | | 43 03 04.2 | 70 42 00.0 | Odlorne Point - White Island |
| SS4 | 1991 | Voyager | | | 43 03 09.0 | 70 41 52.2 | Odlorne Point - White Island |
| SS5 | 1991 | Voyager | | | 43 03 19.8 | 70 41 40.8 | Odlorne Point - White Island |
| SS6 | 1991 | Voyager | | | 43 03 29.5 | 70 42 39.0 | Jaffrey Point - Wood Island |
| SS7 | 1991 | Voyager | | | 43 03 33.6 | 70 42 24.6 | Jaffrey Point - Wood Island |
| SS8 | 1991 | Voyager | | | 43 03 44.4 | 70 42 08.4 | Jaffrey Point - Wood Island |
| SS9 | 1991 | Voyager | | | 43 04 06.6 | 70 42 40.8 | Cove S of USCG station - Gerrish Island |
| SS10 | 1991 | Voyager | | | 43 04 16.2 | 70 42 21.6 | Cove S of USCG station - Gerrish Island |
| SS11 | 1991 | Voyager | | | 43 04 22.8 | 70 42 04.2 | Cove S of USCG station - Gerrish Island |
| SS12 | 1991 | Voyager | | | 43 04 28.8 | 70 42 46.8 | Salamander Point - Ft. McClary |
| SS13 | 1991 | Voyager | | | 43 04 38.4 | 70 42 40.8 | Salamander Point - Ft. McClary |
| SS14 | 1991 | Voyager | | | 43 04 46.8 | 70 42 38.4 | Salamander Point - Ft. McClary |
| SS15 | 1991 | Voyager | | | 43 04 28.5? | 70 43 20.0? | Cove on Newcastle (south of Clark Island (PNSY)) |
| SS16 | 1991 | Voyager | | | 43 04 31.2 | 70 43 27.0 | S of Clark Island |
| SS17 | 1991 | Voyager | | | 43 04 32.0 | 70 43 29.0 | S of Clark Island |
| SS18 | 1991 | Voyager | | | 43 04 22.8 | 70 43 55.2 | Goat Island - Henderson Point (PNSY) |
| SS19 | 1991 | Voyager | | | 43 04 27.6 | 70 43 55.2 | Goat Island - Henderson Point (PNSY) |
| SS21 | 1991 | Voyager | | | 43 04 33.6 | 70 43 33.6 | S of Clark Island |
| SS22 | 1991 | Voyager | | | 43 04 37.8 | 70 44 36.6 | Pierce Island - PNSY (blue drydock building) |
| SS23 | 1991 | Voyager | | | 43 04 43.8 | 70 44 35.4 | Pierce Island - PNSY (blue drydock building) |
| SS24 | 1991 | Voyager | | | 43 04 47.4 | 70 45 27.0 | N side of Memorial bridge - no sample |
| SS25 | 1991 | Voyager | | | 43 04 49.8 | 70 45 24.0 | N side of Memorial bridge - no sample |
| SS26 | 1991 | Voyager | | | 43 04 52.8 | 70 45 21.0 | N side of Memorial Br., contaminates, no sample |

# APPENDIX 1. STATION LOCATIONS.

| Station | Year | Navigation method | Latitude | Longitude | Corrected Latitude | Corrected Longitude | Basic Location |
|---|---|---|---|---|---|---|---|
| SS27 | 1991 | Voyager | | | 43 05 10.8 | 70 45 56.4 | N side of Interstate Rte. 1B bridge |
| SS28 | 1991 | Voyager | | | 43 05 14.4 | 70 45 48.6 | N side of Interstate Rte. 1B bridge |
| SS29 | 1991 | Voyager | | | 43 05 18.6 | 70 45 43.8 | N side of Interstate Rte. 1B bridge |
| SS30 | 1991 | Voyager | | | 43 05 36.6 | 70 46 14.4 | N of I95 bridge - Spinney Creek, no sample |
| SS31 | 1991 | Voyager | | | 43 05 39.6 | 70 46 00.9 | N of I95 bridge - Spinney Creek |
| SS32 | 1991 | Voyager | | | 43 05 42.6 | 70 46 04.2 | N of I95 bridge - Spinney Creek |
| SS33 | 1991 | Voyager | | | 43 05 46.8 | 70 46 58.8 | N of I95 bridge - Spinney Creek, no sample |
| SS34 | 1991 | Voyager | | | 43 05 47.4 | 70 46 52.8 | PSNH plant - Eliot, ME |
| SS35 | 1991 | Voyager | | | 43 05 48.6 | 70 46 50.4 | PSNH plant - Eliot, ME, no sample |
| SS36 | 1991 | Voyager | | | 43 05 52.8 | 70 46 52.8 | PSNH plant - Eliot, ME, no sample |
| SS37 | 1991 | Voyager | | | 43 06 01.2 | 70 47 13.8 | Fuel Tanks - Eliot town landing |
| SS38 | 1991 | Voyager | | | 43 06 05.4 | 70 47 07.2 | Fuel Tanks - Eliot town landing |
| SS39 | 1991 | Voyager | | | 43 06 12.6 | 70 47 03.6 | Fuel Tanks - Eliot town landing |
| SS40 | 1991 | Voyager | | | 43 05 25.2 | 70 45 44.4 | N of Interstate Rte. 1B bridge |
| SS50 | 1991 | Internav | | | 43 04 51.5 | 70 41 44.4 | E of Phillips Island |
| SS51 | 1991 | Internav | | | 43 04 51.8 | 70 41 32.9 | Cove E of Phillips Island |
| SS52 | 1991 | Internav | | | 43 05 02.0 | 70 41 33.2 | Chauncey Creek |
| SS53 | 1991 | Internav | | | 43 04 58.3 | 70 41 53.4 | Cove N of Phillips Island |
| SS54 | 1991 | Internav | | | 43 04 38.5 | 70 41 42.4 | E of Gooseberry Island |
| SS55 | 1991 | Internav | | | 43 04 33.3 | 70 41 54.5 | E of Fishing Island |
| SS56 | 1991 | Internav | | | 43 04 28.4 | 70 42 01.7 | SE of Fishing Island |
| SS57 | 1991 | Internav | | | 43 04 40.3 | 70 42 15.0 | SE corner of Pepperrell Cove, NNW of Fishing Isl. |
| SS58 | 1991 | Internav | | | 43 04 44.4 | 70 42 02.3 | E corner of Pepperrell Cove, W of Gooseberry Isl. |
| SS59 | 1991 | Internav | | | 43 04 50.5 | 70 42 18.6 | NW corner of Pepperrell Cove, W of Phillips Isl. |
| SS60 | 1991 | Internav | | | 43 04 42.9 | 70 42 32.9 | SW corner of Pepperrell Cove |
| SS61 | 1991 | Internav | | | 43 04 41.3 | 70 43 29.0 | Middle of Clark Cove |
| SS62 | 1991 | Internav | | | 43 04 45.8 | 70 43 14.0 | Half-way between Jamaica Isl. and Hick Rocks |
| SS63 | 1991 | Internav | | | 43 04 53.0 | 70 43 22.5 | Entrance to back channel (Jamaica Isl. side) |
| SS64 | 1991 | Internav | | | 43 05 02.7 | 70 43 40.9 | Half way up back channel (Jamaica Isl. side) |
| SS65 | 1991 | Internav | | | 43 05 04.6 | 70 44 05.2 | Bridge in back channel (Jamaica Island side) |
| SS66 | 1991 | Internav | | | 43 05 04.4 | 70 43 38.5 | In cove of back channel (Jamaica Island side) |
| SS67 | 1991 | Internav | | | 43 05 00.3 | 70 43 25.9 | In cove at E end of back channel |
| SS68 | 1991 | Internav | | | 43 04 21.3 | 70 42 50.8 | Cove between USCG station and Salamander Pt. |
| SS69 | 1991 | Internav | | | 43 04 21.0 | 70 43 18.1 | Cove W of Salamander Point, E side of cove |
| SS70 | 1991 | Internav | | | 43 04 22.1 | 70 43 19.1 | Cove W of Salamander Pt., outside edge of cove |
| SS71 | 1991 | Internav | | | 43 05 02.6 | 70 44 36.5 | Back channel - midchannel by east end bridge |
| SS72 | 1991 | Internav | | | 43 04 59.4 | 70 44 54.1 | Behind Wattlebury Island |
| SS73 | 1991 | Internav | | | 43 05 00.7 | 70 44 49.0 | Close to shore by small cove behind Wattlebury Isl. |
| SS74 | 1991 | Internav | | | 43 04 59.0 | 70 44 46.0 | Between Wattlebury Island and PNSY |
| SS75 | 1991 | Internav | | | 43 04 49.6 | 70 44 56.9 | Tip of PNSY (off of pier 2) |
| SS76 | 1991 | Internav | | | 43 05 04.1 | 70 45 40.7 | Next to scrap yard pier |
| SS77 | 1991 | Internav | | | 43 05 05.8 | 70 45 35.3 | Midway between Interstate Rte. 1B bridge |
| SS78 | 1991 | Internav | | | 43 05 04.0 | 70 45 23.7 | Near entrance to W side of Badgers Island |
| SS79* | 1991 | | 43 04 53.4 | 70 45 21.6 | 43 06 15.0 | 70 45 37.0 | Under Interstate Rte. 1B bridge, Badgers Island side |
| SS80 | 1991 | Internav | | | 43 05 15.3 | 70 45 49.1 | Off Freeman's Point |
| SS81 | 1991 | Internav | | | 43 05 21.4 | 70 45 47.9 | Mid-channel off Freeman's Point |
| SS82 | 1991 | Internav | | | 43 05 23.7 | 70 45 42.2 | N side of channel, off cove by FEA's house |
| SS83 | 1991 | Internav | | | 43 05 25.7 | 70 45 37.0 | Cove by FEA's house |
| SS91* | 1991 | Voyager | 43 05 09.6 | 70 45 42.6 | 43 05 09.0 | 70 45 37.0 | Middle of Interstate Rte. 1B bridge |
| SS92* | 1991 | Voyager | 43 05 06.0 | 70 45 46.8 | 43 05 03.0 | 70 45 40.0 | Scrapyard pier (Lat Long?) |
| SS93 | 1991 | Voyager | | | 43 05 03.0 | 70 45 32.4 | W entrance to Badgers Island (mid-channel) |
| SS94* | 1991 | Voyager | 43 05 01.8 | 70 45 08.4 | 43 04 59.5 | 70 45 04.0 | Warrens Lobster House (behind Badgers Isl.) |
| SS95* | 1991 | Voyager | 43 04 38.4 | 70 45 07.2 | 43 04 37.0 | 70 45 01.5 | Commercial fish pier (Lat-Long?) |
| SS110 | 1991 | Internav | | | 43 04 11.5 | 70 44 19.1 | Channel between Shapleigh Isl. and Goat Isl. |
| SS111 | 1991 | Internav | | | 43 04 05.1 | 70 44 30.6 | Channel between Frame Pt. and Goat Isl. |
| SS112 | 1991 | Internav | | | 43 04 07.2 | 70 44 07.1 | South of Goat Island |
| SS113 | 1991 | Internav | | | 43 04 07.6 | 70 43 57.7 | North of Pest Island |
| SS114 | 1991 | Internav | | | 43 04 02.6 | 70 44 06.7 | West of Pest Island |
| SS115 | 1991 | Internav | | | 43 03 58.7 | 70 44 16.4 | Channel NE off Leach Island |
| SS116 | 1991 | Internav | | | 43 03 58.5 | 70 44 22.9 | NE of Leach Island |

