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Department of Environmental Conservation

Norton Basin/Little Bay
Baseline Data Collection - 2002

Fisheries, Benthic Communities, and Sediment Profile Image Analysis

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EXECUTIVE SUMMARY

The New York State Department of Environmental Conservation (NYSDEC), in partnership with the Port Authority of New York/New Jersey (PANY/NJ), is evaluating the ecological condition of borrow pits in Norton Basin and Little Bay, Far Rockaway, NY. Borrow pits, and the dead-end basins in which they commonly occur are often severely degraded because of restricted tidal circulation, which results in seasonal stratification of the water column and poor water quality. In some cases, hypoxic or anoxic water masses may be present year-round within borrow pits.

The Norton Basin and Little Bay study areas are located on the north shore of the Rockaway Peninsula, in Queens, NY. These embayments are located southeast and south of the Edgemere Landfill, respectively. There are several 45 to 65 ft deep borrow pits in the Norton Basin/Little Bay complex. Baseline studies in Norton Basin and Little Bay were conducted along with studies at two reference areas in Jamaica Bay (Grass Hassock Channel and the Raunt).

Benthic macroinvertebrate surveys of the study and reference areas were conducted during June and October 2002. Fifteen sampling stations were located in Norton Basin and nine sampling stations were located in Little Bay. Three sampling stations were located in both the Grass Hassock Channel and the Raunt reference areas. Benthic macroinvertebrate density, biomass, and taxonomic composition were measured and compared among depth strata and study/reference areas.

Fish and macrocrustacean assemblages were surveyed during May, June, and August 2002. Experimental gill nets were deployed overnight in borrow pits and reference areas. Trawl surveys were conducted in Norton Basin, the Raunt, and Grass Hassock Channel. Trawling was not conducted in Little Bay because of the presence of numerous submerged wrecks and other large debris, as documented in bathymetric surveys conducted by the U.S. Army Corps of Engineers, New York District (USACE-NYD) in 2000.

Fine-scale characterization of benthic habitats within the study and reference areas was performed during May 2002 using sediment profile imagery (SPI). Duplicate photographs were taken at the sediment-water interface at each of 100 stations with a Hulcher sediment profile camera. A range of sediment and biotic parameters were measured/estimated and recorded for each station. The SPI images and accompanying data are included on a CD-ROM (**Appendix III-A**).

Benthic macroinvertebrates were virtually absent from the fine, organic, highly aqueous sediments in the Little Bay borrow pit. Arthropods dominated the benthic macroinvertebrate communities of Grass Hassock Channel and the Norton Basin borrow pits during June and October. Annelids were the dominant major taxa in the shallow areas of Norton Basin. Arthropods and annelids were co-dominant major taxa in the Raunt during June; however, arthropods were numerically dominant at this site during October. Molluscs and other invertebrates represented a minor component of the macroinvertebrate community among all sites during both seasons.

Macroinvertebrate densities were significantly lower in the intermediate depths of Little Bay, relative to Grass Hassock Channel or the Raunt. Total abundance of benthic macroinvertebrates was lower in the borrow pits and the intermediate depths of Norton Basin relative to Grass Hassock Channel or the Raunt in both June and October.

May gill net collections in Norton Basin were dominated by striped searobin (*Prionotus evolans*). Most individuals were collected within the deeper strata of the Norton Basin borrow pits. Species composition and richness within Norton Basin was comparable to that of Grass Hassock Channel; however, collections from the Raunt were dominated by decapod crustaceans. Catch per unit effort (CPUE) in surface and bottom strata within Grass Hassock Channel was twice that of equivalent depth strata within Norton Basin during May. CPUE in mid-depth strata within Grass Hassock

Channel was four times greater than that of Norton Basin. CPUE within the Raunt was comparable to that of shallow areas within Norton Basin. Surface CPUE in Little Bay was comparable to that of Norton Basin, and approximately one half of CPUE measured within Grass Hassock Channel. Relatively few fish were collected from mid-water strata in Little Bay during May, and none were collected in the deeper strata of the Little Bay borrow pit.

June gill net collections in Norton Basin were dominated by striped searobin. Most individuals were collected within the deeper strata of the borrow pits. Species composition and richness within Norton Basin was similar to that of Grass Hassock Channel; however, collections from the Raunt were dominated by decapod crustaceans. CPUE from deeper strata within Norton Basin was comparable to equivalent depths within Grass Hassock Channel. CPUE at mid-depth strata within Norton Basin was twice that of equivalent depth strata within Grass Hassock Channel. Surface CPUE within Grass Hassock Channel was more than twice that observed within surface waters of Norton Basin. No fish were collected from surface and mid-water strata in Little Bay, and none were collected at the bottom of the Little Bay borrow pit. CPUE in the Raunt was nearly twice that of shallow water habitats in Norton Basin.

August gill net collections in Norton Basin were dominated by striped searobin, bluefish (*Pomatomus saltatrix*), and Atlantic menhaden (*Brevoortia tyrannus*). Collections from Grass Hassock Channel were dominated by blue crab (*Callinectes sapidus*), weakfish (*Cynoscion regalis*) and Atlantic menhaden. Gill net collections from the Raunt were dominated by blue crab, Atlantic horseshoe crab (*Limulus polyphemus*), and weakfish. Very few fish were collected from surface and mid-water strata within Norton Basin. CPUE was markedly greater at reference areas relative to the Norton Basin and Little Bay pits. CPUE at the bottom of the Norton Basin borrow pits was one-half that of equivalent depth strata in Grass Hassock Channel. CPUE at the shallow water sampling station in Norton Basin was one-fourth that of the Raunt. No fish were collected at the bottom of the Little Bay borrow pit. Very few fish were collected from surface water and intermediate depth strata within Little Bay.

Trawl surveys of Grass Hassock Channel yielded no fish during May and June, and only a few individuals during August. Norton Basin trawl samples were dominated by macrocrustaceans (blue crab and Atlantic horseshoe crab) during May, June, and August. Trawl samples from the Raunt were dominated by Atlantic horseshoe crab in May and lady crab in June. Blue crab and lady crab were the two most abundant species collected in trawl samples from the Raunt during August.

SPI images from Norton Basin exhibited a range of sediment characteristics, depending on depth. Borrow pit sediments were organic fines, while intermediate-depth and entrance channel sediments ranged from silt to fine sand. Entrance channel sediments were primarily sand and shell hash. SPI samples from Little Bay over-penetrated the soft aqueous sediments present therein and did not yield satisfactory images of the sediment-water interface. Gas voids and bacteria mats were characteristic features of SPI images from Little Bay. Grass Hassock Channel sediments ranged from silt to fine sand, and *Ampelisca* mats were present in 90% of SPI images from this area. The dominant sediment type in the Raunt was silt, with fine sand present at stations located near the confluence of the Raunt and Runway Channel. Approximately 75% of the SPI images from the Raunt included *Ampelisca* colonies.

