FINAL REPORT

May 2011

Results of The August 2010 Sediment-Profile Imaging and Sediment Toxicity Survey at the Historic Area Remediation Site

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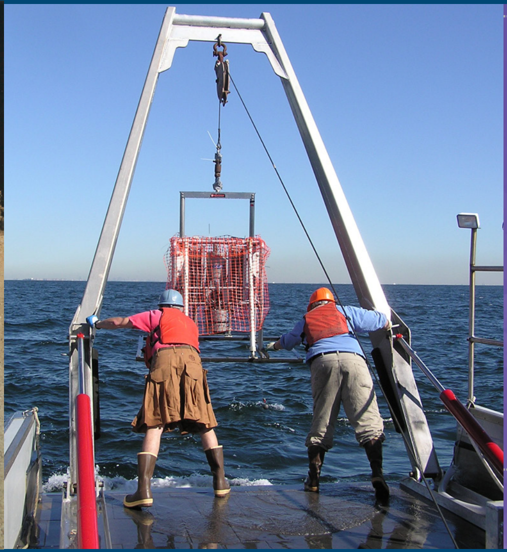

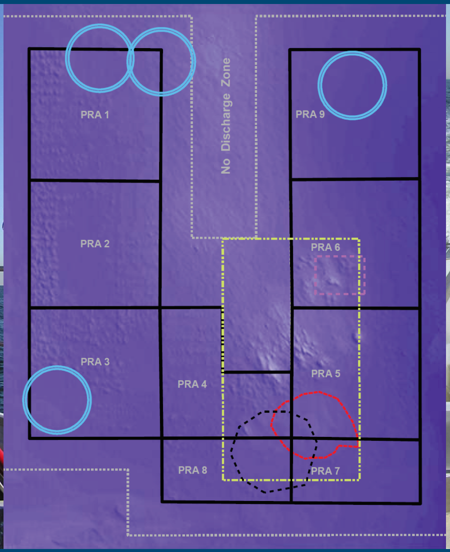

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EXECUTIVE SUMMARY

Since the closure of the Mud Dump Site (MDS) in September 1997 and its redesignation as the Historic Area Remediation Site (HARS), placement of remediation dredged material has been ongoing in HARS Priority Remediation Areas (PRAs) 1 through 5 and 8. The remediation consists of placing a “cap” layer of at least 1 m of uncontaminated dredged material on top of the existing surface sediments.

The HARS Site Management and Monitoring Plan (SMMP), developed by the U.S. Army Corps of Engineers (USACE) New York District (NYD) and Region 2 of the U.S. Environmental Protection Agency (USEPA), includes periodic monitoring to ensure that placement of remediation material is occurring at designated locations within the HARS boundary and is not resulting in any adverse environmental impacts.

The 2009 bathymetric survey of the HARS indicated that at least 95% of the PRA 1 area available for remediation had been covered with at least 1 m of remediation material, resulting in the need for postremediation monitoring to characterize baseline seafloor conditions and evaluate sediment toxicity. A need was also identified for general monitoring of the entire HARS and its surrounding area to assess any temporal changes in sediment quality or sediment toxicity compared to previous surveys.

To address these objectives, the August 2010 survey involved three types of monitoring activities: 1) sediment-profile and plan-view images were collected within PRA 1 and throughout the HARS to characterize the physical and biological condition of surface sediments and to assess benthic recolonization status, 2) benthic infaunal community composition was evaluated at stations within PRA 1 for comparison to reference stations outside of PRA 1, and 3) sediment toxicity was measured at stations within PRA 1 and throughout the HARS to characterize existing conditions and to determine if there had been significant changes over time.

Both the profile and plan-view images revealed that fine to very fine sand was the dominant sediment type at the majority of stations in PRA 1, although silt/clay, coarse sand, gravel, and rocks were observed at a few stations. Except for two stations in the shipwreck buffer zone, the surface sediment at all the PRA 1 stations consisted of remediation material placed there since the HARS was designated in 1997. Due to the widespread presence of sand, physical habitat conditions at many of the PRA 1 stations appeared comparable to those existing on the ambient sandy bottom in areas surrounding the HARS.

Sediment toxicity was not present at the PRA 1 stations, as determined by the standard 10-day amphipod test. Given the absence of toxicity, it is not surprising that the profile and plan-view images revealed that benthic infauna inhabited the surface sediments at stations throughout PRA 1.

The images showed that large worm tubes were present at the sediment surface at all of the sampling stations in PRA 1. At about half of these stations, there also was evidence that subsurface-dwelling, Stage 3 taxa were present, often in conjunction with surface-dwelling Stage 1 or shallow-dwelling Stage 2 organisms. These results provided one line of evidence that the remediation material was being successfully recolonized.

The benthic infaunal analysis indicated that for a given habitat type, there was a moderate degree of similarity in community composition between the PRA 1 stations and reference stations. Eight of the numerically dominant taxa at the PRA 1 stations were also among the dominants at the reference stations. The average number of taxa, as well as average diversity, evenness, and species richness, were roughly comparable between the PRA 1 and reference stations.

One notable finding of the 2010 survey was the occurrence of relatively large worm tubes at the sediment surface at a high proportion of stations, both within and outside the HARS. Such tubes have been observed in past HARS monitoring surveys, but they did not have the same widespread distribution across the entire survey area. It is likely that many of the tubes were constructed by *Asabellides oculata*, a polychaete that was among the top numerical dominants collected in the grab samples.

The general HARS monitoring showed that stations located outside the HARS boundary were characterized primarily by fine to medium sand representing native sediment, consistent with the results of previous surveys. Stations within the HARS were characterized by either relict dredged material or various types of remediation material, including red clay, organic-rich mud, clean fine sand, and rocks/gravel.

The sediment-profile images collected in 2010 showed a mosaic of different successional stages across the HARS, with Stage 3 occurring predominantly at stations with muddy (i.e., silt/clay) sediment. The sediment at all of the general HARS monitoring stations was found to be nontoxic, results consistent with those of the previous three sediment toxicity surveys of 2000, 2002 and 2005. Given the absence of any significant toxicity in these last three surveys, consideration should be given to reducing either the frequency of such monitoring and/or the total number of stations tested for toxicity.

Advanced Stage 3 succession, relatively deep redox depths, the widespread presence of large surface tubes, and the absence of sediment toxicity were all considered evidence that reasonably healthy benthic habitat conditions existed within the HARS and surrounding areas at the time of the August 2010 survey.

1.0 INTRODUCTION

1.1 Background

On 1 September 1997 the New York Bight Dredged Material Disposal Site, known as the Mud Dump Site (MDS), was dedesignated as an official ocean disposal site by the U.S. Environmental Protection Agency (USEPA). This action was the culmination of more than a year of cooperation and coordination between The Clinton administration, the Department of the Army, the USEPA, and the U.S. Department of Transportation. The closure of the MDS ended its use over more than three-quarters of a century as a repository for dredged sediments removed from the Port of New York.

After closure of the MDS, the site and surrounding areas, which had been used historically for placement of contaminated dredged material, were redesignated as the Historic Area Remediation Site, or HARS, located about six nautical miles (11 km) east of Sandy Hook, New Jersey (Figure 1-1). The remediation consists of placing a “cap” layer of at least 1 m of uncontaminated dredged material on top of the existing surface sediments. The “remediation material” to be used for capping is defined as dredged material that meets current Category I standards and will not cause significant undesirable effects, including through bioaccumulation. These materials have included sand, silt and red clay from dredging projects and Confined Aquatic Disposal cell construction throughout the New York and New Jersey area.