# APPENDIX 1. STATION LOCATIONS.

| Station | Year | Navigation method | Latitude | Longitude | Corrected Latitude | Corrected Longitude | Basic Location |
|---|---|---|---|---|---|---|---|
| SS117 | 1991 | Internav | | | 43 03 47.0 | 70 44 14.4 | Channel between Portsmouth shore and Leach Isl. |
| SS118 | 1991 | Internav | | | 43 03 46.1 | 70 44 13.8 | Channel between Portsmouth shore and Leach Isl. |
| SS119 | 1991 | Internav | | | 43 03 37.0 | 70 44 09.7 | SW of Clampit Island |
| SS120 | 1991 | Internav | | | 43 03 34.8 | 70 44 09.3 | SW of Clampit Island |
| SS121 | 1991 | Internav | | | 43 03 37.0 | 70 44 00.0 | SE of Clampit Island - N of Blunts Island |
| SS122 | 1991 | Internav | | | 43 03 22.8 | 70 43 25.2 | Transect-Little Harbor Yacht Club to Witches Creek |
| SS123 | 1991 | Internav | | | 43 03 17.1 | 70 43 26.2 | Transect-Little Harbor Yacht Club to Witches Creek |
| SS124 | 1991 | Internav | | | 43 03 12.4 | 70 43 39.5 | Transect-Little Harbor Yacht Club to Witches Creek |
| SS125 | 1991 | Internav | | | 43 03 22.7 | 70 43 05.6 | Transect -Jaffrey Point to Frost Point |
| SS126 | 1991 | Internav | | | 43 03 22.0 | 70 43 07.7 | Transect -Jaffrey Point to Frost Point |
| SS127 | 1991 | Internav | | | 43 03 15.1 | 70 43 10.5 | Transect -Jaffrey Point to Frost Point |
| SS128* | 1991 | Internav | 43 03 12.6 | 70 42 50.7 | 43 03 12.6 | 70 42 57.6 | Transect - Jaffrey Point to Ordiorne Point |
| SS129* | 1991 | Internav | 43 03 09.3 | 70 42 52.1 | 43 03 09.3 | 70 42 58.8 | Transect - Jaffrey Point to Ordiorne Point |
| SS130 | 1991 | Internav | | | 43 03 28.3 | 70 41 43.4 | East of Whaleback Light |
| SS131 | 1991 | Internav | | | 43 03 27.7 | 70 41 21.9 | South of White Island, East of Whaleback |
| SS132 | 1991 | Internav | | | 43 03 18.7 | 70 41 30.1 | SE of Whaleback Light |
| SS133 | 1991 | Internav | | | 43 03 15.8 | 70 41 06.0 | Transect -Bouy 2KR to Gerrish Isl. (Sewards Cove) |
| SS134 | 1991 | Internav | | | 43 03 32.6 | 70 40 56.4 | Transect -Bouy 2KR to Gerrish Isl. (Sewards Cove) |
| SS135 | 1991 | Internav | | | 43 03 42.8 | 70 40 53.1 | Transect -Bouy 2KR to Gerrish Isl. (Sewards Cove) |
| SS136 | 1991 | Internav | | | 43 03 55.5 | 70 42 18.0 | Transect -Newcastle to Gerrish Island |
| SS137 | 1991 | Internav | | | 43 04 03.8 | 70 42 11.2 | Transect -Newcastle to Gerrish Island |
| SS138 | 1991 | Internav | | | 43 04 03.0 | 70 41 57.3 | North of Wood Island, West of Gerrish Island |
| SS139 | 1991 | Internav | | | 43 04 02.7 | 70 41 51.1 | North of Wood Island, West of Gerrish Island |
| SS140 | 1991 | Internav | | | 43 04 07.9 | 70 41 50.8 | North of Wood Island, West of Gerrish Island |
| SS141 | 1991 | Internav | | | 43 04 08.7 | 70 41 56.6 | North of Wood Island, West of Gerrish Island |
| SS142 | 1991 | Internav | | | 43 04 25.7 | 70 42 18.7 | Area between USCG Station and Fishing Island |
| SS143 | 1991 | Internav | | | 43 04 24.8 | 70 42 25.5 | Area between USCG Station and Fishing Island |
| SS144 | 1991 | Internav | | | 43 04 35.5 | 70 42 22.3 | Area between USCG Station and Fishing Island |
| SS145 | 1991 | Internav | | | 43 04 31.3 | 70 42 34.9 | Area between USCG Station and Fishing Island |
| SS146 | 1991 | Internav | | | 43 04 36.8 | 70 42 51.2 | Area North of Salamander Pt , Newcastle |
| SS147 | 1991 | Internav | | | 43 04 32.3 | 70 42 55.5 | Area North of Salamander Pt , Newcastle |
| SS148 | 1991 | Internav | | | 43 04 29.4 | 70 43 08.7 | Area North of Salamander Pt , Newcastle |
| SS149 | 1991 | Internav | | | 43 04 34.4 | 70 43 09.5 | Area North of Salamander Pt , Newcastle |
| SS150 | 1991 | Internav | | | 43 04 57.5 | 70 43 29.7 | Backchannel PNSY -N of Jamaica Island |
| SS151 | 1991 | Internav | | | 43 05 02.2 | 70 43 4836 | Backchannel PNSY |
| SS152 | 1991 | Internav | | | 43 04 25.1 | 70 44 08.2 | Off Henderson Pt PNSY (Pull and Be Damned Point) |
| SS 170 | 1992 | GPS - ECOS | 43 04.71 | 70 43.49 | 43 04 42.6 | 70 43 29.4 | NEAR ENTRANCE TO CLARK COVE |
| SS 171 | 1992 | GPS - ECOS | 43 04.58 | 70 43.73 | 43 04 34.8 | 70 43 43.8 | NEAR POLICE DOCK BY CAUSEWAY TO CLARK IS. |
| SS200 | 1991 | Internav | | | 43 04 39.3 | 70 42 29.2 | NW of Fishing Island |
| SS201 | 1991 | Internav | | | 43 04 42.6 | 70 42 12.8 | NW of Fishing Island |
| SS202 | 1991 | Internav | | | 43 04 52.5 | 70 42 02.4 | Area W of Fishing Island |
| SS203 | 1991 | Internav | | | 43 04 30.0 | 70 42 38.4 | Area NE of Salamander Pt., Newcastle |
| SS204 | 1991 | Internav | | | 43 04 58.8 | 70 43 28.5 | Back channel of PNSY - N of Jamaica Island |
| SS205 | 1991 | Internav | | | 43 05 02.0 | 70 43 38.1 | Back channel of PNSY |
| SS206 | 1991 | Internav | | | 43 05 03.1 | 70 43 38.8 | Back channel of PNSY |
| SS207 | 1991 | Internav | | | 43 04 58.2 | 70 43 41.4 | Back channel of PNSY |
| SS208 | 1991 | Internav | | | 43 04 57.8 | 70 43 51.7 | Back channel of PNSY |
| SS209 | 1991 | Internav | | | 43 04 58.3 | 70 43 47.6 | Back channel of PNSY |
| SS210 | 1991 | Internav | | | 43 04 55.2 | 70 43 32.1 | Back channel of PNSY - N of Jamaica Island |
| SS211 | 1991 | Internav | | | 43 04 30.8 | 70 43 10.6 | Area between Salamander Point, Newcastle and Clark Island |
| SS212 | 1991 | Internav | | | 43 04 43.4 | 70 44 19.9 | Off dry dock 9 at PNSY |
| SS213 | 1991 | Internav | | | 43 04 42.0 | 70 44 25.0 | Area SW of dry dock 9 at PNSY |
| SS214 | 1991 | Internav | | | 43 04 46.5 | 70 44 30.8 | Off berth 3 at PNSY |
| SS215 | 1991 | Internav | | | 43 04 50.2 | 70 44 38.2 | S of pier 2 at PNSY |
| SS216 | 1991 | Internav | | | 43 04 50.8 | 70 44 36.5 | S of pier 2 at PNSY |
| SS217 | 1991 | Internav | | | 43 04 19.9 | 70 43 52.0 | N of causeway between Goat Isl. and Newcastle |
| SS218 | 1991 | Internav | | | 43 04 21.0 | 70 44 15.1 | Area N of Goat Island |
| SS219 | 1991 | Internav | | | 43 04 18.9 | 70 44 12.7 | Area N of Goat Island |
| SS220 | 1991 | Internav | | | 43 04 19.6 | 70 44 21.9 | Area N of causeway between Shapleigh Island |