In general, Norton Basin appears to support a more abundant and diverse biota and exhibits greater substrate/habitat heterogeneity in comparison to Little Bay. The borrow pits located in Norton Basin exhibit substrate/habitat characteristics which resemble those of Little Bay; however, sampling locations of intermediate and shallow depths in Norton Basin appear to support habitats and communities which resemble those of intermediate-depth and shallow reference areas in Jamaica Bay.

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ACRONYMS USED IN THIS REPORT

ANOVA – Analysis of Variance

CD-ROM – compact disk-read only memory

CPUE – catch per unit effort

HTML – hypertext markup language

LPIL – lowest practical identification level

mcy – million cubic yards

MLW – mean low water

NPS-GNRA – National Park Service Gateway National Recreation Area

NYC – New York City

NYSDEC – New York State Department of Environmental Conservation

PANY/NJ – Port Authority of New York/New Jersey

RPD – redox potential discontinuity

SNK – Student-Newman-Keuls

SPI – sediment profile imagery

TL – total length

TOC – total organic carbon

USACE-NYD – U.S. Army Corps of Engineers, New York District

1.0 INTRODUCTION

A common environmental problem in urbanized coastal areas is the prevalence of poor water quality and habitat degradation within dead-end canals and basins. Dead-end basins, and particularly dredged areas within these basins, are often severely degraded because of restricted tidal circulation, which results in seasonal stratification of the water column and poor water quality. Chronic water pollution in dead-end basins often stems from decades of unregulated human and industrial waste discharge, both from vessels and from shore facilities. In some cases, hypoxic or anoxic water masses may be present year-round within the deeper waters of dead-end basins. Invertebrate communities of dead-end basins are typically species-poor and dominated by a few opportunistic taxa (e.g., tubificid worms). High concentrations of heavy metals and other industrial contaminants often occur in the sediments of dead -end basins (Hawkins et al. 1992, Maxted et al. 1997).

Norton Basin and Little Bay are two dead-end basins located on the north shore of the eastern Rockaway Peninsula of Jamaica Bay, in the Borough of Queens, New York City (NYC). The basins are drained by a common channel leading into the southeastern edge of Jamaica Bay. Borrow pits were excavated in each of the two basins basin in 1938 during the development of Edgemere Landfill, which constitutes the northwest boundary of Little Bay. Historically, this area was characterized by extensive subtidal estuarine shallows and intertidal salt marsh habitat.

Preliminary biological and hydrographic sampling, conducted by the U.S. Army Corps of Engineers, New York District (USACE-NYD) in 1998-1999, indicated degraded conditions within the study area, particularly in Little Bay. Side slopes of the borrow pits in both basins are nearly vertical, and this basin geometry has apparently resulted in very low rates of tidal circulation within deeper waters. Preliminary benthic grab and sediment profile imagery (SPI) samples from both pits indicated an impoverished benthic community (USACE-NYD, unpublished data). Sediments were highly aqueous/organic and black in color. Additional indicators of poor sediment quality were a high gas void content in SPI samples, a strong odor of hydrogen sulfide, and the presence of chemolithotrophic bacterial mats.

In September 2000, USACE-NYD conducted a pilot site characterization study in Norton Basin, Little Bay, and two reference areas located in Jamaica Bay (Grass Hassock Channel and the Raunt). This study included sediment analyses [grain size, total organic carbon (TOC), % solids], water quality profiles, and a preliminary survey of living resources (fish, macrocrustaceans) using gill nets and trawls (Barry A. Vittor & Associates 2001). A bathymetric survey of the study area and a sea-bed classification of the study and reference areas were also performed during 2000 (C&R Environmental 2001). These surveys were intended to provide preliminary information on the biological and physico-chemical attributes of Norton Basin/Little Bay with comparison to shallow and deep reference locations within Jamaica Bay, and to guide the data collection efforts during Phase I (Baseline Environmental Studies) of the Norton Basin/Little Bay project.

The Phase I Baseline Environmental Study of the Norton Basin/Little Bay project was initiated in 2001 and continued through 2002. Data were gathered to further characterize conditions within the study and reference areas identified in the pilot study. The comprehensive baseline study includes water quality monitoring, hydrodynamic studies, sediment characterization, bioassay/bioaccumulation studies, characterization of benthic macroinvertebrate communities, SPI surveys, and fish surveys. The results of Year 1 of the baseline study (2001) are summarized in Vittor & Associates (2003). We report here on the results of benthic macroinvertebrate community analyses, fish surveys, and a SPI survey conducted by The New York State Department of Environmental Conservation (NYSDEC) during Year 2 of the baseline study (2002).

2.0 STUDY AREA

2.1 Norton Basin

Norton Basin is located east of the Edgemere Landfill. With its three 45 to 50 ft. deep (MLW) borrow pits, the basin has a planar surface area of approximately 55.5 acres, a bottom surface area of approximately 56.9 acres, and a total volume of approximately 2.3 million cubic yards (mcy). The borrow pits have soft, mud substrates, while shallower areas of the basin include sandy substrates. Side-scan sonar surveys conducted in 2000 have revealed at least two 30 - 40 ft. wrecks and extensive debris (i.e., tires, pilings, other structures) on the floor of the basin. There are several small submerged structures along the eastern shore of the basin, which are thought to be smaller boats or automobiles (CR Environmental, Inc. 2001).

2.2 Little Bay

Little Bay is located southeast of the Edgemere Landfill. With its three 60 to 65 ft. deep (MLW) borrow pits, the basin has a planar surface of approximately 24.5 acres, a bottom surface area of approximately 25.2 acres, and a total volume of approximately 1.2 mcy. The borrow pits have soft, mud substrates, while shallower areas of the inlet tend to have sandy substrates. Side-scan sonar surveys detected several 30 - 40 ft. wrecks and extensive debris (i.e., tires, pilings, other structures) on the floor of the basin (CR Environmental, Inc. 2001).

2.3 Reference Areas

Two reference areas (Grass Hassock Channel and the Raunt) located within the National Park Service's Gateway National Recreation Area (NPS-GNRA) were selected for comparison to Norton Basin/Little Bay. These reference areas were intended to provide information on biotic and physico-chemical conditions from both shallow and deep estuarine habitats within Jamaica Bay.

2.3.1 Grass Hassock Channel

Grass Hassock Channel is a wide, 30 – 50 ft. deep tidal channel, which originates at the confluence of Winhole Channel and Beach Channel, northeast of the Cross Bay Boulevard Bridge, and terminates at the Jo-Co Marsh Pit, east of Runway 4L at JFK Airport. The Channel is bounded by Jo-Co Marsh and Silver Hole Marsh to the west and by Conchs Hole Point, the Edgemere Landfill, Norton Basin, and Motts Point to the east. The substrate of Grass Hassock Channel is very patchy, and includes sand/silt, shell/gravel, extensive *Ampelisca* mats, and dense sponge colonies (CR Environmental, Inc. 2001).