The HARS is divided into nine Priority Remediation Areas (PRAs) where remediation material is being placed (Figure 1-2). A Buffer Zone surrounds the PRAs, and the No Discharge Zone is an area outside the PRAs where no further disposal is permitted (Figure 1-2). The U. S. Army Corps of Engineers (USACE) New York District (NYD) is responsible for managing the placement of remediation material at the HARS. The regional office of the USEPA (Region 2) and the NYD have prepared a Site Management and Monitoring Plan (SMMP), which identifies a number of actions, provisions, and practices to manage remediation activities and monitoring tasks (USACE/USEPA 2009). The program requires periodic monitoring to ensure that placement of remediation material is occurring at designated locations within the HARS boundary and is not resulting in any adverse environmental impacts.

Since the designation of the HARS in 1997, placement of remediation material has been ongoing. Placement activity to date has been most intense in PRAs 1 and 2, although significant placement has also occurred in PRAs 3, 4, 5, and 8 (Figure 1-3). In accordance with the HARS SMMP, environmental monitoring surveys also have occurred periodically since September 1997. As summarized in Table 1-1, this past monitoring has included four sediment-profile imaging (SPI) surveys, three sediment toxicity surveys, one subbottom profiling survey, thirteen single-beam bathymetric survey, and eleven multibeam bathymetric surveys.

1.2 Objectives of the 2010 Monitoring Survey

The 2009 bathymetric survey of the HARS indicated that at least 95% of the area of PRA 1 available for remediation had been covered with at least 1 m of remediation material. In

Table 1-1.

Chronology of Past Environmental Monitoring Activity at the HARS

Date	Monitoring activity	Description
September 1997	Single-beam Bathymetry	1997 Capping Project
October 1997	Single-beam Bathymetry	1997 Capping Project
October 1997	Single-beam Bathymetry	1997 Capping Project
December 1997	Single-beam Bathymetry	1997 Capping Project
February 1997	Single-beam Bathymetry	1997 Capping Project
April 1998	Single-beam Bathymetry	1997 Capping Project
July 1998	Single-beam Bathymetry	Portion of PRA 1
July 1998	Single-beam Bathymetry	Portion of PRA 4
August 1998	Sediment Profile Imaging (SPI)	PRAs 1, 2, and 3
September 1998	Single-beam Bathymetry	PRAs 1, 2, and 3
October 1998	Multibeam Bathymetry	Entire HARS
April 1999	Single-beam Bathymetry	1997 Capping Project
August 1999	Single-beam Bathymetry	PRA 1 and northern portion of PRA 2
February 2000	Multibeam Bathymetry	PRA 2
March 2000	Multibeam Bathymetry	Entire HARS
March 2000	SPI and Sidescan Sonar	PRAs 1, 2, and 3
October 2000	Sediment Toxicity	Both within and outside of PRA 1
July 2002	SPI and Sediment Toxicity	Entire HARS
Aug-Sept 2002	Single-beam Bathymetry	Entire HARS
Aug-Oct 2003	Single-beam Bathymetry	PRAs 1, 2, and 3
Aug-Sept 2004	Multibeam Bathymetry	Entire HARS
August 2005	Multibeam Bathymetry and Backscatter	Entire HARS
August 2005	SPI and Sediment Toxicity	Entire HARS
August 2006	Multibeam Bathymetry and Backscatter	Entire HARS
August 2006	SPI and Sub-bottom Profiling	Entire HARS
April 2007	Multibeam Bathymetry	PRAs 1 and 2
September 2007	Multibeam Bathymetry and Backscatter	Entire HARS
June-July 2008	Multibeam Bathymetry	Entire HARS
September 2009	Multibeam Bathymetry	Entire HARS
September 2010	Multibeam Bathymetry	Entire HARS

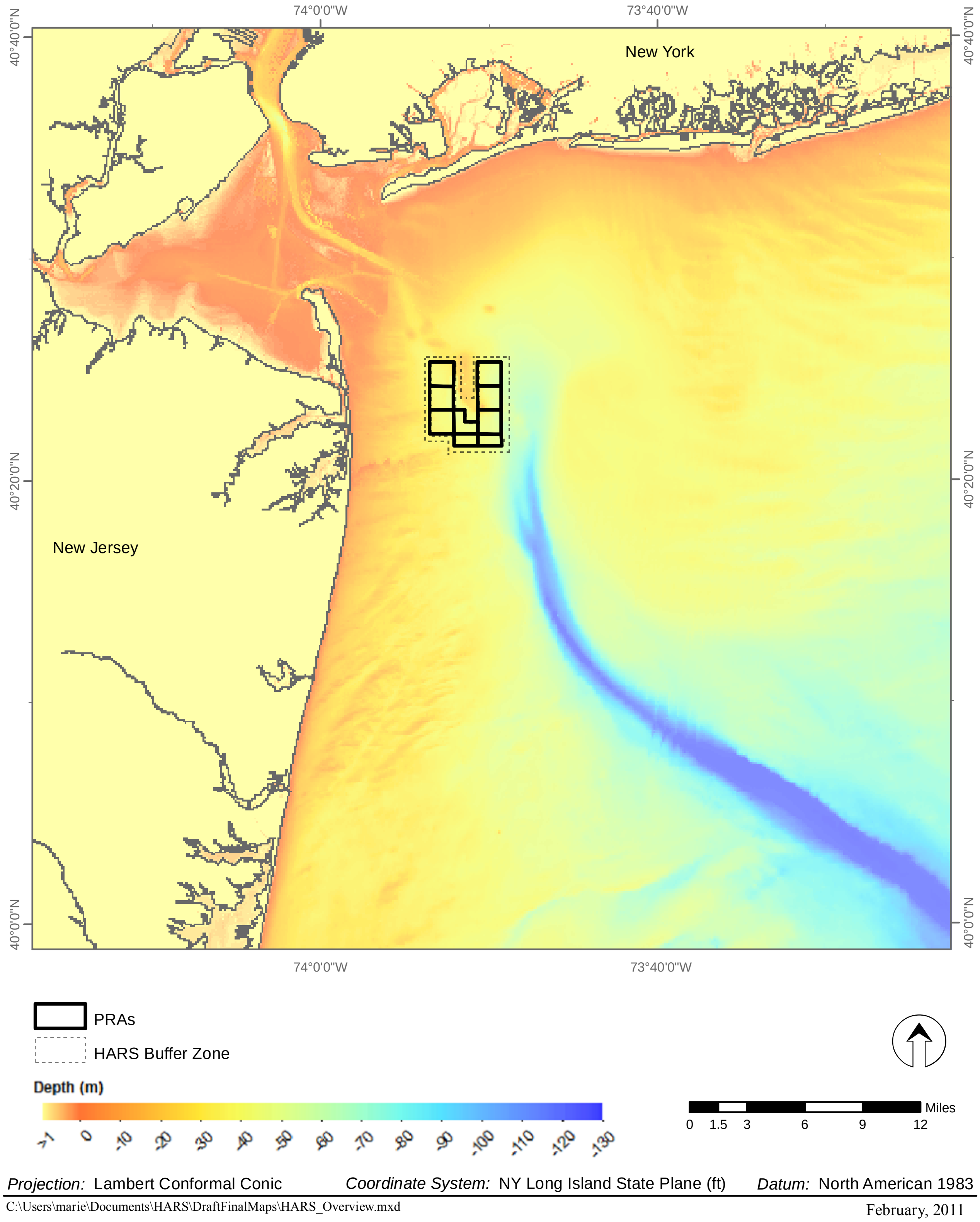

Figure 1-1. Location of the Historic Area Remediation Site (HARS) in the New York Bight