## APPENDIX 1. STATION LOCATIONS.

| Station | Year | Navigation method | Latitude | Longitude | Corrected Latitude | Corrected Longitude | Basic Location |
|---|---|---|---|---|---|---|---|
| | | | | | | | and Goat Island |
| SS221 | 1991 | Internav | | | 43 04 18.0 | 70 44 14.0 | Area N of Goat Island |
| SS222 | 1991 | Internav | | | 43 04 25.2 | 70 44 15.1 | Just S of Goat Island |
| SS223 | 1991 | Internav | | | 43 04 34.7 | 70 42 14.3 | W of Fishing Island |
| SS224 | 1991 | Internav | | | 43 04 32.5 | 70 42 18.0 | W of Fishing Island |
| SS225 | 1991 | Internav | | | 43 04 21.1 | 70 42 27.2 | Area NE of USCG station |
| SS226 | 1991 | Internav | | | 43 04 25.0 | 70 42 08.0 | NE of Fort Pt. light |
| SS227 | 1991 | Internav | | | 43 04 26.2 | 70 42 11.2 | Area NE of USCG station |
| SS228 | 1991 | Internav | | | 43 04 24.2 | 70 42 15.9 | Area NE of USCG station |
| SS229 | 1991 | Internav | | | 43 04 23.8 | 70 42 19.7 | Area NE of USCG station |
| SS 250* | 1993 | Hand voy. | 43 05 16.8 | 70 45 28.2 | 43 05 17.5 | 70 45 24.5 | Halfway across cove by Simply Italian restaurant |
| SS251* | 1993 | Hand voy. | 43 05 14.4 | 70 45 35.4 | 43 05 15.5 | 70 45 31.7 | Near front of cove by Simply Italian restaurant |
| SS252* | 1993 | Hand voy. | 43 05 07.8 | 70 44 32.4 | 43 05 09.4 | 70 44 28.5 | Halfway into cove by Traip Academy |
| SS253* | 1993 | Hand voy. | 43 05 05.4 | 70 44 28.2 | 43 05 06.6 | 70 44 22.2 | In back channel between bridges, water depth 19' |
| SS254* | 1993 | Hand voy. | 43 05 05.4 | 70 44 28.2 | 43 05 06.6 | 70 44 22.2 | In back channel between bridges, water depth 19' |
| SS255* | 1993 | Hand voy. | 43 06 23.4 | 70 43 52.2 | 43 06 26.1 | 70 43 47.4 | Upper Spruce Creek, water depth 1'-2' |
| SS256* | 1993 | Hand voy. | 43 06 07.8 | 70 43 41.4 | 43 06 08.3 | 70 43 34.4 | Ent. to cove in Upper Spruce Cr., water depth 2' |
| SS257 | 1993 | Hand voy. | | | 43 06 06.6 | 70 43 46.8 | Across from cove for SS256, water depth 5' |
| SS258 | 1993 | Hand voy. | | | 43 05 54.6 | 70 43 47.4 | Ent. to cove in Upper Spruce Cr., water depth 6' |
| SS259* | 1993 | Hand voy. | 43 05 52.8 | 70 43 31.2 | 43 05 48.1 | 70 43 23.5 | Mid-Spruce Creek, just up from Eagle Pt. |
| SS260* | 1993 | Hand voy. | 43 05 44.4 | 70 43 12.6 | 43 05 46.5 | 70 43 07.7 | Cove opp. Eagle Pt., adj. (75'?) to mussel bar |
| SS261 | 1993 | Hand voy. | | | 43 05 32.4 | 70 43 16.2 | Off island by Admiralty Village, water depth 1' |
| SS262* | 1993 | Hand voy. | 43 05 30.0 | 70 43 12.6 | 43 05 27.4 | 70 43 08.5 | Off Admiralty Vil., mid-channel, water depth 16' |
| SS263* | 1993 | Hand voy. | 43 05 27.0 | 70 43 04.2 | 43 05 24.9 | 70 43 01.7 | Lower Spruce Cr., by PH stn., water depth 2'-3' |
| SS264 | 1993 | Hand voy. | | | 43 05 19.2 | 70 43 31.8 | South of island in cove by Admiralty Village |
| SS265* | 1993 | Hand voy. | 43 05 10.2 | 70 43 11.4 | 43 05 12.5 | 70 43 08.6 | Halfway across rr. trestle in Lower Spruce Cr. |
| SS266* | 1993 | Hand voy. | 43 05 05.4 | 70 43 01.8 | 43 05 06.9 | 70 42 56.8 | In cove just north of rr. trestle in Spruce Cr. |
| SS267* | 1993 | Hand voy. | 43 05 09.6 | 70 44 13.2 | 43 05 10.9 | 70 44 11.3 | Halfway across cove by bridge to PNS |
| | | | | | | | |
| **CORE SERIES** | | | | | | | |
| | | | | | | | |
| PH-2 | 1992 | Chart | | | 43 04 18.8 | 70 42 40.1 | SSE of pier at USCG station, in eelgrass bed |
| PH-3A | 1992 | Chart | | | 43 04 45.6 | 70 43 31.2 | S of Jamaica Island |
| PH-7A | 1992 | Chart | | | 43 04 45.0 | 70 43 39.0 | Just off Seavey Island in Clark Cove |
| PH-15 | 1992 | Chart | | | 43 05 08.1 | 70 45 50.5 | In Piscataqua R., NE of Outer Cutt's Cove, eelgrass |
| PH-17 | 1992 | Chart | | | 43 04 57.6 | 70 44 49.5 | Just S of Wattlebury Island, in eelgrass bed |
| PH-19 | 1992 | Chart | | | 43 04 55.4 | 70 43 29.0 | W of Jamaica I. in back channel of PNSY, eelgrass |
| PH-51 | 1992 | Chart | | | 43 04 50.9 | 70 41 35.5 | E of Phillips Island in inlet of Gerrish Island |
| PH-100 | 1992 | Chart | | | 43 04 56.0 | 70 41 50.0 | E of N end of Phillips Island |
| PH-101 | 1992 | Chart | | | 43 05 01.0 | 70 41 50.7 | Cove N of Phillips Island, N corner of cove |
| PH-1 | 1991 | Chart | | | 43 04 42.5 | 70 41 46.8 | E of Gooseberry Island |
| PH-2 | 1991 | Chart | | | 43 04 18.8 | 70 42 40.1 | SSE of pier at USCG station, in eelgrass bed |
| PH-3 | 1991 | Chart | | | 43 04 45.5 | 70 43 22.0 | Between Jamaica I. and Hick Rocks, in eelgrass |
| PH-4 | 1991 | Chart | | | 43 04 41.2 | 70 43 26.9 | N of Clark Island, 11' deep mud bottom |
| PH-5 | 1991 | Chart | | | 43 04 45.5 | 70 43 28.6 | S of Jamaica Island, 13' deep mud bottom |
| PH-6 | 1991 | Chart | | | 43 04 38.0 | 70 43 35.0 | N of Clark Island causeway, 11' deep mud bottom |
| PH-7 | 1991 | Chart | | | 43 04 44.2 | 70 43 34.5 | Clark Cove, near Norway ball #17 |
| PH-8 | 1991 | Chart | | | 43 04 40.0 | 70 43 38.2 | W of Clark Island pier, 8' deep mud bottom |
| PH-10 | 1991 | Chart | | | 43 04 43.5 | 70 44 17.2 | S of dry dock 2 at PNSY, 3'+ of sediment |
| PH-11 | 1991 | Chart | | | 43 04 05.5 | 70 44 29.5 | S of Shapleigh Island, in eelgrass bed |
| PH-12 | 1991 | Chart | | | 43 04 50.5 | 70 44 37.0 | SE of dry dock 1 at PNSY, 75' from pier, 3.5' of sed. |
| PH-13 | 1991 | Chart | | | 43 04 56.3 | 70 44 42.2 | Off dry dock 3 at PNSY, 60' from pier, 40" of sed. |
| PH-14 | 1991 | Chart | | | 43 04 33.7 | 70 44 38.4 | N of Pierce Island, in eelgrass bed |
| PH-15 | 1991 | Chart | | | 43 05 08.1 | 70 45 50.5 | In Piscataqua R., NE of Outer Cutt's Cove, eelgrass |
| PH-16 | 1991 | Chart | | | 43 05 12.4 | 70 45 33.0 | E of Freeman's Pt., near mouth of inlet, in eelgrass |
| PH-17 | 1991 | Chart | | | 43 04 57.6 | 70 44 49.5 | Just S of Wattlebury Island, in eelgrass bed |
| PH-19 | 1991 | Chart | | | 43 04 55.4 | 70 43 29.0 | W of Jamaica I. in back channel of PNSY, eelgrass |
| PH-20 | 1991 | Chart | | | 43 05 10.4 | 70 43 01.2 | Near N shore of entrance to Barters Creek |
| PH-21 | 1991 | Chart | | | 43 05 28.5 | 70 43 14.0 | E of Admiralty Village |