2.3.2 The Raunt

The Raunt is a shallow (7 – 25 ft. deep) tidal gut, which originates at the confluence of Runway Channel and Beach Channel, northeast of Rockaway Inlet. The Raunt passes in a northeasterly direction through Little Egg Marsh, Big Egg Marsh, and Yellow Bar Hassock and terminates at Goose Pond Marsh, in the community of Broad Channel, Queens, NY. Bottom sediments in the Raunt are predominantly sands and silts, with seasonally dense mats of sea lettuce (*Ulva lactuca*) and extensive beds of tube-dwelling amphipods (*Ampelisca* spp.) in the upper reaches. The *Ampelisca* mats gradually diminish and the substrate becomes an unoccupied hard sand bottom in the lower reaches of the Raunt (CR Environmental, Inc. 2001).

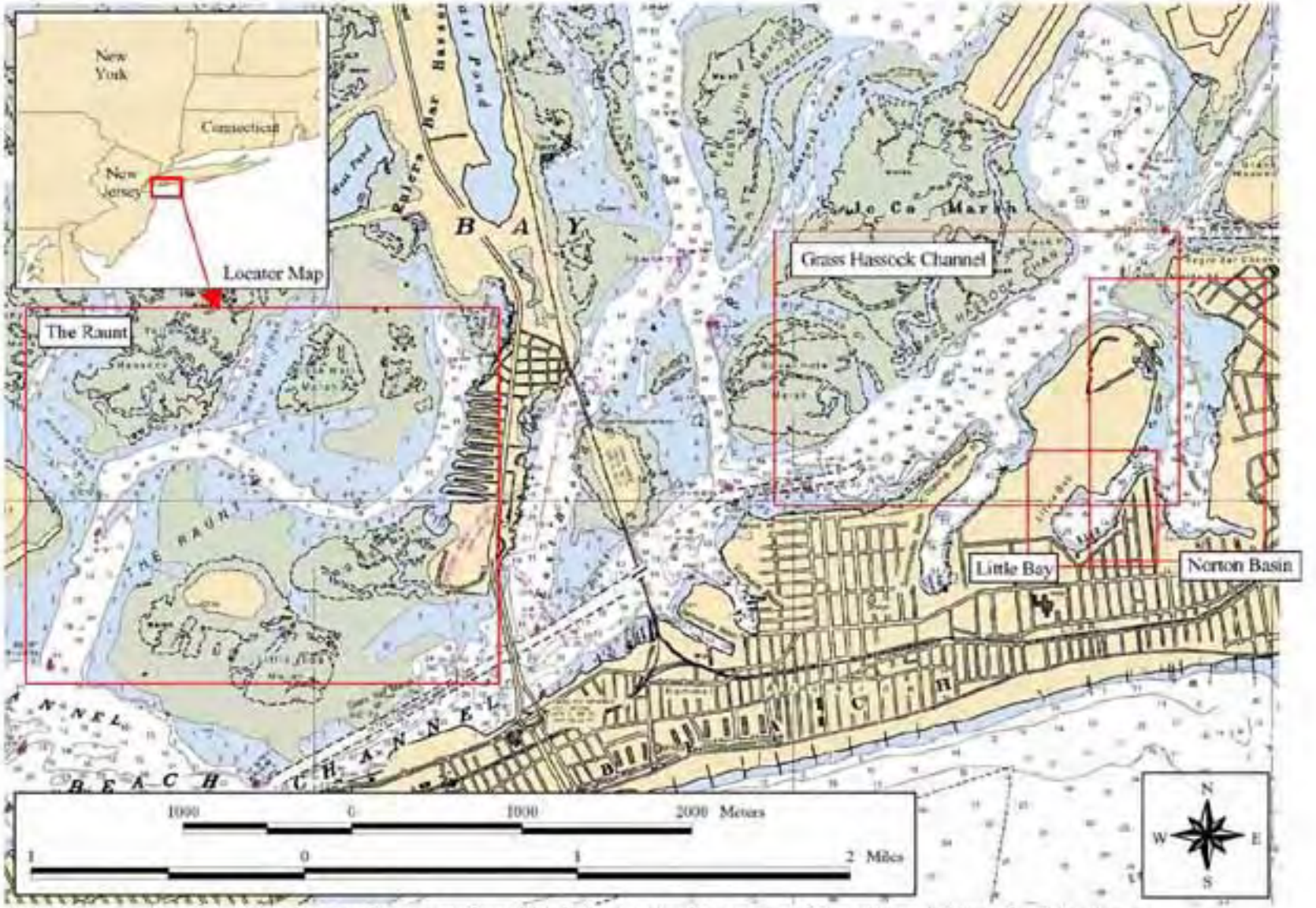

Figure 2.1 Locations of study areas (Norton Basin and Little Bay) and reference areas (Grass Hassock Channel and the Raunt).

3.0 METHODS

3.1 Benthic Macroinvertebrates

A total of 180 samples (three replicate samples from each of 30 sampling stations, X2 collection dates) were collected within the study and reference areas (**Fig. 3.1.1, Table 3.1.1**) using a 0.04m2 Ted Young modified Van Veen grab during June and October 2002. Three sampling sites were located in the Grass Hassock Channel reference area (GH1, GH2, and GH3); three were located in the Raunt reference area (R1, R2, and R3); nine were located in the Little Bay study area (LB1 through LB9); eleven were located in the Norton Basin study area (NB1 through NB11); and four were located in the entrance to Norton Basin (NB12 through NB15). Samples were sieved through a 0.5-mm mesh screen and preserved with a 10% buffered formalin/Rose Bengal solution in the field. Benthic samples were shipped to Barry A. Vittor & Associates, Inc.'s taxonomic laboratory in Mobile, Alabama for analysis.

In the laboratory, macroinvertebrates were identified to the lowest practical identification level (LPIL), which in most cases was to species unless the specimen was unidentifiable (a juvenile, damaged, or unknown). The number of individuals of each taxon, excluding fragments, was recorded. A voucher collection was prepared, composed of representative individuals of each species not previously encountered in samples from this region.

Macroinvertebrate density and biomass were calculated per unit area for each station. Species diversity and community "evenness" were also determined and compared among sampling stations. The data were graphically and statistically analyzed to identify differences in macroinvertebrate density among the study and reference areas. Data were log (y+1) transformed to meet normality assumptions. Transformed abundance data were analyzed using a one-way Analysis of Variance (ANOVA) and post-hoc comparisons were conducted using the Student-Newman-Keuls (SNK) test. Statistical analyses were conducted using the SuperANOVA General Linear Modeling Program for the Macintosh PC (Version 1.11).