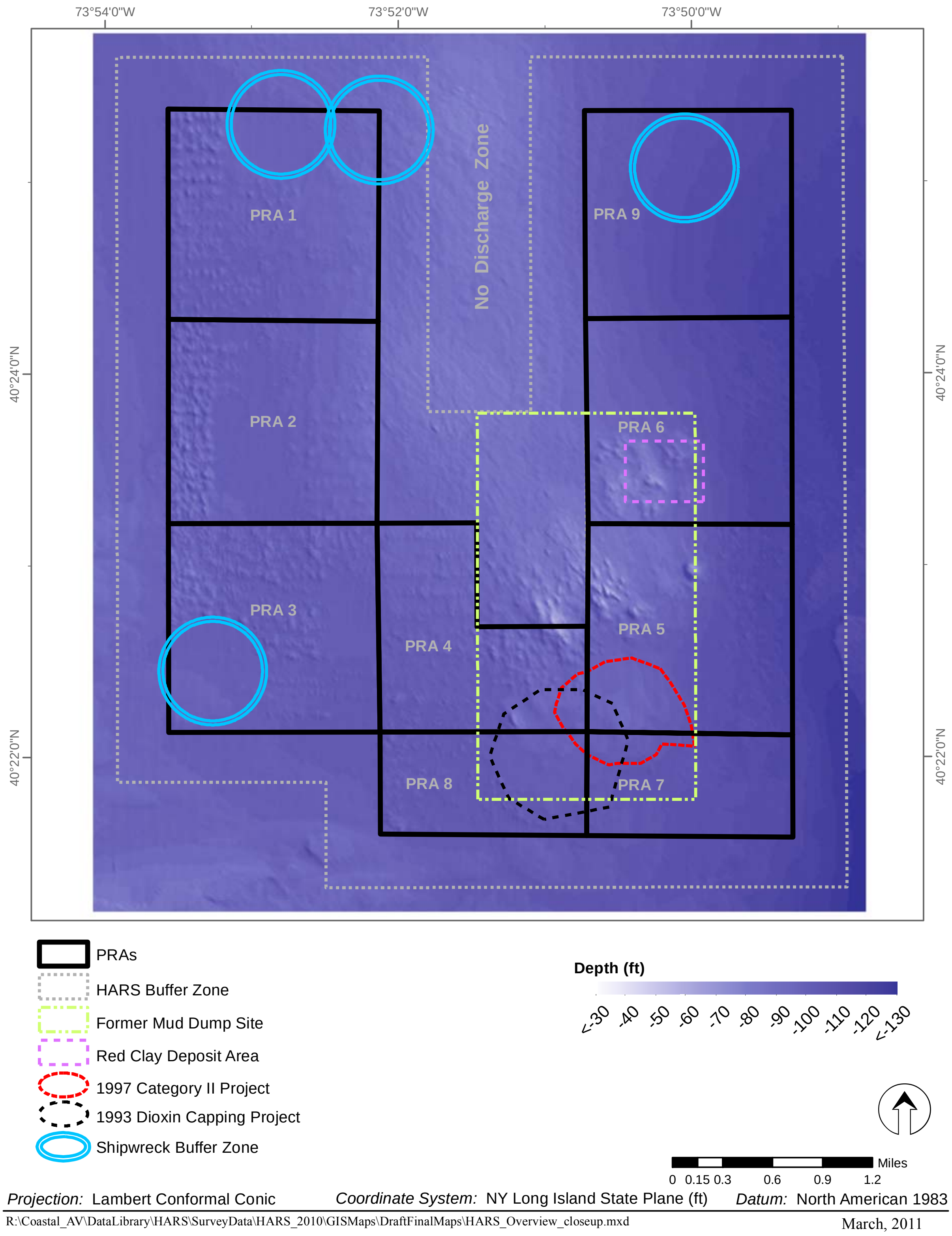

Figure 1-2. Locations of HARS PRAs 1 through 9, the HARs Buffer and No Discharge Zones, and the former Mud Dump Site relative to 2010 survey bathymetry