## APPENDIX 1. STATION LOCATIONS.

| Station | Year | Navigation method | Latitude | Longitude | Corrected Latitude | Corrected Longitude | Basic Location |
|---|---|---|---|---|---|---|---|
| **MARSH CORE SERIES** | | | | | | | |
| Note: + samples are composites of a number of cores along a transect running across the marsh through a given vegetation type. | | | | | | | |
| MS1 | 1992 | Chart | | | 43 05 32.8 | 70 43 23.5 | Admiralty Vil. north, same loc. as ADVMSAT/SP stns. |
| MS 2 | 1992 | Chart | | | 43 05 31.0 | 70 43 25.0 | Admiralty Village middle |
| MS 3 | 1992 | Chart | | | 43 05 30.2 | 70 43 26.5 | Admiralty Village south |
| MS 4 | 1992 | Chart | | | 43 04 38.1 | 70 43 31.5 | Clark Cove high marsh, same loc. as CIEM stations |
| MS 5 | 1992 | Chart | | | 43 04 38.0 | 70 43 33.0 | Clark Cove low marsh, same loc. as CIEM stations |
| MS 6 | 1992 | Chart | | | 43 04 35.4 | 70 43 31.0 | Clark River high marsh, same loc. as CIPR stations |
| MS 7 | 1992 | Chart | | | 43 04 35.0 | 70 43 32.4 | Clark River low marsh, same loc. as CIPR stations |
| MS 8 | 1992 | Chart | | | 43 05 04.9 | 70 43 24.5 | Dions yacht yard, same location as BNBC station |
| MS 9 | 1992 | Chart | | | 43 05 00.9 | 70 44 03.8 | Fr. marsh at backgate to PNSY, same loc. as BGBC |
| MS 10 | 1992 | Chart | | | 43 04 53.9 | 70 43 35.1 | Jamaica Island, same location as JIBC station |
| MS 11 | 1992 | Chart | | | 43 04 07.8 | 70 44 29.6 | Station 11 west, low marsh |
| MS 12 | 1992 | Chart | | | 43 04 08.0 | 70 44 28.0 | Station 11 middle, high marsh |
| MS 13 | 1992 | Chart | | | 43 04 08.8 | 70 44 24.2 | Station 11 east, low marsh, same loc. as SHIM stns. |
| **NHPA SERIES** | | | | | | | |
| NHPA 1 | 1993 | Chart | | | | | Fishing Island |
| NHPA 2 | 1993 | Chart | | | 43 05 05.8 | 70 45 58.8 | Inner Cutt's Cove |
| NHPA 3 | 1993 | Chart | | | 43 04 53.5 | 70 45 50.5 | Outer North Mill Pond |
| NHPA 4 | 1993 | Chart | | | 43 05 08.0 | 70 45 52.1 | Cutt's Cove eelgrass bed |
| NHPA 5 | 1993 | Chart | | | 43 05 08.8 | 70 45 54.6 | Cutt's Cove mud flat |
| NHPA 6 | 1993 | Chart | | | 43 05 08.8 | 70 45 54.6 | Cutt's Cove mud flat, duplicate of NHPA 5 |
| NHPA 7 | 1993 | Chart | | | | | North of Schiller plant |
| NHPA 8 | 1993 | Chart | | | | | South of fish pier |
| NHPA 9 | 1993 | Chart | | | | | North of defense fuel tanks |
| NHPA 10 | 1993 | Chart | | | | | North of Sprague, unvegetated control |
| NHPA 11 | 1993 | Chart | | | | | North of Sprague, eelgrass bed |
| NHPA 12 | 1993 | Chart | | | | | North of Sprague |
| NHPA 13 | 1993 | Chart | | | | | North of Sprague, duplicate of NHPA 12 |
| NHPA 14 | 1993 | Chart | | | | | Broad Cove |
| NHPA 15 | 1993 | Chart | | | | | Broad Cove, eelgrass bed by NH Rte. 4 |
| NHPA 16 | 1993 | Chart | | | 43 05 00 | 70 45 56.6 | Inner Inner Cutt's Cove |

# APPENDIX 2. TEXTURE OF SURFICIAL SEDIMENT SAMPLES

| STATION | ID | CLASSIFICATION | | %GSM | %SSC | MEAN | SORT. | SKEW. | KURT. | % MOIST | % LOI |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | G/S/M | S/S/C | | | | | | | | |
| **SS SERIES** | | | | | | | | | | | |
| SS 1 | N/A | CNGS | | | | | | | | | |
| SS 2 | N/A | GS | | 12/87/01 | | 1.17 | 1.49 | -0.38 | 1.62 | 0.3 | 1.1 |
| SS 3 | N/A | S | | 04/94/02 | | 2.73 | 0.84 | -0.46 | 3.32 | 18.8 | 0.7 |
| SS 4 | N/A | S | | 01/97/02 | | 2.63 | 0.55 | -0.30 | 1.20 | 14.5 | 0.6 |
| SS 5 | N/A | SG | | 64/35/01 | | -1.73 | 1.56 | 0.11 | 0.72 | 10.3 | 4.4 |
| SS 6.1 | N/A | SG | | 58/40/02 | | -1.62 | 2.94 | 0.61 | 0.51 | | |
| SS 6.2 | N/A | SG | | 58/40/02 | | -1.67 | 2.98 | 0.59 | 0.51 | | |
| SS 7 | N/A | GS | | 14/83/03 | | 1.10 | 1.63 | -0.55 | 1.49 | 15.6 | 1.0 |
| SS 8 | N/A | SG | | 67/33/00 | | -2.43 | 2.82 | 0.71 | 0.52 | | |
| SS 9 | N/A | S | | 01/97/02 | | 1.15 | 0.83 | 0.09 | 1.59 | 13.6 | 0.6 |
| SS 10 | N/A | SG | | 53/47/00 | | -1.55 | 2.75 | 0.07 | 0.53 | | |
| SS 11 | N/A | S | | 01/97/02 | | 2.88 | 0.27 | 0.21 | 1.15 | 16.6 | 0.4 |
| SS 12 | N/A | SG | | 42/57/01 | | -0.72 | 2.53 | -0.50 | 0.62 | | |
| SS 13 | N/A | SG | | 39/60/01 | | -0.82 | 2.91 | -0.58 | 0.53 | | |
| SS 14 | N/A | GMS | | 06/78/16 | | 3.20 | 1.64 | -0.03 | 4.28 | 31.5 | 1.7 |
| SS 15 | N/A | MS | MS | 00/53/47 | 53/31/16 | 4.97 | 2.30 | 0.66 | 1.30 | 33.8 | 4.4 |
| SS 16 | N/A | SG | | 50/49/01 | | -1.41 | 2.50 | -0.17 | 0.61 | | |
| SS 17 | N/A | G | | 85/14/01 | | -3.47 | 2.07 | 0.66 | 1.44 | | |
| SS 18 | N/A | GS | | 28/67/05 | | 0.13 | 1.87 | -0.24 | -2.17 | 17.5 | 0.7 |
| SS 19 | N/A | CNGS | | | | | | | | | |
| SS 20 | N/A | CNGS | | | | | | | | | |
| SS 21 | N/A | MS | MS | 00/60/40 | 60/25/15 | 4.68 | 2.58 | 0.70 | 2.09 | 33.1 | 3.9 |
| SS 22 | N/A | SG | | 73/27/00 | | -2.27 | 2.19 | 0.29 | 0.75 | | |
| SS 23 | N/A | SG | | 37/63/00 | | -0.13 | 2.05 | -0.43 | 0.71 | 4.7 | 0.6 |
| SS 24 | N/A | CNGS | | | | | | | | | |
| SS 25 | N/A | CNGS | | | | | | | | 11.3 | 0.0 |
| SS 26 | N/A | CNGS | | | | | | | | | |
| SS 27 | N/A | MS | SS | 00/77/23 | 78/21/01 | 3.53 | 1.65 | 0.56 | 1.26 | 22.3 | 2.0 |
| SS 28 | N/A | SG | | 73/27/00 | | -2.37 | 1.96 | -0.08 | 0.73 | | |
| SS 29 | N/A | G | | 87/12/01 | | -3.60 | 1.78 | 0.59 | 1.59 | | |
| SS 30 | N/A | CNGS | | 87/13/00 | | | | | | | |
| SS 31 | N/A | G | | 87/13/0 | | -3.93 | 1.75 | 0.82 | 1.76 | | |
| SS 32 | N/A | SG | | 56/43/01 | | -0.90 | 2.29 | -0.26 | 0.70 | 7.8 | 1.1 |
| SS 33 | N/A | CNGS | | | | | | | | | |
| SS 34 | N/A | SG | | 37/63/00 | | -0.95 | 1.83 | -0.63 | 0.89 | | |
| SS 37 | N/A | SG | | 65/33/02 | | -1.43 | 2.25 | 0.31 | 0.71 | 11.8 | 1.4 |
| SS 38 | N/A | G | | 98/02/00 | | -4.87 | 0.57 | 0.82 | 6.12 | | |
| SS 39 | N/A | MS | S/SS | 05/85/10 | 90/9/1 | 2.15 | 1.37 | 0.23 | 3.77 | 14.0 | 0.9 |
| SS 40 | N/A | SG | | 68/30/02 | | -0.73 | 2.41 | 0.28 | 0.50 | | |
| SS 50 | N/A | SM | SS | 00/35/65 | 35/46/19 | 5.55 | 2.78 | 0.44 | 1.10 | 44.7 | 6.2 |
| SS 51 | N/A | SM | SS | 00/33/67 | 33/49/18 | 5.43 | 2.31 | 0.32 | 0.79 | 50.9 | 6.0 |
| SS 52 | N/A | SG | | 59/38/03 | | -1.77 | 2.61 | 0.57 | 0.56 | 23.0 | 1.6 |
| SS 53 | N/A | M | SL | 00/09/91 | 09/74/17 | 6.47 | 1.96 | -0.15 | 1.25 | 59.4 | 7.6 |
| SS 54 | N/A | MS | MS | 01/84/15 | 85/9/6 | 3.00 | 1.47 | 0.37 | 3.10 | 30.7 | 1.8 |
| SS 55 | N/A | S | S | 00/97/03 | 97/01/02 | 2.95 | 0.25 | 0.15 | 1.37 | 25.8 | 0.7 |
| SS 56 | N/A | S | | 00/98/02 | | 2.92 | 0.20 | 0.24 | 1.23 | 27.5 | 0.4 |
| SS 57 | N/A | GMS | | 27/45/28 | | 1.90 | 4.01 | 0.06 | 0.92 | 29.7 | 2.8 |
| SS 58 | N/A | GMS | SM | 00/19/81 | 19/49/32 | 6.95 | 3.33 | 0.41 | 0.88 | 58.3 | 8.2 |
| SS 59 | N/A | SM | SSL | 00/28/72 | 28/54/18 | 5.55 | 2.23 | 0.53 | 0.84 | 50.1 | 5.2 |
| SS 60 | N/A | GS | SSL | 26/71/03 | | 0.60 | 2.01 | -0.18 | 0.80 | 25.9 | 2.1 |
| SS 61 | N/A | SM | SSL | 00/49/51 | 49/36/15 | 5.03 | 2.45 | 0.58 | 1.07 | 47.1 | 4.3 |
| SS 62 | N/A | SG | | 31/64/05 | | 0.37 | 2.16 | -0.11 | 0.80 | 22.1 | 1.8 |
| SS 63 | N/A | SG | | 32/65/03 | | -0.13 | 1.73 | 0.02 | 1.07 | 25.7 | 2.6 |
| SS 64 | N/A | GMS | | 06/84/10 | | 2.67 | 1.79 | -0.06 | 4.06 | 25.3 | 1.6 |
| SS 65 | N/A | G | | 90/10/00 | | -4.36 | 1.43 | 0.95 | 2.65 | | |
| SS 66 | N/A | SM | SSL | 00/45/55 | 45/40/15 | 5.07 | 2.40 | 0.53 | 1.21 | 45.7 | 5.7 |
| SS 67 | N/A | GM | | 09/21/70 | | 5.73 | 3.36 | -0.23 | 1.07 | 56.5 | 7.7 |
| SS 68 | N/A | SG/MSG | | 56/39/05 | | -1.00 | 2.74 | 0.41 | 0.63 | | |