3.2 Gill Net Sampling

Experimental gill nets were deployed over a range of tidal conditions to characterize fish use of the proposed study and reference areas. Each gill net measured 125' x 8' in size and contained five panels of 1 in., 1.5 in., 2 in., 3 in., and 4 in. (stretched) monofilament mesh. On May 6-9, June 24-26 and August 12-14, 2002, gill nets were deployed at a total of three deep-water stations (one in the Little Bay borrow pit, one in the larger Norton Basin borrow pit, and one in the Grass Hassock Channel reference area) and four shallow-water stations (one in Little Bay, two in Norton Basin and one in the Raunt reference area) (**Figure 3.2.1, Figure 3.2.2, and Figure 3.2.3**). Six nets were deployed at each of the deep-water stations (two at the surface, two at mid-water, approximately 20-25 feet below the surface, and two along the bottom). Two nets were deployed at the shallow-water stations (bottom only). All fishes and macrocrustaceans collected in gill nets were processed in the field. Captured organisms were identified to species, enumerated, weighed, measured [total length (TL) or carapace width], and released alive, if possible. Catch per unit effort (CPUE) was calculated by dividing fish and macrocrustacean biomass by the number of hours that gill nets were deployed.

3.3 Bottom Trawling

A 16' otter trawl (1 3/8 in. mesh walls, 1 in. mesh cod end) was deployed in the Norton Basin study area and Grass Hassock Channel and the Raunt reference areas. Standard trawling procedures of approximately 4 knots in speed and 10 minute durations were used where possible. Trawl runs within Norton Basin were too short to complete the 10 minute standard duration. While trawl runs within the reference areas were consistent with regards to depth, trawl runs within Norton Basin often covered a mosaic of water depths (i.e., shallow areas and borrow pits). On May 6-9, 2002,

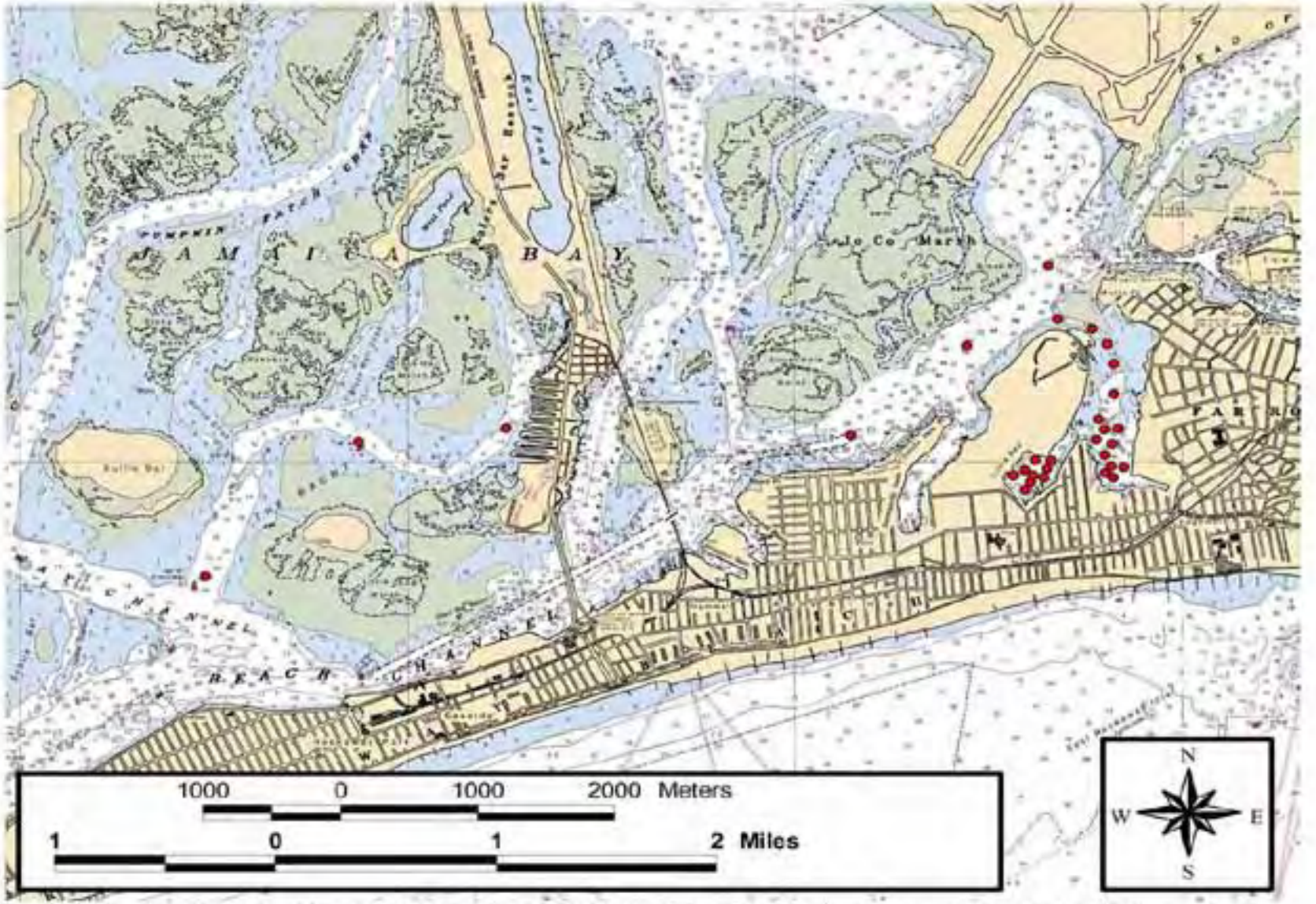

Figure 3.1.1 Locations of benthic grab sampling stations within Norton Basin study and reference areas, June and October 2002.

Table 3.1.1 Benthic sampling station locations (latitude and longitude) and depth, Norton Basin study and reference areas, June and October 2002.

Site	Latitude	Longitude	Depth (ft.)
LB-1	40° 35.8926 '	73° 46.8135 '	32
LB-2	40° 35.9400 '	73° 46.8740 '	40
LB-3	40° 35.9320 '	73° 46.7860 '	50
LB-4	40° 35.9816 '	73° 46.8133 '	44
LB-5	40° 35.9560 '	73° 46.8155 '	64
LB-6	40° 35.9391 '	73° 46.7453 '	50
LB-7	40° 36.0019 '	73° 46.7572 '	30
LB-8	40° 35.9617 '	73° 46.6744 '	50
LB-9	40° 36.0333 '	73° 46.6470 '	31
NB-1	40° 35.9182 '	73° 46.3504 '	26
NB-2	40° 35.9630 '	73° 46.4163 '	29
NB-3	40° 35.9853 '	73° 46.3327 '	30
NB-4	40° 36.0086 '	73° 46.3939 '	45
NB-5	40° 36.0484 '	73° 46.4341 '	29
NB-6	40° 36.0879 '	73° 46.3894 '	32
NB-7	40° 36.1460 '	73° 46.4565 '	29
NB-8	40° 36.1677 '	73° 46.4035 '	45
NB-9	40° 36.2315 '	73° 46.3423 '	20
NB-10	40° 36.2723 '	73° 46.4115 '	23
NB-11	40° 36.4266 '	73° 46.3524 '	43
NB-12	40° 36.4778 '	73° 46.3577 '	18
NB-13	40° 36.5357 '	73° 46.3947 '	15
NB-14	40° 36.5851 '	73° 46.4528 '	13
NB-15	40° 36.6096 '	73° 46.5612 '	10
GH-1	40° 36.2638 '	73° 47.6327 '	23
GH-2	40° 36.7156 '	73° 46.8842 '	49
GH-3	40° 36.2022 '	73° 46.6634 '	26
R-1	40° 35.6329 '	73° 51.0451 '	12
R-2	40° 36.0881 '	73° 50.2277 '	9
R-3	40° 36.2022 '	73° 49.4790 '	10