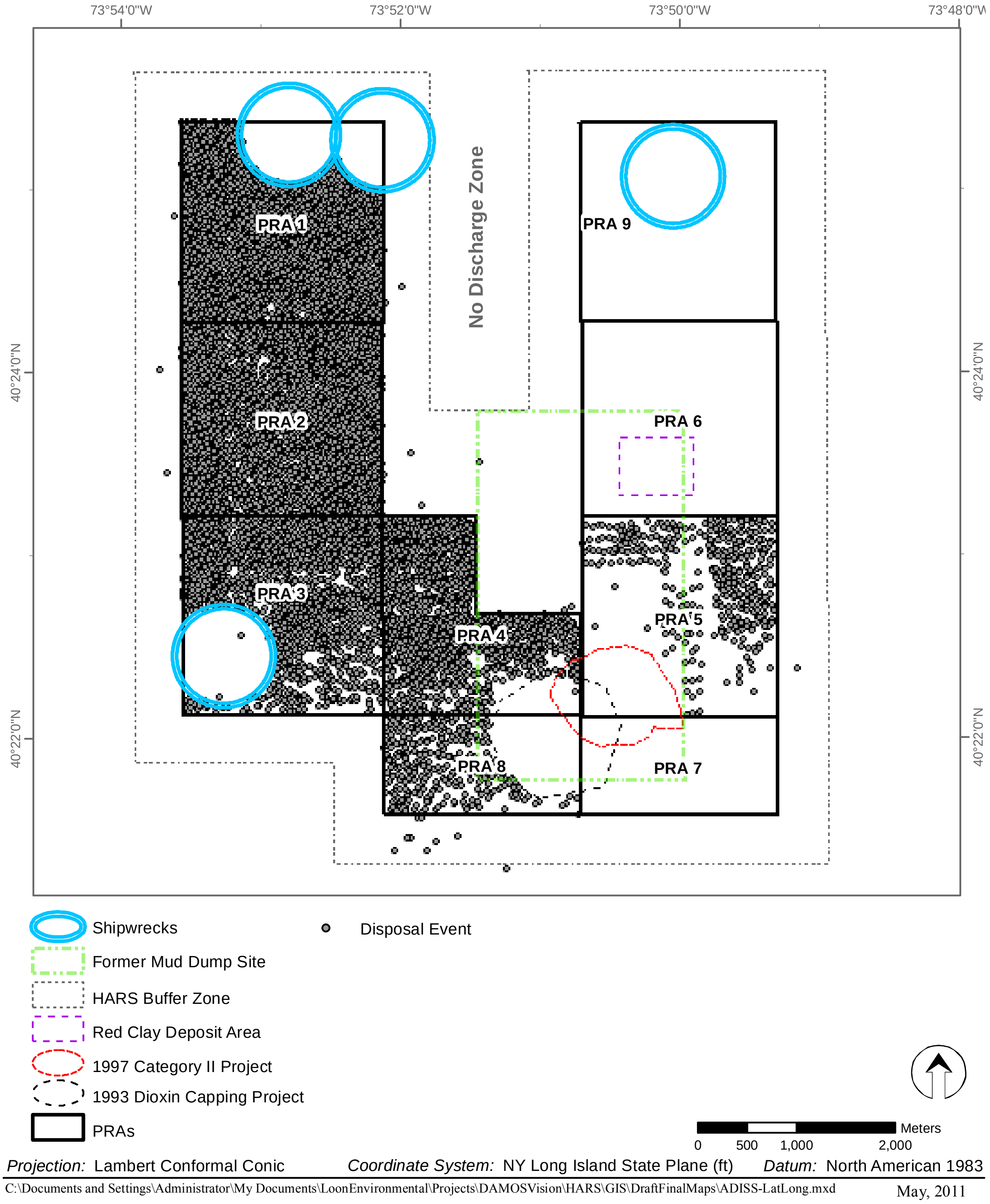

Figure 1-3. Placement of remediation material within the HARS from March 1998 to August 2010. Placement points outside the HARS boundary are an artifact of using the mid-point of the barge trackline to create this map and do not necessarily represent the location where the bulk of material was released by the barge.

accordance with the HARS SMMP, upon completion of capping operations, “postremediation monitoring” should be conducted within PRA 1. The SMMP also identifies the need for periodic “general monitoring” of the entire HARS and its surrounding area. Such monitoring is required to verify that the remediation material placed at the HARS is not causing any significant adverse environmental impacts.

In fulfillment of these requirements, this report presents the results of a monitoring survey conducted at the HARS in August 2010. This survey had two objectives:

1) Provide a baseline postremediation characterization of sediment physical and biological conditions, as well as sediment toxicity, within PRA 1. Results of future postremediation monitoring surveys in PRA 1 can be compared to this characterization.

2) Assess any temporal changes in sediment quality and sediment toxicity that may have occurred in areas or stations that have been sampled in the past, both within PRA 1 and throughout the HARS.

To address these objectives, the August 2010 survey involved 1) sediment-profile and plan-view images within PRA 1 and throughout the HARS to characterize the physical and biological condition of surface sediments and assess benthic recolonization status, 2) benthic infaunal community composition at stations within PRA 1 compared to reference stations outside of PRA 1, and 3) sediment toxicity at stations within PRA 1 and throughout the HARS to characterize existing conditions and to determine if there has been any significant change over time.

2.0 METHODS

2.1 Field Operations and Sampling Design

The 24–31 August 2010 field survey was performed by Germano & Associates, Inc., and CR Environmental, Inc. The 42-ft F/V *First Light* was used for all field operations. SPI and plan-view images were collected on 25–28 August at 90 stations (Figure 2-1). Grab samples for toxicity testing were collected on 30 and 31August at a subset of 75 of the imaging stations, and on 29 and 30 August, at 20 of these 75 stations, samples for benthic community analysis also were collected (Figure 2-2).

The 90 stations at which SPI and plan-view images were collected included 15 stations within PRA 1 and 75 stations outside of PRA 1 (Table 2-1 and Figure 2-1). Stations that were sampled in previous surveys were labeled with their original station numbers; those sampled for the first time in the 2010 survey were named using a "2010" prefix (Table 2-1 and Figure 2-3). Of the 90 stations, 44 were historical stations from the original 1994 USEPA toxicity study. These stations are identified in Table 2-1 and Figure 2-1 with a simple numeric identifier ranging between 1 and 49.

Of the 15 stations within PRA 1, four were sampled in the three previous SPI surveys of 2002, 2005, and 2006 (G-1200; plus Stations 04, 07, and 11 sampled in 1994) and one station (E0800) was sampled in 2002 and 2005 (Table 2-1 and Figure 2-3). The remaining ten stations within PRA 1 were sampled for the first time in the 2010 survey.

Of the 75 SPI/plan-view stations located outside of PRA 1, 19 stations (13–20, 24–30, 34, 36, L1200, and P2800) were sampled in the three previous SPI surveys of 2002, 2005, and 2006. Twenty-four stations (1–3, 5, 6, 8–10, 12, 22, 31–33, 35, 37–40, 42–46, and 49) were sampled previously in both 2002 and 2005, two stations (97_00_04 and 97_00_6) were sampled in 2005 and 2006, and 21 stations (2001_2, _3, _5, _6, _8; 2002_1, _4, _9, _10; 2003_5, _10; 2004_2, _4, _6, _9; 97_00_9; and NOREMED_1, _2, _3, _4, _5) were sampled in 2005 only. The remaining nine stations were sampled for the first time in the August 2010 survey (Table 2-1 and Figure 2-4).

Surface sediments for toxicity testing were collected at 75 stations; these stations were a subset of the 90 SPI/plan-view stations (Figure 2-2). Specifically, toxicity samples were collected at all 15 of the SPI/plan-view stations located in PRA 1 and at an additional 60 stations located outside of PRA 1 (Table 2-1 and Figure 2-2). Many of the sediment toxicity stations sampled in 2010 were also sampled in one or more of the three previous sediment toxicity surveys of 1994, 2002, and 2005 (Table 2-1 and Figure 2-5). For example, 43 of the 44 historical stations from the original 1994 USEPA toxicity study were sampled for toxicity in 2010, and these stations also were sampled in the previous toxicity surveys of 2002 and 2005 (Table 2-1 and Figure 2-5). Four other 2010 toxicity stations (Stations E0800, G-1200, L-1200 and P-2800) were not among the original 1994 USEPA stations but were sampled in the previous toxicity surveys of 2002 and 2005 (Table 2-1). A total of 28 toxicity stations, located both within and outside of PRA 1, were sampled for the first time in the 2010 survey (Table 2-1 and Figure 2-5).

Table 2-1.

Coordinates and Survey History of HARS Stations Sampled in the August 2010 Survey for SPI/Plan-view and Toxicity, and for Benthic Infauna (2010 only; shaded)

Stations in PRA 1 Sampled for SPI/Plan-view and Toxicity in 2010:

Station	Latitude (NAD83)	Longitude (NAD83)	Past Toxicity Testing	Past SPI/Plan-view Sampling
4	40.423167	-73.881833	1994, 2002, 2005	2002, 2005, 2006
7	40.4185	-73.883667	1994, 2000,2002, 2005	2002, 2005, 2006
11	40.411833	-73.880167	1994, 2002, 2005	2002, 2005, 2006
E0800	40.41309	-73.88924	2002, 2005	2000, 2002, 2005
G-1200	40.40588	-73.88456	2002, 2000, 2005	2000, 2002, 2005, 2006
2010-01	40.421156	-73.891787	None	None
2010-02	40.410671	-73.885083	None	None
2010-03	40.408032	-73.892215	None	None
2010-04	40.405607	-73.877594	None	None
2010-05	40.405964	-73.871389	None	None
2010-06	40.408888	-73.874598	None	None
2010-07	40.413881	-73.871745	None	None
2010-08	40.418017	-73.871745	None	None
2010-09	40.420728	-73.877237	None	None
2010-10	40.416234	-73.878236	None	None

Stations Outside of PRA 1 Sampled for SPI/Plan-view and Toxicity in 2010:

Station	Latitude (NAD83)	Longitude (NAD83)	Past Toxicity Testing	Past SPI/Plan-view Sampling
1	40.4335	-73.8835	1994, 2002, 2005	2002, 2005
2	40.434333	-73.814833	1994, 2002, 2005	2002, 2005
3	40.434333	-73.801667	1994, 2002, 2005	2002, 2005
5	40.422	-73.861667	1994, 2000, 2002, 2005	2002, 2005
6	40.4255	-73.8465	1994, 2002, 2005	2002, 2005
8	40.415833	-73.862333	1994, 2000, 2002, 2005	2002, 2005
9	40.417167	-73.84	1994, 2002, 2005	2002, 2005
10	40.417667	-73.827	1994, 2002, 2005	2002, 2005
12	40.412667	-73.864167	1994, 2000, 2002, 2005	2002, 2005
13	40.407667	-73.862667	1994, 2000, 2002, 2005	2002, 2005, 2006
14	40.400333	-73.839333	1994, 2002, 2005	2002, 2005, 2006

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Table 2-1., continued

Coordinates and Survey History of HARS Stations Sampled in the August 2010 Survey for SPI/Plan-view and Toxicity, and for Benthic Infauna (2010 only; shaded)

Stations Outside of PRA 1 Sampled for SPI/Plan-view and Toxicity in 2010:

Station	Latitude (NAD83)	Longitude (NAD83)	Past Toxicity Testing	Past SPI/Plan-view Sampling
16	40.396	-73.858333	1994, 2000, 2002, 2005	2002, 2005, 2006
17	40.395	-73.846167	1994, 2002, 2005	2002, 2005, 2006
18	40.3965	-73.833167	1994, 2000, 2002, 2005	2002, 2005, 2006
19	40.392167	-73.880333	1994, 2002, 2005	2002, 2005, 2006
20	40.391	-73.865	1994, 2002, 2005	2002, 2005, 2006
22	40.390833	-73.844333	1994, 2002, 2005	2002, 2005
24	40.383333	-73.857667	1994, 2002, 2005	2002, 2005, 2006
25	40.384167	-73.848167	1994, 2002, 2005	2002, 2005, 2006
26	40.384167	-73.836833	1994, 2002, 2005	2002, 2005, 2006
27	40.3855	-73.828833	1994, 2000, 2002, 2005	2002, 2005, 2006
28	40.377833	-73.887667	1994, 2002, 2005	2002, 2005, 2006
29	40.375167	-73.871833	1994, 2002, 2005	2002, 2005, 2006
30	40.3765	-73.836167	1994, 2002, 2005	2002, 2005, 2006
31	40.366833	-73.835833	1994, 2002, 2005	2002, 2005
32	40.367667	-73.83	1994, 2000, 2002, 2005	2002, 2005
33	40.366833	-73.824667	1994, 2002, 2005	2002, 2005
34	40.362833	-73.8755	1994, 2002, 2005	2002, 2005, 2006
35	40.359667	-73.878833	1994, 2002, 2005	2002, 2005
36	40.354333	-73.841833	1994, 2002, 2005	2002, 2005, 2006
37	40.348667	-73.870667	1994, 2002, 2005	2002, 2005
38	40.350167	-73.861833	1994, 2002, 2005	2002, 2005
39	40.349833	-73.830667	1994, 2002, 2005	2002, 2005
40	40.349833	-73.824	1994, 2002, 2005	2002, 2005
42	40.332833	-73.883333	1994, 2000, 2002, 2005	2002, 2005
43	40.334	-73.869	1994, 2000, 2002, 2005	2002, 2005
44	40.333167	-73.8505	1994, 2000, 2002, 2005	2002, 2005
45	40.333833	-73.834333	1994, 2000, 2002, 2005	2002, 2005
46	40.333333	-73.8265	1994, 2000, 2002, 2005	2002, 2005
49	40.4205	-73.842167	1994, 2000, 2002, 2005	2002, 2005
L1200	40.38787	-73.88456	2002, 2005	2002, 2005, 2006

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Table 2-1., continued

Coordinates and Survey History of HARS Stations Sampled in the August 2010 Survey for SPI/Plan-view and Toxicity, and for Benthic Infauna (2010 only; shaded)

Stations Outside of PRA 1 Sampled for SPI/Plan-view and Toxicity in 2010:

Station	Latitude (NAD83)	Longitude (NAD83)	Past Toxicity Testing	Past SPI/Plan-view Sampling
P2800	40.37346	-73.86582	2002, 2005	2002, 2005, 2006
2001_2	40.373181	-73.871185	None	2005
2001_8	40.402786	-73.880767	None	2005
2002_4	40.380536	-73.864598	None	2005
2010-12	40.391333	-73.893941	None	None
2010-14	40.387828	-73.875088	None	None
2010-15	40.384444	-73.889349	None	None
2010-16	40.384323	-73.870375	None	None
2010-17	40.380939	-73.87968	None	None
2010-18	40.369941	-73.87533	None	None
2010-19	40.369941	-73.884635	None	None
NOREMED_2	40.40951	-73.832016	None	2005
2002_1	40.385684	-73.859458	None	2005
NOREMED_5	40.378677	-73.825364	None	2005
97_00_9	40.389531	-73.834289	None	2005
2002_10	40.39617	-73.874047	None	2005
2003_5	40.380513	-73.891438	None	2005
2004_2	40.378497	-73.877221	None	2005
2004_6	40.376925	-73.860495	None	2005

Stations Outside of PRA 1 Sampled Only for SPI/Plan-view in 2010:

Station	Latitude (NAD83)	Longitude (NAD83)	Past Toxicity Testing	Past SPI/Plan-view Sampling
15	40.4	-73.8285	1994, 2002, 2005	2002, 2005, 2006
NOREMED_1	40.369752	-73.891761	None	2005
NOREMED_3	40.361029	-73.835808	None	2005
NOREMED_4	40.36364	-73.864168	None	2005
97_00_4	40.366895	-73.848334	None	2005, 2006
97_00_6	40.369404	-73.843664	None	2005, 2006

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Table 2-1., continued

Coordinates and Survey History of HARS Stations Sampled in the August 2010 Survey for SPI/Plan-view and Toxicity, and for Benthic Infauna (2010 only; shaded)

Stations Outside of PRA 1 Sampled Only for SPI/Plan-view in 2010:

Station	Latitude (NAD83)	Longitude (NAD83)	Past Toxicity Testing	Past SPI/Plan-view Sampling
2001_3	40.378914	-73.871785	None	2005
2001_5	40.396006	-73.884681	None	2005
2001_6	40.384422	-73.881182	None	2005
2002_9	40.391897	-73.871302	None	2005
2003_10	40.402036	-73.891403	None	2005
2004_9	40.373992	-73.853929	None	2005
2005_4	40.403621	-73.870002	None	2005
2010-11	40.398946	-73.889349	None	None
2010-13	40.387586	-73.889228	None	None