## APPENDIX 2. TEXTURE OF SURFICIAL SEDIMENT SAMPLES

| STATION | ID | CLASSIFICATION G/S/M | S/S/C | %GSM | %SSC | MEAN | SORT. | SKEW. | KURT. | % MOIST | % LOI |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SS 69 | N/A | SM | SM | 00/40/60 | 40/39/21 | 5.65 | 2.77 | 0.62 | 1.05 | 47.9 | 5.6 |
| SS 70 | N/A | MSG | SLS | 00/53/47 | 53/40/07 | 4.82 | 2.26 | 0.64 | 0.88 | 38.1 | 3.5 |
| SS 71 | N/A | GS | | 29/66/05 | | -0.20 | 1.75 | -0.13 | 1.26 | 28.4 | 4.4 |
| SS 72 | N/A | G | | 92/06/02 | | -3.95 | 1.57 | 0.38 | 1.50 | | |
| SS 73 | N/A | G | | 92/06/02 | | -3.18 | 1.28 | 0.51 | 3.42 | | |
| SS 74 | N/A | GMS | | 19/56/25 | | 2.18 | 3.39 | 0.03 | 0.94 | 24.2 | 2.0 |
| SS 75 | N/A | SG | | 46/53/01 | | -0.50 | 2.23 | -0.34 | 0.58 | 15.2 | 0.7 |
| SS 76 | N/A | SG | | 77/22/01 | | -2.95 | 2.17 | 0.57 | 0.59 | | |
| SS 77 | N/A | SG | | 76/24/00 | | -3.08 | 2.20 | 0.65 | 0.58 | | |
| SS 78 | N/A | MSG | | 31/61/08 | | 0.28 | 2.58 | 0.25 | 1.26 | | |
| SS 79 | N/A | MS | | 1/87/12 | 88/7/5 | 2.20 | 1.64 | 0.53 | 2.57 | | |
| SS 80 | N/A | SG | | 58/42/00 | | -1.78 | 2.54 | 0.31 | 0.53 | | |
| SS 81 | N/A | SG | | 72/28/00 | | -1.92 | 2.17 | 0.67 | 0.55 | | |
| SS 82 | N/A | G | | 83/16/01 | | -3.22 | 2.01 | 0.54 | 1.18 | | |
| SS 83 | N/A | GMS | | 12/68/20 | | 2.50 | 2.93 | 0.05 | 2.20 | 26.8 | 2.2 |
| SS 91 | N/A | G/SG | | 80/20/00 | | -2.50 | 1.67 | 0.16 | 0.86 | | |
| SS 92 | N/A | SG | | 64/36/00 | | -1.83 | 2.12 | 0.27 | 0.56 | 36.1 | 4.9 |
| SS 93 | N/A | GS | | 15/83/02 | | 1.40 | 1.78 | -0.51 | 2.17 | 20.8 | 0.8 |
| SS 94 | N/A | SG | | 73/25/02 | | -2.35 | 2.25 | 0.24 | 0.75 | | |
| SS 95 | N/A | SM | SM | 01/39/60 | 40/39/21 | 5.62 | 3.28 | 0.42 | 1.11 | 22.8 | 1.1 |
| SS 110 | N/A | GMS | SLS | 11/49/40 | 60/28/12 | 3.83 | 3.49 | 0.25 | 1.14 | 45.0 | 4.3 |
| SS 111 | N/A | MS | MS | 0/65/35 | 65/20/15 | 4.62 | 2.61 | 0.71 | 1.60 | 40.4 | 6.0 |
| SS 112 | N/A | SM | SM | 0/13/87 | 13/55/32 | 6.78 | 2.76 | 0.21 | 1.00 | 63.7 | 9.2 |
| SS 113 | N/A | M | M | 0/7/93 | 7/60/33 | 6.94 | 2.51 | 0.23 | 0.98 | 63.9 | 10.7 |
| SS114 | N/A | SM | SSL | 0/15/85 | 15/70/15 | 5.99 | 2.09 | 0.17 | 1.05 | 57.2 | 9.7 |
| SS 115 | N/A | SM | SM | 0/28/72 | 28/44/28 | 5.98 | 2.57 | 0.22 | 0.75 | 54.5 | 7.6 |
| SS116 | N/A | GM | SM | 16/29/55 | 45/32/23 | 4.20 | 4.45 | -0.09 | 1.10 | 46.2 | 6.7 |
| SS 117 | N/A | S | | 0/98/2 | | 1.77 | 0.27 | -0.18 | 1.30 | 28.2 | 1.0 |
| SS118 | N/A | GS | S | 10/83/7 | 93/4/3 | 2.27 | 1.75 | -0.09 | 5.56 | 30.9 | 1.3 |
| SS 119 | N/A | S | | 0/98/2 | | 1.43 | 0.88 | -0.28 | 1.17 | 28.8 | 1.0 |
| SS 120 | N/A | S | | 2/92/5 | | 1.88 | 0.81 | 0.18 | 1.83 | 27.2 | 1.2 |
| SS 121 | N/A | GMS | S | 29/63/8 | 92/5/3 | 0.37 | 2.74 | -0.41 | 1.17 | 21.5 | 1.0 |
| SS 122 | N/A | S | | 1/95/4 | | 2.17 | 0.79 | 0.05 | 1.41 | 26.9 | 1.1 |
| SS 123 | N/A | SM | SM/SS | 0/45/55 | 45/38/17 | 5.23 | 2.68 | 0.53 | 1.05 | 49.3 | 6.2 |
| SS 124 | N/A | GMS | MS | 20/62/18 | 82/12/6 | 1.23 | 3.79 | -0.17 | 1.97 | 47.5 | 6.2 |
| SS 125 | N/A | MSG/SG | S | 66/30/4 | 96/1/3 | -2.13 | 2.95 | 0.88 | 0.51 | | |
| SS 126 | N/A | S | | 3/95/2 | | 1.13 | 0.90 | -0.11 | 1.23 | 24.4 | 1.4 |
| SS 127 | N/A | SM | SSL | 0/24/76 | 24/54/22 | 5.95 | 2.74 | 0.28 | 1.11 | 60.0 | 11.2 |
| SS 128 | N/A | SG | | 77/22/1 | | -3.12 | 2.53 | 0.95 | 0.79 | | |
| SS 129 | N/A | SG | | 67/31/2 | | -2.18 | 2.30 | 0.35 | 0.57 | | |
| SS 130 | N/A | GS | | 29/64/7 | | 0.78 | 2.68 | -0.43 | 0.63 | | |
| SS 131 | N/A | GS | | 15/83/2 | | 1.07 | 1.69 | -0.60 | 3.94 | 25.5 | 1.2 |
| SS 132 | N/A | G | | 83/15/2 | | -3.10 | 1.76 | 0.76 | 1.19 | | |
| SS 133 | N/A | G | | 89/10/1 | | -3.53 | 1.48 | 0.78 | 1.19 | | |
| SS 134 | N/A | SG | | 76/22/2 | | -2.43 | 2.27 | 0.46 | 0.98 | | |
| SS 135 | N/A | SG | | 75/23/2 | | -2.57 | 3.02 | 0.81 | 0.77 | | |
| SS 136 | N/A | S | | 0/99/1 | | 1.58 | 0.45 | -0.12 | 1.39 | 24.9 | 1.2 |
| SS 137 | N/A | GS | | 13/86/1 | | 0.58 | 1.22 | -0.38 | 1.23 | 26.5 | 1.1 |
| SS 138 | N/A | SG | S | 59/38/3 | 96/3/1 | -1.60 | 3.23 | 0.37 | 0.51 | 22.2 | 0.9 |
| SS 139 | N/A | S | | 0/97/3 | | 3.08 | 0.36 | 0.00 | 1.33 | 24.6 | 0.6 |
| SS 140 | N/A | CNGS | | | | | | | | | |
| SS 141 | N/A | MS | CS | 0/87/13 | 87/4/9 | 3.23 | 1.68 | 0.46 | 6.35 | 28.8 | 0.8 |
| SS 142 | N/A | GS | | 26/73/1 | | 0.30 | 2.30 | -0.71 | 1.00 | 19.3 | 0.9 |
| SS 143 | N/A | SG | | 66/33/1 | | -2.75 | 2.62 | 0.71 | 0.51 | 21.4 | 0.8 |
| SS 144 | N/A | GS | | 16/80/4 | | 1.05 | 1.90 | -0.49 | 2.06 | 29.1 | 1.1 |
| SS 145 | N/A | SG | | 76/23/1 | | -2.82 | 2.72 | 0.83 | 0.77 | 21.7 | 0.9 |
| SS 146 | N/A | G | | 91/6/3 | | -3.93 | 1.43 | 0.92 | 2.00 | | |
| SS 147 | N/A | SG | | 67/32/1 | | -2.37 | 2.74 | 0.51 | 0.57 | 29.9 | 3.3 |
| SS 148 | N/A | SG | | 47/50/3 | | -1.42 | 2.66 | -0.37 | 0.56 | 23.8 | 1.5 |