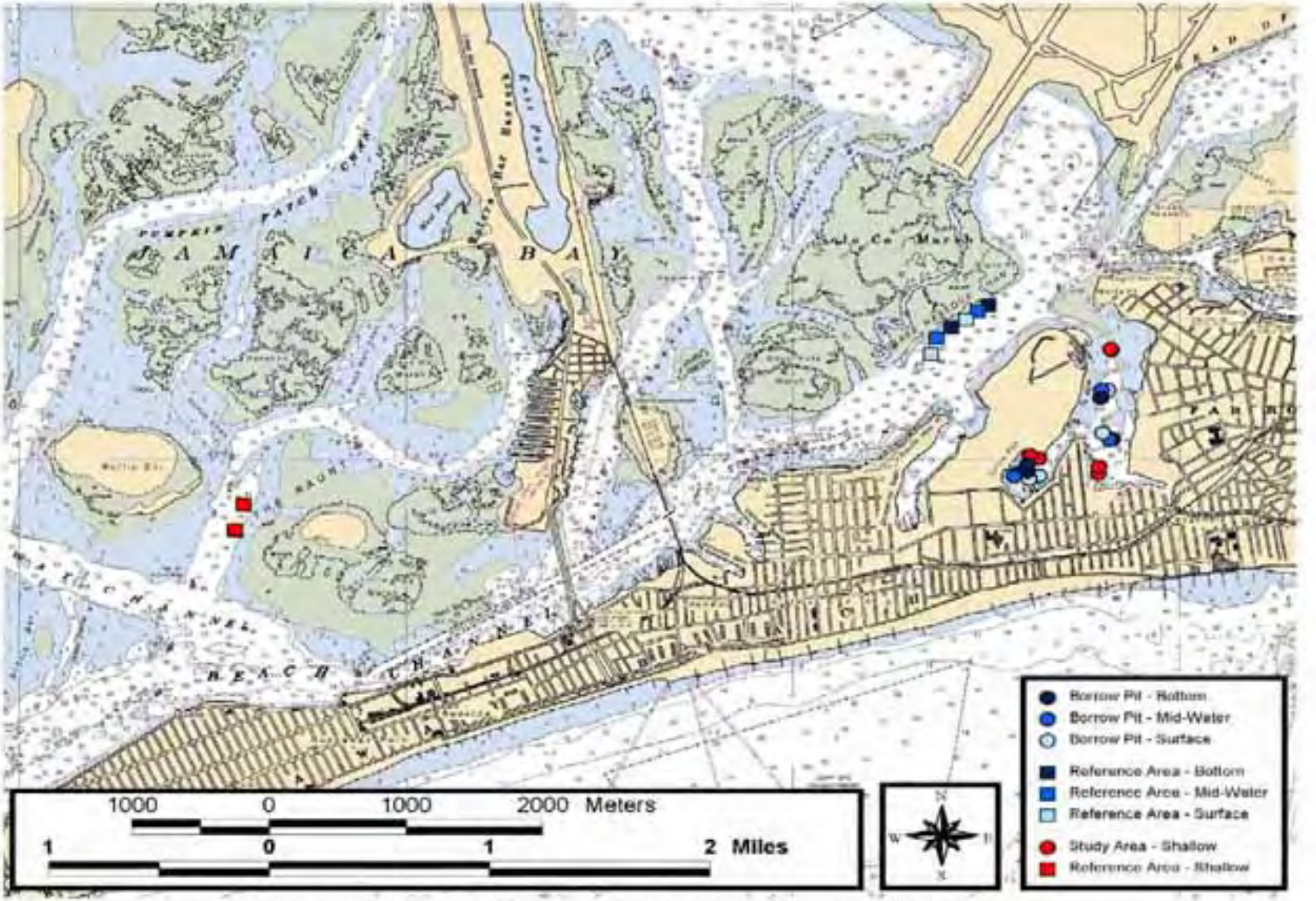

Figure 3.2.1 Locations of gill net sampling stations within Norton Basin study and reference areas, May 2002.