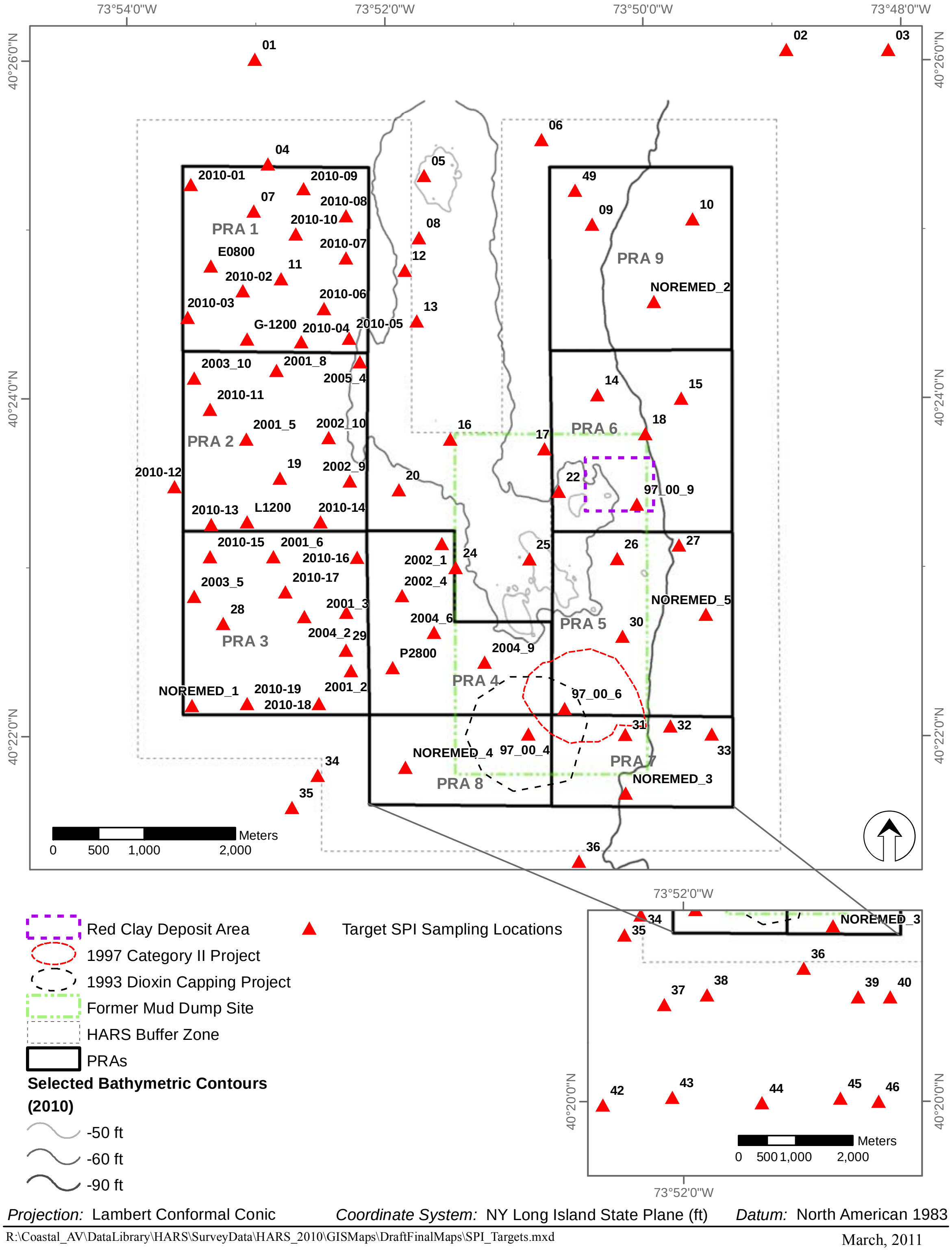


Figure 2-1. Ninety stations where SPI and plan-view images were collected in the August 2010 survey. Stations located to the south of the HARS are shown on the inset map.

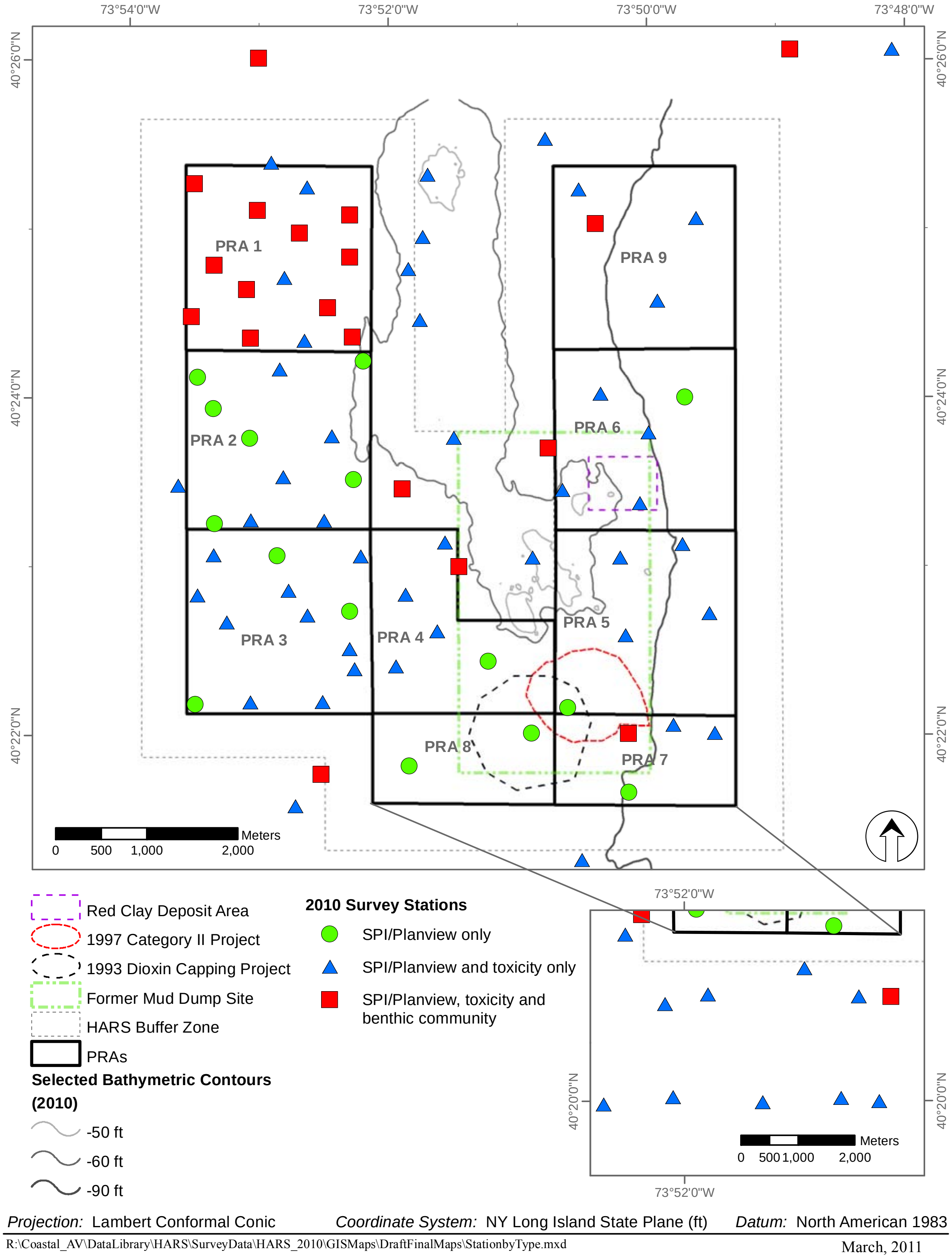
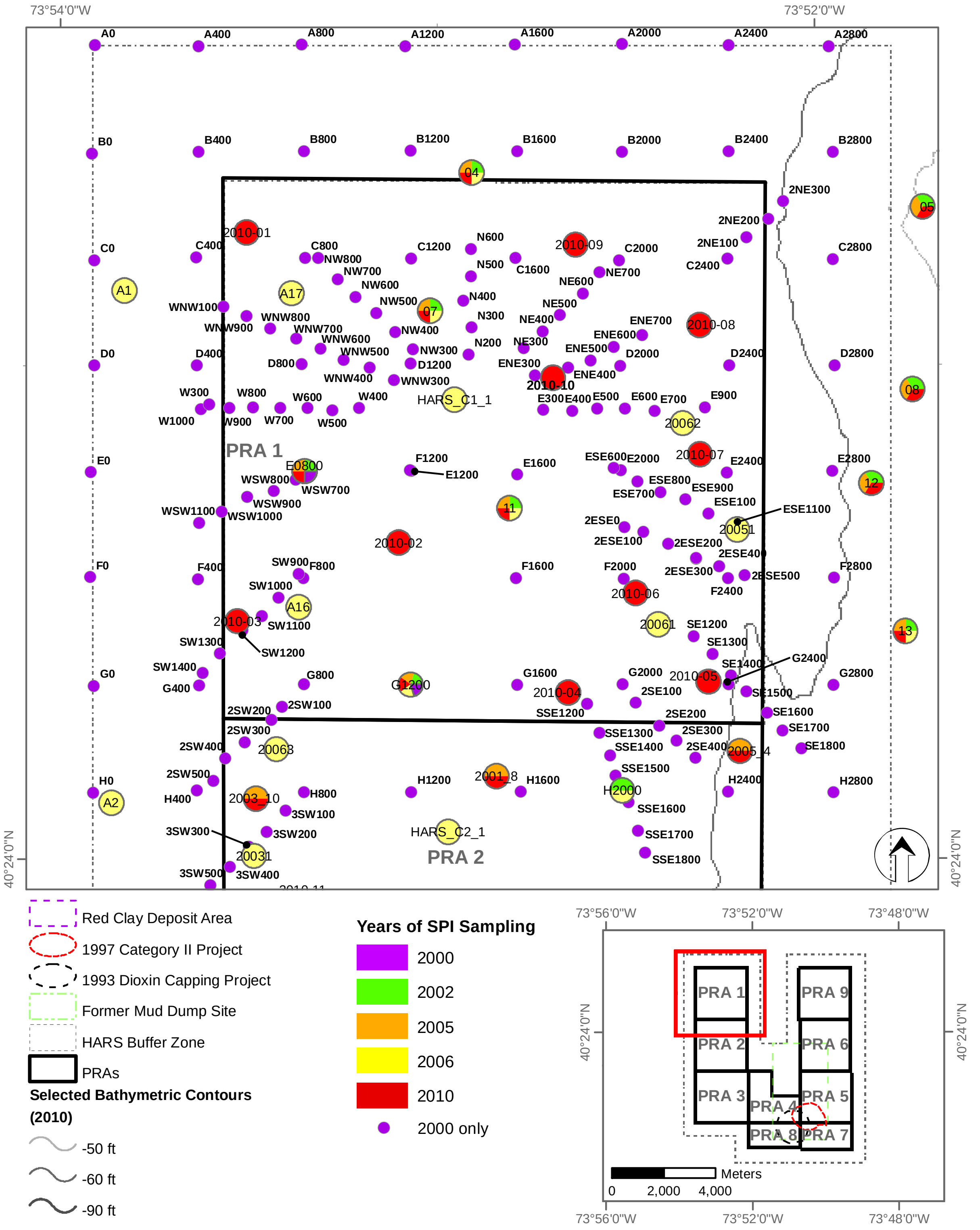