| APPENDIX 2. TEXTURE OF SURFICIAL SEDIMENT SAMPLES | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION | ID | CLASSIFICATION | | %GSM | %SSC | MEAN | SORT. | SKEW. | KURT. | % MOIST | % LOI |
| | | G/S/M | S/S/C | | | | | | | | |
| SS 149 | N/A | SG | | 32/67/1 | | -0.60 | 2.49 | -0.62 | 0.68 | 24.9 | 1.2 |
| SS 150 | N/A | MSG/SG | | 78/19/3 | | -2.46 | 2.39 | 0.68 | 1.10 | | |
| SS 151 | N/A | S | | 3/92/5 | | 2.00 | 0.99 | -0.02 | 1.91 | 28.5 | 1.1 |
| SS 170 | N/A | GMS | | 20/50/30 | | 2.45 | 4.20 | 0.02 | 1.18 | | |
| SS 171 | N/A | GMS | MS | 6/71/23 | 77/14/9 | 1.92 | 2.25 | 0.21 | 1.54 | | |
| SS 200 | N/A | SG | | 38/59/3 | | 0.48 | 2.55 | -0.45 | 0.61 | 23.4 | 3.7 |
| SS 201 | N/A | SM | SM | 0/49/51 | 49/32/19 | 5.51 | 2.87 | 0.61 | 1.17 | 50.5 | 4.8 |
| SS 202 | N/A | SM | SSL | 1/40/59 | 40/46/14 | 4.97 | 2.27 | 0.66 | 1.92 | 39.4 | 4.0 |
| SS 203 | N/A | S | | 3/96/1 | | 1.17 | 0.77 | -0.32 | 1.25 | 25.8 | 0.3 |
| SS 204 | N/A | MS | MS | 0/78/22 | 78/13/9 | 3.60 | 2.01 | 0.57 | 2.94 | 44.0 | 3.2 |
| SS 205 | N/A | MS | MS | 2/61/37 | 62/23/15 | 4.40 | 2.90 | 0.54 | 1.61 | 40.6 | 3.5 |
| SS 206 | N/A | MS | SLS | 1/60/39 | 61/30/9 | 4.53 | 2.24 | 0.50 | 1.02 | 37.0 | 3.4 |
| SS 207 | N/A | SM | SM | 0/33/67 | 33/45/22 | 5.67 | 2.50 | 0.53 | 0.90 | 60.0 | 6.9 |
| SS 208 | N/A | SM | SM | 0/28/72 | 28/41/31 | 6.67 | 3.34 | 0.49 | 0.80 | 55.3 | 6.4 |
| SS 209 | N/A | GM | | 14/32/54 | | 4.82 | 4.07 | 0.00 | 1.20 | 42.7 | 3.7 |
| SS 210 | N/A | SM | SM | 0/46/54 | 46/31/23 | 5.63 | 3.24 | 0.64 | 0.97 | 51.3 | 6.7 |
| SS 211 | N/A | SG | | 74/25/1 | | -2.87 | 2.52 | 0.72 | 0.80 | 27.4 | 0.4 |
| SS 211A | N/A | SG | | 51/47/2 | | -1.23 | 2.43 | -0.04 | 0.49 | 25.1 | 0.7 |
| SS 212 | N/A | SM | SM | 0/38/62 | 37/35/28 | 6.17 | 3.37 | 0.43 | 0.86 | 58.0 | 6.5 |
| SS 213 | N/A | SG | | 74/24/2 | | -2.73 | 2.50 | 0.56 | 0.76 | 33.8 | 1.8 |
| SS 214 | N/A | MSG | | 33/37/30 | | 1.97 | 5.41 | 0.18 | 0.92 | 40.6 | 5.1 |
| SS 215 | N/A | SM | SM | 0/35/65 | 35/35/30 | 6.33 | 3.44 | 0.46 | 0.80 | 53.2 | 8.3 |
| SS 216 | N/A | SM | SM | 2/33/65 | 35/40/25 | 5.73 | 3.11 | 0.47 | 0.98 | 56.6 | 7.5 |
| SS 217 | N/A | GMS | | 10/72/18 | | 2.77 | 2.92 | 0.10 | 3.07 | 42.2 | 3.3 |
| SS 218 | N/A | SG | | 51/49/0 | | -0.97 | 2.47 | 0.01 | 0.69 | 14.8 | 0.9 |
| SS 219 | N/A | SG | | 50/48/2 | | -1.17 | 2.49 | -0.06 | 0.58 | 17.6 | 0.6 |
| SS 220 | N/A | G | | 84/16/0 | | -3.67 | 2.15 | 0.91 | 1.29 | 14.4 | 1.1 |
| SS 221 | N/A | G | | 83/17/0 | | -2.70 | 2.00 | 0.63 | 1.13 | 12.3 | 0.6 |
| SS 223 | N/A | MSG | | 47/47/6 | | -0.17 | 2.74 | 0.31 | 0.73 | 22.5 | 1.2 |
| SS 224 | N/A | SG | | 34/66/0 | | -0.17 | 2.51 | -0.53 | 0.73 | 21.9 | 1.1 |
| SS 226 | N/A | GS | | 16/79/5 | | 1.63 | 2.35 | -0.60 | 3.83 | 24.7 | 1.0 |
| SS 227 | N/A | GS | | 10/86/4 | | 1.78 | 1.68 | -0.33 | 2.33 | 25.6 | 3.1 |
| SS 228 | N/A | SG | | 55/44/1 | | -1.83 | 2.78 | 0.18 | 0.52 | 19.9 | 0.4 |
| SS 229 | N/A | GS | | 24/76/0 | | 0.27 | 1.89 | -0.60 | 0.91 | 25.1 | 1.0 |
| SS 250 | N/A | SM | SM | 2/13/85 | 15/57/28 | 6.40 | 2.61 | 0.24 | 0.97 | 45.8 | 6.6 |
| SS 251 | N/A | SM | SSL | 1/44/55 | 45/39/16 | 5.13 | 2.26 | 0.55 | 1.25 | 38.1 | 3.8 |
| SS 252 | N/A | MS | SLS | 4/57/39 | 61/29/10 | 4.60 | 2.60 | 0.32 | 1.54 | 31.3 | 2.8 |
| SS 253 | N/A | G | | | | | | | | | |
| SS 254 | N/A | G | | 83/15/2 | | -2.50 | 1.48 | 0.40 | 0.98 | 25.5 | 1.0 |
| SS 255 | N/A | SM | SM | 0/16/84 | 16/54/30 | 6.83 | 3.18 | 0.49 | 0.89 | 48.4 | 6.7 |
| SS 256 | N/A | M | M | 0/7/93 | 7/56/37 | 7.57 | 3.15 | 0.37 | 0.80 | 46.2 | 5.8 |
| SS 257 | N/A | SM | SM | 0/20/80 | 20/50/30 | 6.33 | 2.54 | 0.36 | 0.70 | 46.7 | 5.7 |
| SS 258 | N/A | SM | SS | 3/15/82 | 17/66/17 | 6.32 | 2.10 | -0.46 | 0.99 | 53.5 | 6.7 |
| SS 259 | N/A | SM | SSL | 2/36/62 | 38/44/18 | 5.37 | 2.41 | 0.30 | 0.86 | 47.3 | 5.3 |
| SS 260 | N/A | SM | SM | 0/31/69 | 31/42/27 | 6.33 | 3.23 | 0.63 | 0.88 | 46.3 | 5.3 |
| SS 261 | N/A | SM | SM | 2/42/56 | 44/35/21 | 5.37 | 2.28 | 0.50 | 0.80 | 45.2 | 4.7 |
| SS 262 | N/A | MS | MS | 0/74/26 | 74/15/11 | 3.97 | 2.25 | 0.75 | 2.61 | 32.3 | 2.5 |
| SS 263 | N/A | SM | SSL | 1/21/78 | 22/74/4 | 5.70 | 1.74 | -0.19 | 0.67 | 47.2 | 5.1 |
| SS 264 | N/A | M | M | 0/9/91 | 9/57/34 | 7.23 | 3.16 | 0.45 | 0.81 | 55.0 | 6.4 |
| SS 265 | N/A | SG | | 44/50/6 | | -0.43 | 2.59 | 0.16 | 1.00 | 27.3 | 0.6 |
| SS 266 | N/A | SM | SM | 0/20/80 | 20/50/30 | 6.80 | 3.19 | 0.49 | 0.83 | 49.7 | 6.6 |
| SS 267 | N/A | SM | SM | 2/29/69 | 31/45/24 | 5.67 | 2.52 | 0.13 | 0.82 | 50.1 | 5.9 |
| | | | | | | | | | | | |
| PH SERIES | | | | | | | | | | | |
| PH 1 | 1E+05 | MS | MS | 00/85/15 | 85/10/05 | 3.33 | 1.28 | 0.56 | 5.33 | 32.0 | 2.0 |
| PH 1 | 1E+05 | MS | MS | 00/85/15 | 85/09/06 | 3.37 | 1.16 | 0.47 | 4.92 | 31.0 | 2.0 |
| PH 1 | 1E+05 | MS | MS | 00/87/13 | 87/08/05 | 3.23 | 1.09 | 0.40 | 3.69 | 37.0 | 2.0 |
| PH 1 | 1E+05 | MS | MS | 00/87/13 | 87/08/05 | 3.33 | 1.28 | 0.42 | 5.41 | 27.0 | 2.0 |
| PH 2 | 1E+05 | SM | SM | 00/25/75 | 25/46/29 | 6.60 | 3.22 | 0.53 | 0.80 | 61.0 | 7.0 |