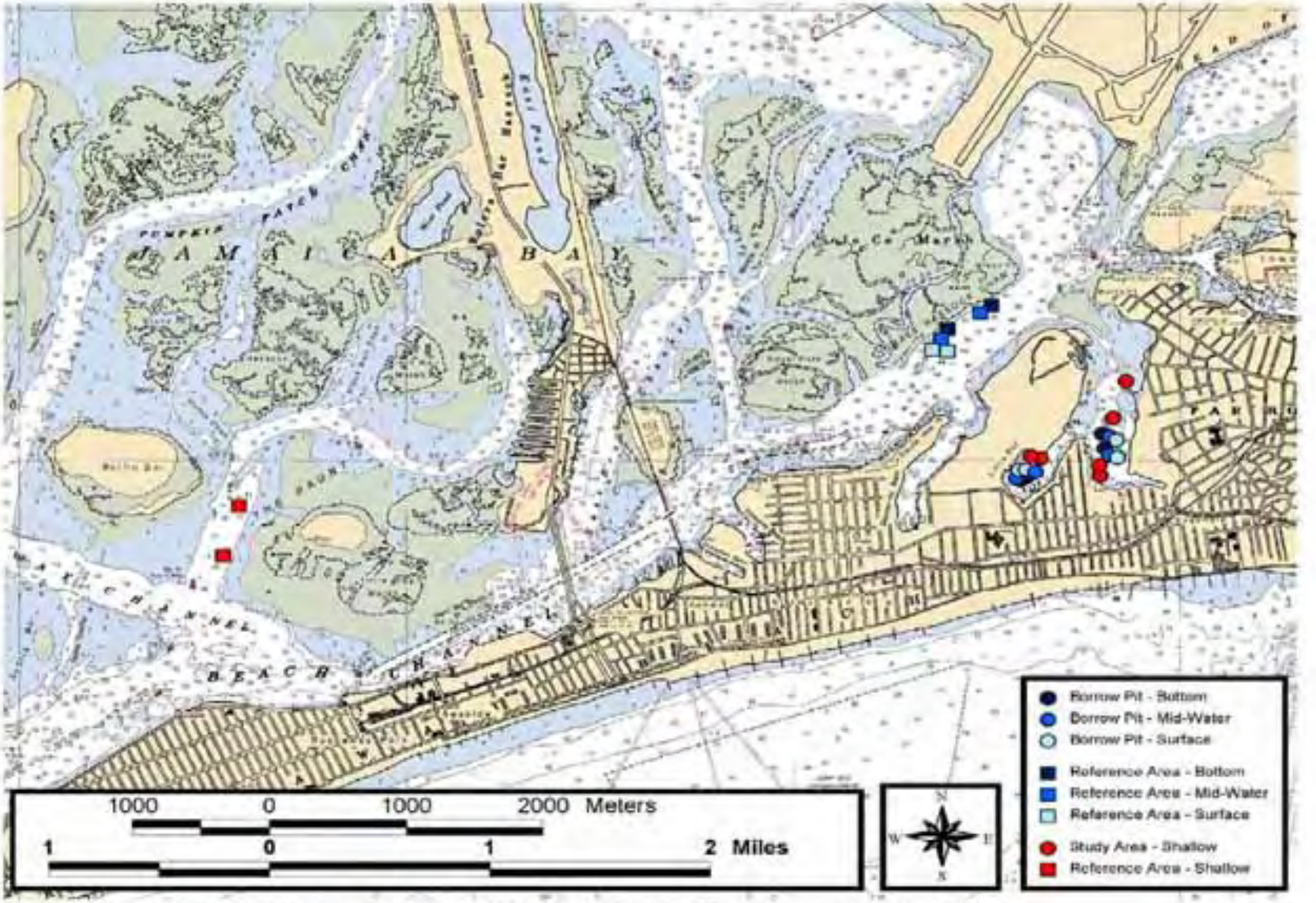

Figure 3.2.2 Locations of gill net sampling stations within Norton Basin study and reference areas, June 2002.

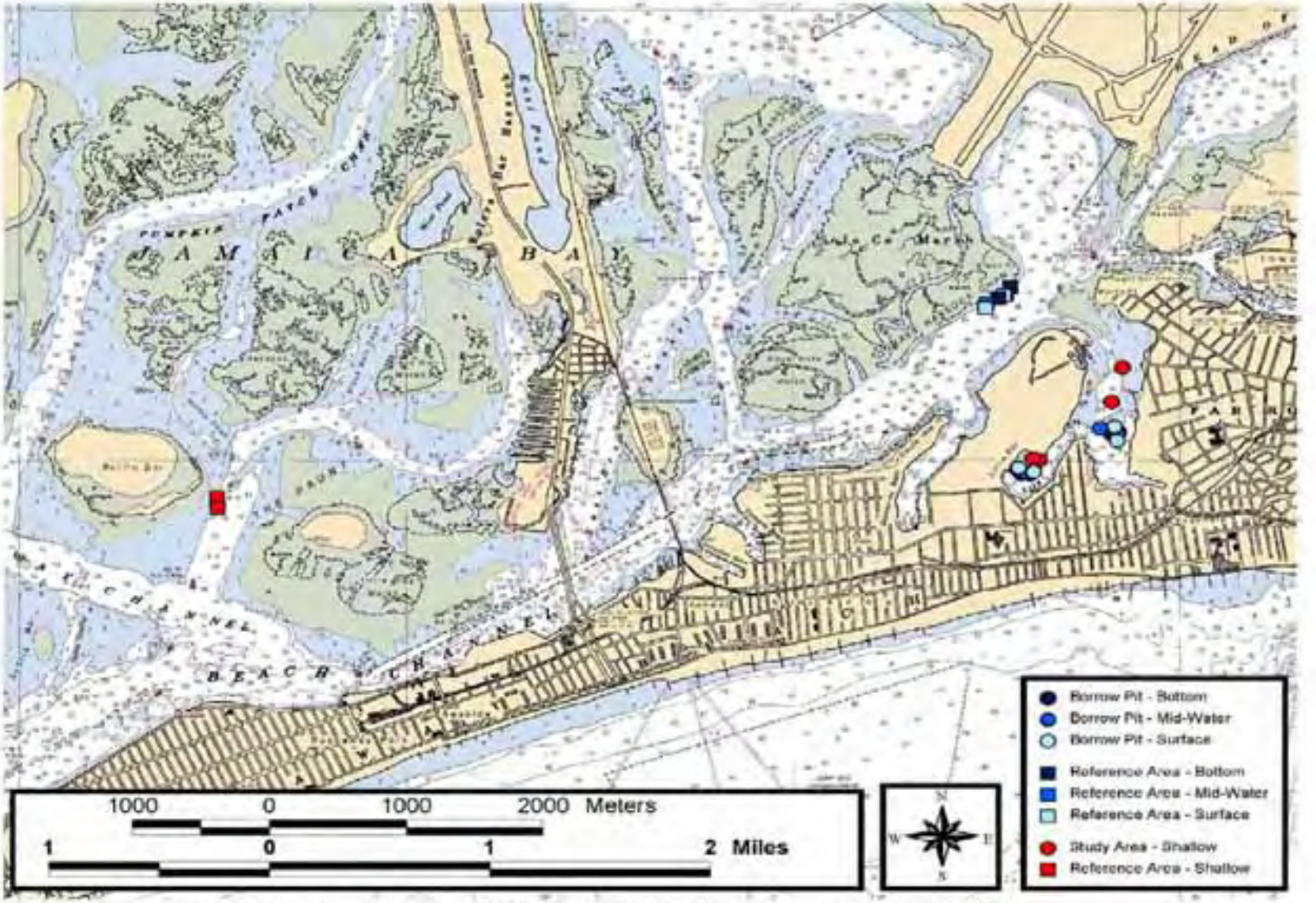

Figure 3.2.3 Locations of gill net sampling stations within Norton Basin study and reference areas, August 2002.

three trawls were pulled for a duration of 5 minutes in Norton Basin and three trawls were pulled for a duration of 10 minutes in each reference area (**Figure 3.3.1**). On June 24-26, 2002, five trawls were pulled for a duration of 6-9 minutes in Norton Basin, five trawls were pulled for a duration of 10 minutes in the Grass Hassock Channel reference area and four trawls were pulled for a duration of 2-10 minutes in the Raunt reference area (**Figure 3.3.2**). On August 12-14, 2002, five trawls were pulled for a duration of 8-9 minutes in Norton Basin and five trawls were pulled for a duration of 10 minutes in each reference area (**Figure 3.3.3**). All fish and macrocrustaceans captured in trawls were processed in the field. Captured organisms were identified to species, enumerated, weighed, measured (TL or carapace width), and released alive, if possible. CPUE was calculated by dividing fish and macrocrustacean biomass by trawl duration (in minutes).