Figure 2-2. Subset of 75 stations where sediment toxicity samples were collected. At 20 of these 75 stations, benthic community samples also were collected.



Projection: Lambert Conformal Conic *Coordinate System:* NY Long Island State Plane (ft) *Datum:* North American 1983

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Figure 2-3. Stations in PRA 1 where SPI and plan-view images were collected in 2010 and in past HARS monitoring surveys.

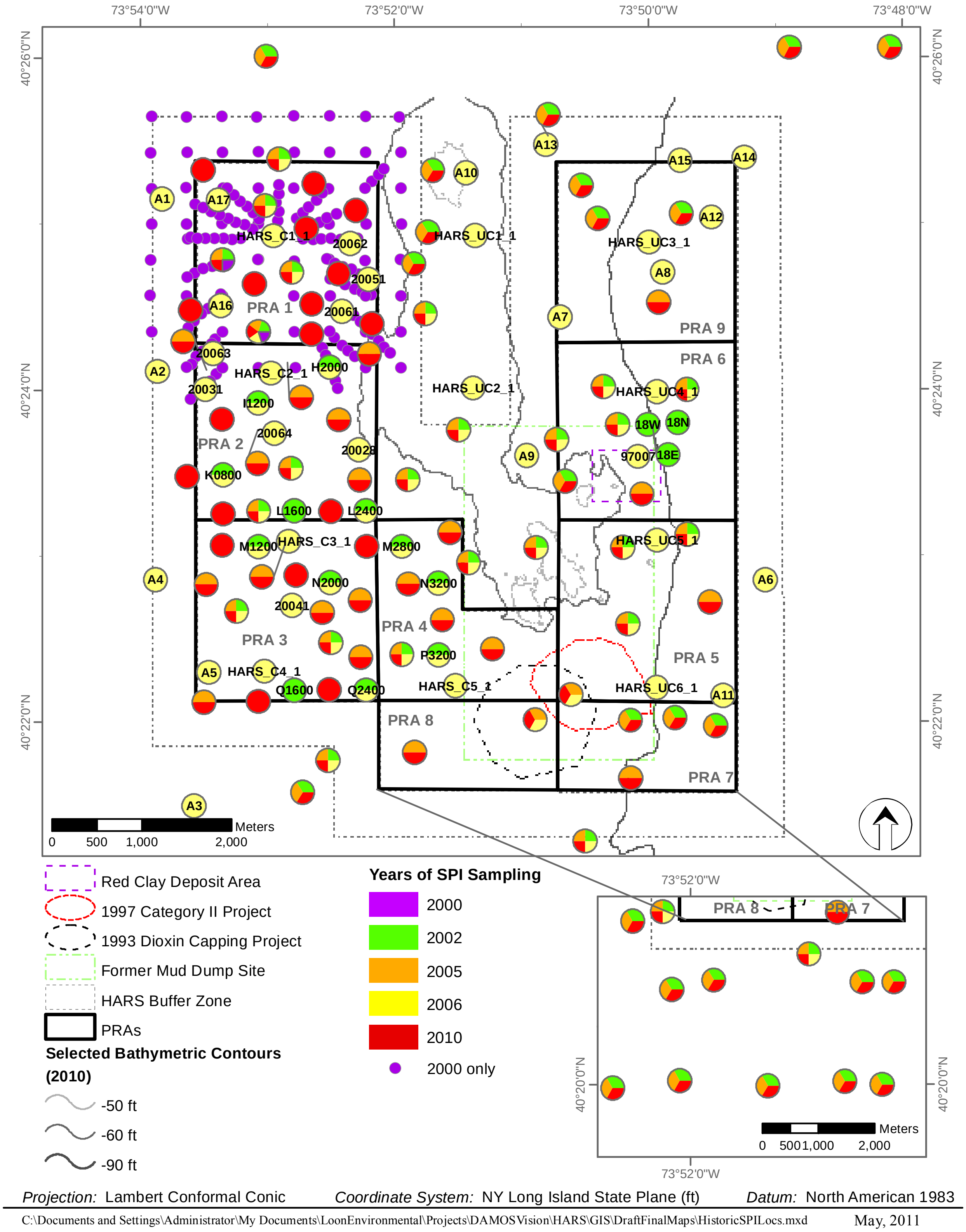


Figure 2-4. Stations in the HARS where SPI and plan-view images were collected in 2010 and in past monitoring surveys