# APPENDIX 2. TEXTURE OF SURFICIAL SEDIMENT SAMPLES

| STATION | ID | CLASSIFICATION G/S/M | S/S/C | %GSM | %SSC | MEAN | SORT. | SKEW. | KURT. | % MOIST | % LOI |
|---|---|---|---|---|---|---|---|---|---|---|---|
| PH 2 | 1E+05 | SM | SM | 00/23/77 | 23/46/31 | 6.63 | 3.23 | 0.43 | 0.80 | 63.0 | 7.0 |
| PH 2 | 1E+05 | SM | SM | 00/33/67 | 33/41/26 | 6.10 | 3.16 | 0.61 | 0.89 | 56.0 | 6.0 |
| PH 2 | 1E+05 | SM | SM | 00/27/73 | 27/46/27 | 6.33 | 3.14 | 0.57 | 0.86 | 61.0 | 7.0 |
| PH 3 | 1E+05 | SM | SM | 00/48/52 | 48/34/18 | 5.50 | 2.86 | 0.68 | 1.39 | 51.0 | 5.0 |
| PH 3 | 1E+05 | SM | SSLT | 00/47/53 | 47/37/16 | 5.23 | 2.76 | 0.62 | 1.50 | 52.0 | 5.0 |
| PH 3 | 1E+05 | MS | MS | 00/55/45 | 55/29/16 | 4.90 | 2.77 | 0.62 | 1.71 | 49.0 | 4.0 |
| PH 3 | 1E+05 | SM | SSLT | 00/41/59 | 41/41/18 | 5.30 | 2.74 | 0.63 | 1.39 | 54.0 | 6.0 |
| PH 4 | 1E+05 | M | M | 00/07/93 | 07/51/42 | 7.77 | 3.10 | 0.33 | 0.73 | 66.0 | 8.0 |
| PH 4 | 1E+05 | M | M | 00/06/94 | 06/51/43 | 7.97 | 3.14 | 0.27 | 0.73 | 71.0 | 8.0 |
| PH 4 | 1E+05 | M | M | 00/09/91 | 09/42/49 | 8.40 | 3.17 | 0.13 | 0.73 | 67.0 | 9.0 |
| PH 4 | 1E+05 | M | M | 00/07/93 | 07/46/47 | 8.10 | 3.12 | 0.16 | 0.79 | 68.0 | 8.0 |
| PH 5 | 1E+05 | SM | SM | 00/12/88 | 12/45/43 | 7.83 | 3.27 | 0.23 | 0.76 | 71.0 | 8.0 |
| PH 5 | 1E+05 | M | M | 00/08/92 | 08/51/41 | 7.70 | 3.18 | 0.30 | 0.71 | 68.0 | 9.0 |
| PH 5 | 1E+05 | M | M | 00/08/92 | 08/51/41 | 7.67 | 3.18 | 0.33 | 0.72 | 70.0 | 9.0 |
| PH 5 | 1E+05 | M | M | 00/07/93 | 07/51/42 | 7.73 | 3.17 | 0.31 | 0.73 | 69.0 | 9.0 |
| PH 6 | 1E+05 | M | M | 00/06/94 | 06/52/42 | 7.90 | 3.11 | 0.26 | 0.78 | 67.0 | 8.0 |
| PH 6 | 1E+05 | M | M | 00/07/93 | 07/54/39 | 7.63 | 3.14 | 0.40 | 0.74 | 67.0 | 8.0 |
| PH 6 | 1E+05 | M | M | 00/05/95 | 05/49/46 | 8.23 | 3.06 | 0.22 | 0.74 | 67.0 | 8.0 |
| PH 6 | 1E+05 | M | M | 00/06/94 | 06/53/41 | 7.80 | 3.12 | 0.30 | 0.74 | 68.0 | 8.0 |
| PH 7 | 1E+05 | M | M | 00/07/93 | 07/50/43 | 7.83 | 3.22 | 0.29 | 0.71 | 66.0 | 9.0 |
| PH 7 | 1E+05 | M | M | 00/07/93 | 07/49/44 | 7.93 | 3.16 | 0.23 | 0.73 | 70.0 | 9.0 |
| PH 7 | 1E+05 | M | M | 00/07/93 | 07/51/42 | 7.87 | 3.09 | 0.29 | 0.74 | 69.0 | 9.0 |
| PH 7 | 1E+05 | M | M | 00/07/93 | 07/51/42 | 7.77 | 3.12 | 0.33 | 0.74 | 67.0 | 9.0 |
| PH 8 | 1E+05 | M | M | 00/07/93 | 07/52/41 | 7.73 | 3.13 | 0.35 | 0.76 | 62.0 | 9.0 |
| PH 8 | 1E+05 | M | M | 00/06/94 | 06/50/44 | 7.93 | 3.08 | 0.27 | 0.79 | 64.0 | 9.0 |
| PH 8 | 1E+05 | M | M | 00/06/94 | 06/53/41 | 7.77 | 3.09 | 0.30 | 0.75 | 64.0 | 9.0 |
| PH 8 | 1E+05 | M | M | 00/08/92 |  | 7.50 | 3.06 | 0.37 | 0.81 | 62.0 | 9.0 |
| PH 9 | 1E+05 | GMS |  | 08/52/40 |  | 4.50 | 3.95 | 0.40 | 1.30 | 47.0 | 4.0 |
| PH 9 | 1E+05 | MS | MS | 00/58/42 | 58/22/20 | 4.83 | 3.89 | 0.48 | 1.29 | 50.0 | 5.0 |
| PH 9 | 1E+05 | MS | MS | 00/69/31 | 69/17/14 | 4.00 | 3.23 | 0.53 | 1.74 | 38.0 | 4.0 |
| PH 9 | 1E+05 | MS | MS | 00/72/28 | 72/15/13 | 3.80 | 3.20 | 0.48 | 2.27 | 34.0 | 4.0 |
| PH 10 | 1E+05 | SM | SM | 00/29/71 | 29/37/34 | 6.73 | 3.52 | 0.34 | 0.78 | 60.0 | 8.0 |
| PH 10 | 1E+05 | SM | SM | 00/31/69 | 31/38/31 | 6.47 | 3.40 | 0.48 | 0.77 | 53.0 | 7.0 |
| PH 10 | 1E+05 | SM | SM | 00/25/75 | 25/38/37 | 7.00 | 3.53 | 0.26 | 0.76 | 60.0 | 8.0 |
| PH 10 | 1E+05 | SM | SM, | 00/26/74 | 26/39/35 | 6.83 | 3.48 | 0.32 | 0.79 | 57.0 | 7.0 |
| PH 11 | 1E+05 | MS | MS | 00/66/34 | 66/20/14 | 4.37 | 2.62 | 0.72 | 1.81 | 43.0 | 5.0 |
| PH 11 | 1E+05 | GMS |  | 17/54/29 |  | 2.40 | 4.44 | -0.04 | 2.81 | 39.0 | 4.0 |
| PH 11 | 1E+05 | MS | MS | 00/75/25 | 75/15/10 | 3.70 | 2.03 | 0.65 | 2.37 | 32.0 | 3.0 |
| PH 11 | 1E+05 | MS | MS | 00/68/32 | 68/19/13 | 4.13 | 2.32 | 0.74 | 2.22 | 35.0 | 4.0 |
| PH 12 | 1E+05 | MS | MS | 00/73/27 | 73/17/10 | 3.80 | 2.29 | 0.59 | 2.29 | 31.0 | 3.0 |
| PH 12 | 1E+05 | MS | MS | 00/75/25 | 75/15/10 | 3.77 | 2.26 | 0.65 | 2.72 | 27.0 | 3.0 |
| PH 12 | 1E+05 | MS | MS | 00/66/34 | 66/20/14 | 4.43 | 2.67 | 0.72 | 1.99 | 35.0 | 4.0 |
| PH 12 | 1E+05 | MS | MS | 00/64/36 | 64/22/14 | 4.40 | 2.77 | 0.65 | 1.86 | 33.0 | 4.0 |
| PH 13 | 1E+05 | SM | SM | 00/32/68 | 32/38/30 | 6.27 | 3.27 | 0.45 | 0.84 | 65.0 | 9.0 |
| PH 13 | 1E+05 | SM | SM | 00/16/84 | 16/44/40 | 7.43 | 3.27 | 0.24 | 0.80 | 68.0 | 13.0 |
| PH 13 | 1E+05 | SM | SM | 00/13/87 | 13/44/43 | 7.60 | 3.18 | 0.17 | 0.82 | 77.0 | 11.0 |
| PH 13 | 1E+05 | SM | SM | 00/36/64 | 36/38/26 | 6.30 | 3.13 | 0.38 | 0.70 | 49.0 | 6.0 |
| PH 14 | 1E+05 | MS | MS | 00/81/19 | 81/12/07 | 3.20 | 1.97 | 0.38 | 3.85 | 27.0 | 2.0 |
| PH 14 | 1E+05 | MS | MS | 00/80/20 | 80/12/08 | 3.30 | 2.05 | 0.34 | 3.69 | 28.0 | 2.0 |
| PH 14 | 1E+05 | MS | MS | 00/86/14 | 86/09/05 | 3.10 | 1.31 | 0.41 | 2.82 | 27.0 | 2.0 |
| PH 14 | 1E+05 | MS | MS | 00/93/07 | 93/05/02 | 2.80 | 0.74 | 0.16 | 1.49 | 25.0 | 1.0 |
| PH 15 | 1E+05 | SM | SM | 00/41/59 | 41/35/24 | 5.63 | 3.12 | 0.51 | 0.97 | 54.0 | 6.0 |
| PH 15 | 1E+05 | SM | SM | 00/41/59 | 41/34/25 | 5.93 | 3.32 | 0.61 | 0.93 | 52.0 | 6.0 |
| PH 15 | 1E+05 | SM | SM | 00/42/58 | 42/35/23 | 5.55 | 3.05 | 0.58 | 1.00 | 45.0 | 6.0 |
| PH 15 | 1E+05 | SM | SM | 00/40/60 | 40/35/25 | 5.80 | 3.18 | 0.56 | 0.90 | 45.0 | 6.0 |
| PH 16 | 1E+05 | MS | MS | 00/86/14 | 86/08/06 | 3.10 | 1.41 | 0.44 | 3.10 | 26.0 | 2.0 |
| PH 16 | 1E+05 | MS | MS | 00/73/27 | 73/16/11 | 3.77 | 2.19 | 0.71 | 2.23 | 26.0 | 2.0 |
| PH 16 | 1E+05 | S | S | 00/91/09 | 91/06/03 | 2.87 | 0.82 | 0.32 | 1.55 | 23.0 | 1.0 |
| PH 16 | 1E+05 | MS | MS | 00/85/15 | 85/11/04 | 3.13 | 1.12 | 0.47 | 2.32 | 24.0 | 2.0 |