3.4 Sediment Profile Imaging

3.4.1 Field Collection

In May 2002, a total of 199 SPI images were obtained from 100 stations, in the Norton Basin/Little Bay study area and throughout the reference areas (**Figure 3.4.1**). SPI images were taken with a Hulcher Model Minnie sediment profile camera equipped with a UW-Nikkor 35 mm lens (F/3.5, water-corrected) and loaded with Fujichrome 100P slide film. The profile camera was set to take two photographs at each station at 6 and 12 seconds after bottom contact. The weight of the camera frame was adjusted using detachable iron weights to account for differences in sediment type at various locations throughout the study and reference areas.

3.4.2 Image Analysis

The sediment profile photographs were analyzed visually by projecting the images and recording all features seen into a preformatted, standardized spreadsheet file. The images were then digitized using a Nikon Coolscan 2000 scanner and analyzed using Adobe PhotoShop and NTIS Image programs. Steps in the computer analysis of each image were standardized and followed the basic procedures in Viles and Diaz (1991). Data from each image were sequentially saved to a spreadsheet file for later analysis. Details of these analytical methods can be found in Diaz and Schaffner (1988) and Rhoads and Germano (1986), and in the standardized image analysis procedures of Viles and Diaz (1991).

3.4.3 SPI Parameters

3.4.3.1 Prism Penetration

This parameter provides a geotechnical estimate of sediment compaction with the profile camera prism acting as a dead weight penetrometer. Camera penetration is positively correlated with soft sediments, high water content for fine sediments, and poorer sorting coefficients for sandy sediments. Penetration is measured as the distance (in cm) that the sediment moved up the 23-cm height of the camera faceplate.

3.4.3.2 Surface Relief

Small scale surface relief or boundary roughness measured across the 15 cm width of the prism is the difference between the maximum and minimum distance sediment extends up the prism face plate. It is possible, by careful examination of the images, to determine the dominant processes responsible for surface relief, which assists in assessing benthic habitat characteristics.

3.4.3.3 Apparent Color Redox Potential Discontinuity (RPD) Layer

This parameter has been determined to be an important indicator of benthic habitat quality (Rhoads and Germano 1986, Diaz and Schaffner 1988) and provides an estimate of the depth to which

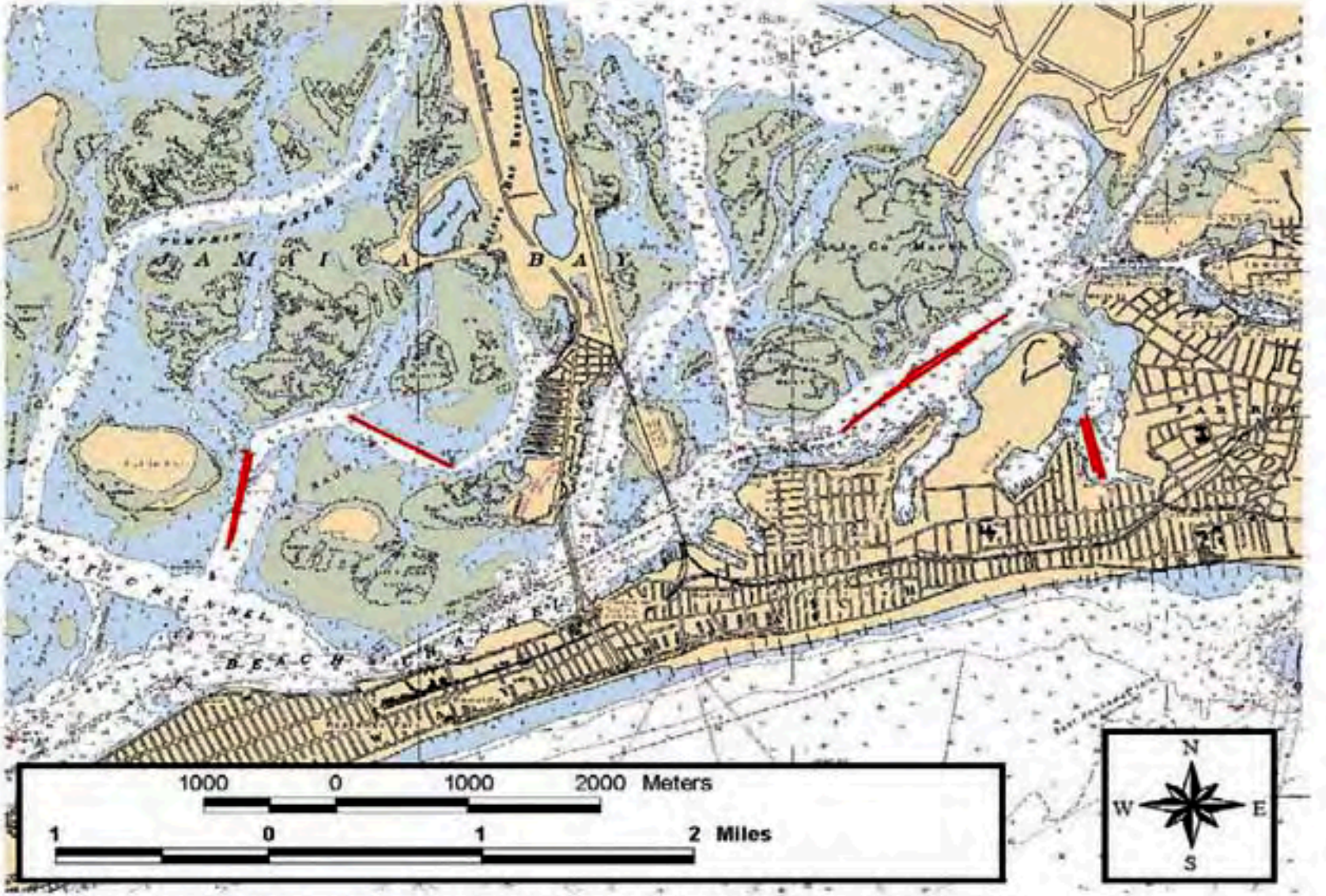

Figure 3.3.1 Locations of bottom trawl sampling lines within Norton Basin study and reference areas, May 2002.

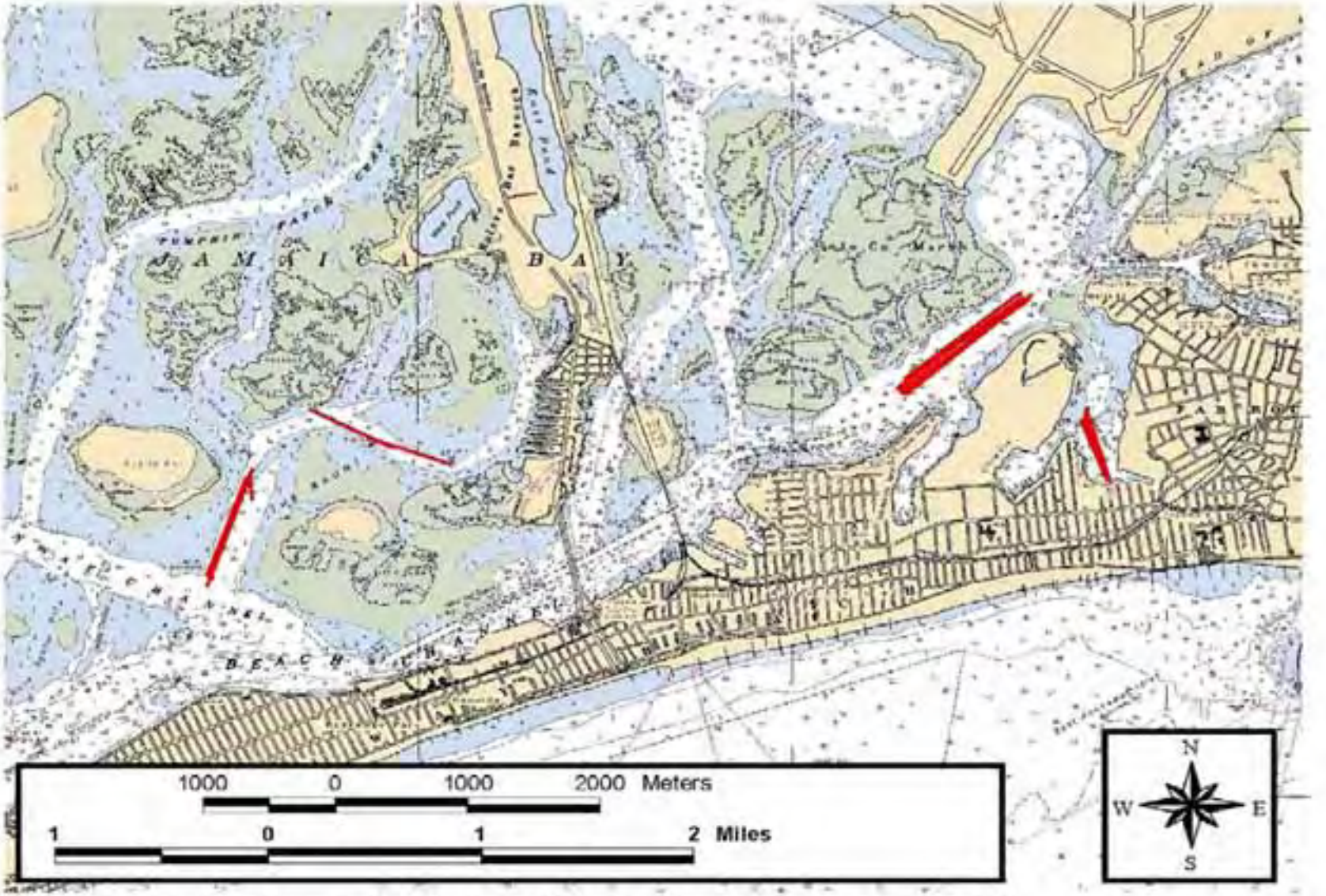

Figure 3.3.2 Locations of bottom trawl sampling lines within Norton Basin study and reference areas, June 2002.

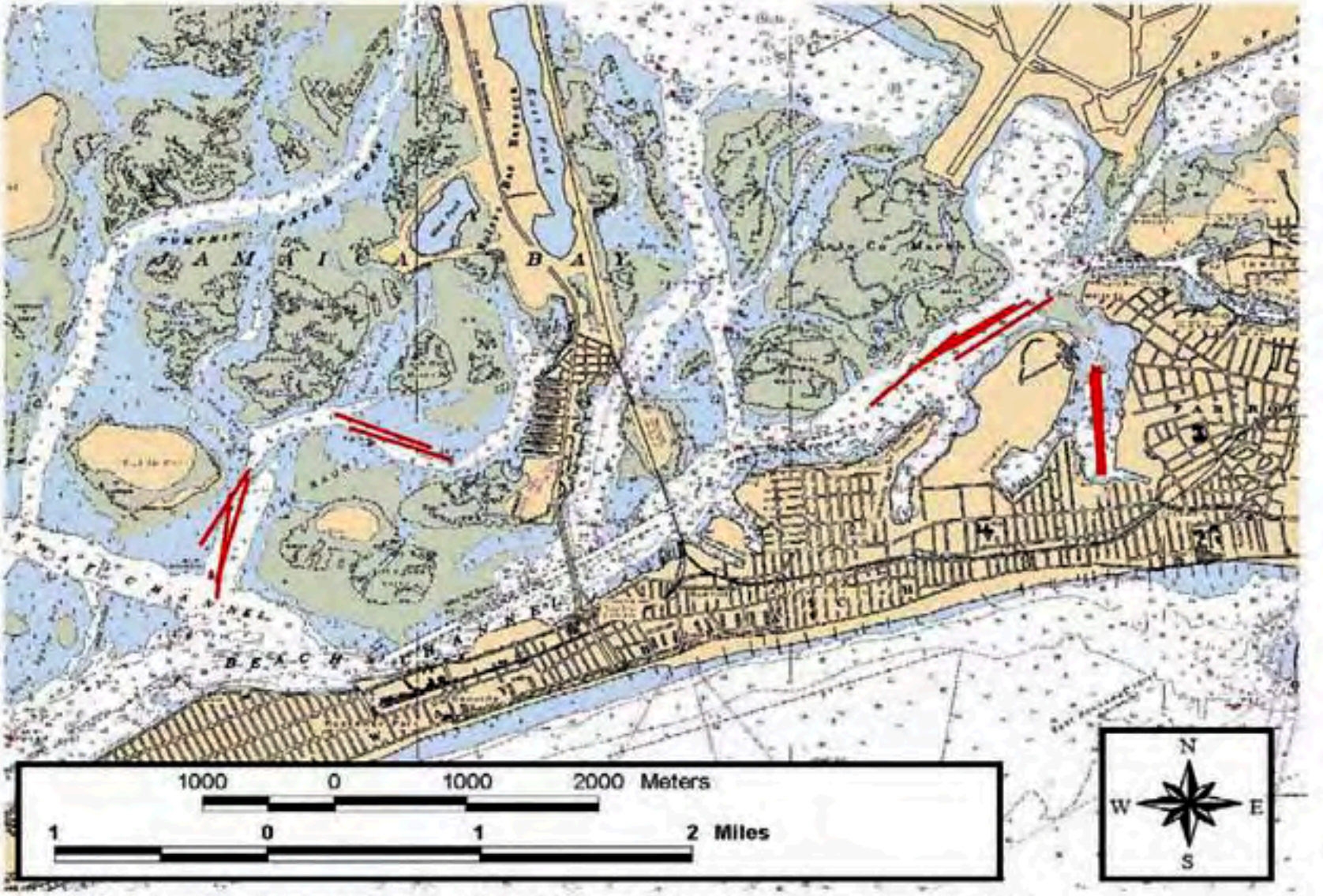

Figure 3.3.3 Locations of bottom trawl sampling lines within Norton Basin study and reference areas, August 2002.