## APPENDIX 2. TEXTURE OF SURFICIAL SEDIMENT SAMPLES

| STATION | ID | CLASSIFICATION G/S/M | S/S/C | %GSM | %SSC | MEAN | SORT. | SKEW. | KURT. | % MOIST | % LOI |
|---|---|---|---|---|---|---|---|---|---|---|---|
| PH 17 | 1E+05 | MS | MS | 00/53/47 | 53/30/17 | 5.03 | 2.88 | 0.64 | 1.30 | 40.0 | 4.0 |
| PH 17 | 1E+05 | MS | MS | 00/57/43 | 57/27/16 | 4.80 | 2.84 | 0.65 | 1.58 | 38.0 | 4.0 |
| PH 17 | 1E+05 | SM | SM | 00/46/54 | 46/32/22 | 5.50 | 3.18 | 0.57 | 0.99 | 44.0 | 5.0 |
| PH 17 | 1E+05 | SM | SM | 00/47/53 | 47/30/23 | 5.60 | 3.25 | 0.63 | 0.95 | 45.0 | 4.0 |
| PH 18 | 1E+05 | GMS | | 15/48/37 | | 3.17 | 4.11 | 0.23 | 0.99 | 41.0 | 6.0 |
| PH 18 | 1E+05 | MSG | | 41/51/08 | | -0.40 | 2.40 | 0.31 | 1.35 | 18.0 | 2.0 |
| PH 18 | 1E+05 | GMS | | 26/53/21 | | 1.00 | 4.61 | 0.02 | 1.36 | 40.0 | 10.0 |
| PH 18 | 1E+05 | GMS | | 27/41/32 | | 2.23 | 4.23 | 0.07 | 0.81 | 30.0 | 4.0 |
| PH 19 | 1E+05 | SM | SM | 00/33/67 | 33/45/22 | 6.00 | 3.13 | 0.60 | 1.04 | 57.0 | 7.0 |
| PH 19 | 1E+05 | SM | SM | 00/35/65 | 35/42/23 | 6.00 | 3.14 | 0.60 | 0.95 | 59.0 | 7.0 |
| PH 19 | 1E+05 | SM | SM | 00/49/51 | 49/34/17 | 5.20 | 2.79 | 0.64 | 1.59 | 46.0 | 5.0 |
| PH 19 | 1E+05 | SM | SM | 00/50/50 | 50/33/17 | 5.10 | 2.37 | 0.62 | 1.09 | 42.0 | 5.0 |
| PH 20 | 1E+05 | GMS | | 08/64/28 | | 3.67 | 2.76 | 0.21 | 3.28 | 28.0 | 2.0 |
| PH 20 | 1E+05 | MS | MS | 00/60/40 | 60/26/14 | 4.83 | 2.69 | 0.67 | 1.50 | 32.0 | 3.0 |
| PH 20 | 1E+05 | MS | MS | 00/70/30 | 70/20/10 | 3.83 | 2.01 | 0.57 | 2.32 | 32.0 | 3.0 |
| PH 20 | 1E+05 | MS | MS | 00/63/37 | 63/25/12 | 4.30 | 3.06 | 0.38 | 2.29 | 35.0 | 3.0 |
| PH 21 | 1E+05 | MS | MS | 00/58/42 | 58/30/12 | 4.63 | 2.31 | 0.67 | 1.37 | 39.0 | 4.0 |
| PH 21 | 1E+05 | MS | MS | 00/52/48 | 52/29/19 | 5.30 | 2.99 | 0.76 | 1.10 | 40.0 | 4.0 |
| PH 21 | 1E+05 | MS | MS | 00/56/44 | 56/27/17 | 5.07 | 2.85 | 0.79 | 1.41 | 39.0 | 4.0 |
| PH 21 | 1E+05 | MS | MS | 00/53/47 | 53/28/19 | 5.30 | 2.93 | 0.73 | 1.26 | 42.0 | 4.0 |
| | | | | | | | | | | | |
| **YR SERIES** | | | | | | | | | | | |
| YR 22 | 1E+05 | S | S | 00/94/06 | 94/04/02 | 2.43 | 1.17 | -0.34 | 2.87 | 38.0 | 2.0 |
| YR 22 | 1E+05 | S | S | 00/94/06 | 94/03/03 | 2.63 | 0.80 | 0.05 | 2.25 | 24.0 | 1.0 |
| YR 22 | 1E+05 | GS | | 07/86/07 | | 2.53 | 1.59 | -0.32 | 4.68 | 23.0 | 1.0 |
| YR 22 | 1E+05 | GS | | 10/85/05 | | 2.13 | 1.76 | -0.47 | 3.48 | 32.0 | 1.0 |
| YR 23 | 1E+05 | S | S | 00/92/08 | 92/05/03 | 2.90 | 0.75 | 0.56 | 5.19 | 22.0 | 1.0 |
| YR 23 | 1E+05 | S | S | 00/98/02 | 98/01/01 | 2.77 | 0.29 | -0.05 | 1.50 | 28.0 | 1.0 |
| YR 23 | 1E+05 | S | S | 00/98/02 | 98/01/01 | 2.63 | 0.31 | 0.27 | 1.64 | 24.0 | 1.0 |
| YR 23 | 1E+05 | S | S | 00/93/07 | 93/04/03 | 2.73 | 0.59 | 0.44 | 4.23 | 27.0 | 1.0 |
| | | | | | | | | | | | |
| **NHPA SERIES** | | | | | | | | | | | |
| NHPA 1 | N/A | MS | SLS | 0/89/11 | 89/8/3 | 3.18 | 0.99 | 0.43 | 2.81 | 30.4 | 2.3 |
| NHPA 2 | N/A | M | M | 0/8/92 | 8/61/31 | 7.13 | 3.06 | 0.51 | 0.91 | 51.0 | 6.9 |
| NHPA 3 | N/A | SM | SM | 3/27/70 | 30/38/32 | 6.13 | 3.01 | 0.01 | 0.82 | 53.5 | 7.1 |
| NHPA 4 | N/A | SM | SM | 0/36/64 | 36/36/28 | 6.13 | 3.30 | 0.49 | 0.85 | 54.7 | 6.5 |
| NHPA 5 | N/A | MS | MS/SS | 0/64/36 | 64/25/11 | 4.23 | 2.07 | 0.62 | 2.38 | 39.9 | 4.3 |
| NHPA 6 | N/A | MS | MS | 0/58/42 | 58/28/14 | 4.67 | 2.43 | 0.72 | 2.24 | 41.2 | 4.1 |
| NHPA 7 | N/A | GS | | 17/76/7 | | 1.17 | 2.23 | -0.29 | 1.66 | 22.1 | 1.2 |
| NHPA 8 | N/A | S | MS | 1/86/13 | 87/7/6 | 2.57 | 1.63 | 0.58 | 2.91 | 34.6 | 1.8 |
| NHPA 9 | N/A | S | S | 4/90/6 | 94/4/2 | 1.93 | 1.24 | 0.01 | 1.93 | 26.9 | 1.1 |
| NHPA 10 | N/A | MS | MS | 2/82/16 | 84/10/6 | 3.10 | 1.77 | 0.24 | 3.57 | 24.4 | 1.3 |
| NHPA 11 | N/A | MS | MS | 0/89/11 | 89/7/4 | 2.67 | 1.12 | 0.48 | 2.51 | 29.5 | 1.2 |
| NHPA 12 | N/A | MS | MS | 2/80/18 | 82/12/6 | 3.20 | 1.73 | 0.29 | 3.09 | 33.1 | 2.1 |
| NHPA 13 | N/A | GMS | | 25/63/12 | | 0.88 | 3.63 | -0.49 | 1.07 | 23.9 | 1.5 |
| NHPA 14 | N/A | SM | SSLT | 0/46/54 | 46/40/14 | 4.90 | 2.57 | 0.59 | 2.21 | 37.0 | 3.4 |
| NHPA 15 | N/A | MS | MS | 2/59/39 | 61/26/13 | 4.40 | 2.58 | 0.59 | 2.01 | 40.7 | 3.7 |
| NHPA 16 | N/A | M/SM | M/SM | 0/10/90 | 10/56/34 | 7.08 | 2.76 | 0.22 | 1.01 | 62.1 | 7.9 |
| | | | | | | | | | | | |
| **MS SERIES** | | | | | | | | | | | |
| MS 1 | N/A | M | M | 00/06/94 | 06/41/53 | 8.58 | 2.94 | 0.11 | 0.89 | 73.1* | 20.1* |
| MS 2 | N/A | M | M | 00/07/93 | 07/53/40 | 7.77 | 2.95 | 0.21 | 0.96 | 78.8 | 42.6 |
| MS 3 | N/A | M | M | 00/05/95 | 05/49/46 | 8.17 | 2.90 | 0.22 | 0.81 | 74.7 | 28.6 |
| MS 4 | N/A | GMS | | 23/44/33 | | 2.20 | 4.50 | 0.05 | 1.08 | 55.9 | 18.7 |
| MS 5 | N/A | GMS | | 27/55/18 | | 1.33 | 3.92 | 0.01 | 1.13 | 47.3 | 10.8 |
| MS 6 | N/A | SM | SSLT | 00/22/78 | 22/60/18 | 5.72 | 2.69 | 0.51 | 1.36 | 68.5 | 32.0 |
| MS 7 | N/A | SM | SSLT | 00/38/62 | 38/45/17 | 5.27 | 2.44 | 0.32 | 1.03 | 71.8 | 28.4 |
| MS 9 | N/A | SM | SM | 00/14/86 | 14/50/36 | 7.18 | 3.25 | 0.29 | 0.87 | 58.7 | 17.8 |
| MS 10 | N/A | MSG/GMS | | 30/52/18 | | 0.60 | 3.70 | 0.15 | 1.43 | 43.8 | 9.1 |

## APPENDIX 2. TEXTURE OF SURFICIAL SEDIMENT SAMPLES

| STATION | ID | CLASSIFICATION | | %GSM | %SSC | MEAN | SORT. | SKEW. | KURT. | % MOIST | % LOI |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | G/S/M | S/S/C | | | | | | | | |
| MS 11 | N/A | SM | SSLT | 00/36/64 | 36/45/19 | 5.42 | 2.78 | 0.30 | 1.04 | 68.7 | 24.9 |
| MS 12 | N/A | MSG/GMS | | 30/42/28 | | 1.60 | 4.42 | 0.12 | 0.96 | 47.3 | 18.5 |
| MS 13 | N/A | GM | | 07/24/69 | | 5.75 | 4.29 | -0.03 | 1.13 | 73.4 | 38.0 |

* THE % MOISTURE AND % LOI WAS NOT MEASURED ON A SPLIT OF THE SAMPLE USED FOR THE GRAIN SIZE ANALYSIS. THE VALUES ARE THE MEANS FOR THE MOIST/LOI MEASURED AT SEVERAL DEPTHS DOWN THE CORE THE GRAIN SIZE SAMPLE CAME FROM. THE AVERAGE SHOULD BE REPRESENTATIVE THOUGH.