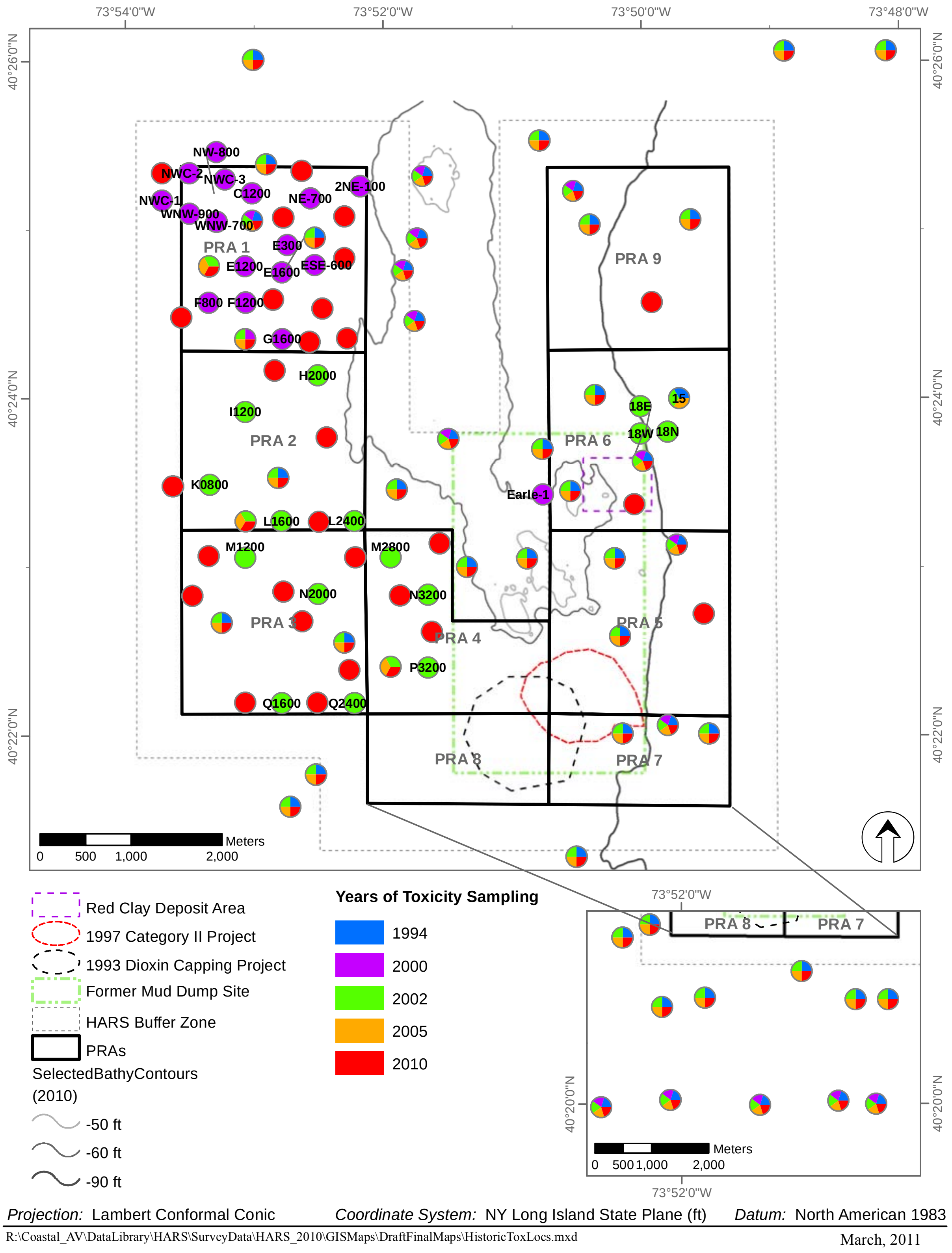


Figure 2-5. Stations where sediment toxicity samples were collected in 2010 and in past HARS monitoring surveys

As a supplement to the SPI/plan-view imaging results and to provide additional insights on the benthic recolonization status within PRA 1, a single grab sample for analysis of benthic infaunal community composition was collected at each of 20 sediment toxicity stations during the August 2010 survey (Table 2-1 and Figure 2-2). There were eleven benthic stations located within PRA 1 (7, E0800, G1200, 2010-01, 2010-02, 2010-03, 2010-05, 2010-06, 2010-07, 2010-08, 2010-10) and nine reference stations located outside of PRA 1 (1, 2, 9, 17, 20, 24, 31, 34, 40; Table 2-1 and Figure 2-2).

2.2 Navigation and Vessel Positioning

A Differential Global Positioning System (DGPS) was used to accurately measure and record vessel and sampling locations during all of the field operations. The DGPS system calculated geographic position by monitoring signals from a network of U.S. Government satellites. Real-time corrections were applied to position solutions using Ultra-High Frequency (UHF) signals transmitted from nearby U.S. Coast Guard base stations. These "differential" corrections were required to achieve submeter horizontal accuracy due to atmospherically induced interferences to the satellite signals. The DGPS system used for this survey was a Trimble Ag GPS132. The DGPS provided digital position, time, and satellite quality data once per second to the HYPACK® hydrographic acquisition software. HYPACK® was used for navigation by providing a visual representation of the location of the vessel in reference to the target sampling location.

2.3 Sediment-Profile and Sediment Plan-view Imaging

2.3.1 Sediment-Profile Image Acquisition

Sediment-profile imaging (SPI) is a monitoring technique used to provide data on both the physical and biological characteristics of the seafloor. The technique involves deploying an underwater camera system to photograph a cross section of the sediment-water interface. Acquisition of high-resolution sediment-profile images was accomplished using a Nikon® D200 digital single-lens reflex camera mounted inside an Ocean Imaging Model 3731 pressure housing system. The pressure housing sat atop a wedge-shaped prism with a front faceplate and a back mirror. The mirror was mounted at a 45° angle to reflect the profile of the sediment-water interface. As the prism penetrated the seafloor, a trigger activated a time-delay circuit that fired an internal strobe to obtain a cross-sectional image of the upper 15–20 cm of the sediment column (Figure 2-6). For each drop of the camera, it remained on the seafloor for approximately 20 sec to ensure that a successful image had been obtained.

At each station, images were collected while the vessel maintained position within a 5-m radius of the target station coordinates. Three replicate images were collected at each sampling station. After the first image was obtained, the camera frame was raised by the boat winch to a height of about 2 to 3 m above the sediment surface, giving the strobe sufficient time (5 seconds) to recharge. The camera was then lowered immediately for the second replicate, and, after the 15-second time delay and camera firing, the entire process of raising and lowering the camera was repeated again for the third replicate. The three station replicates were typically spaced

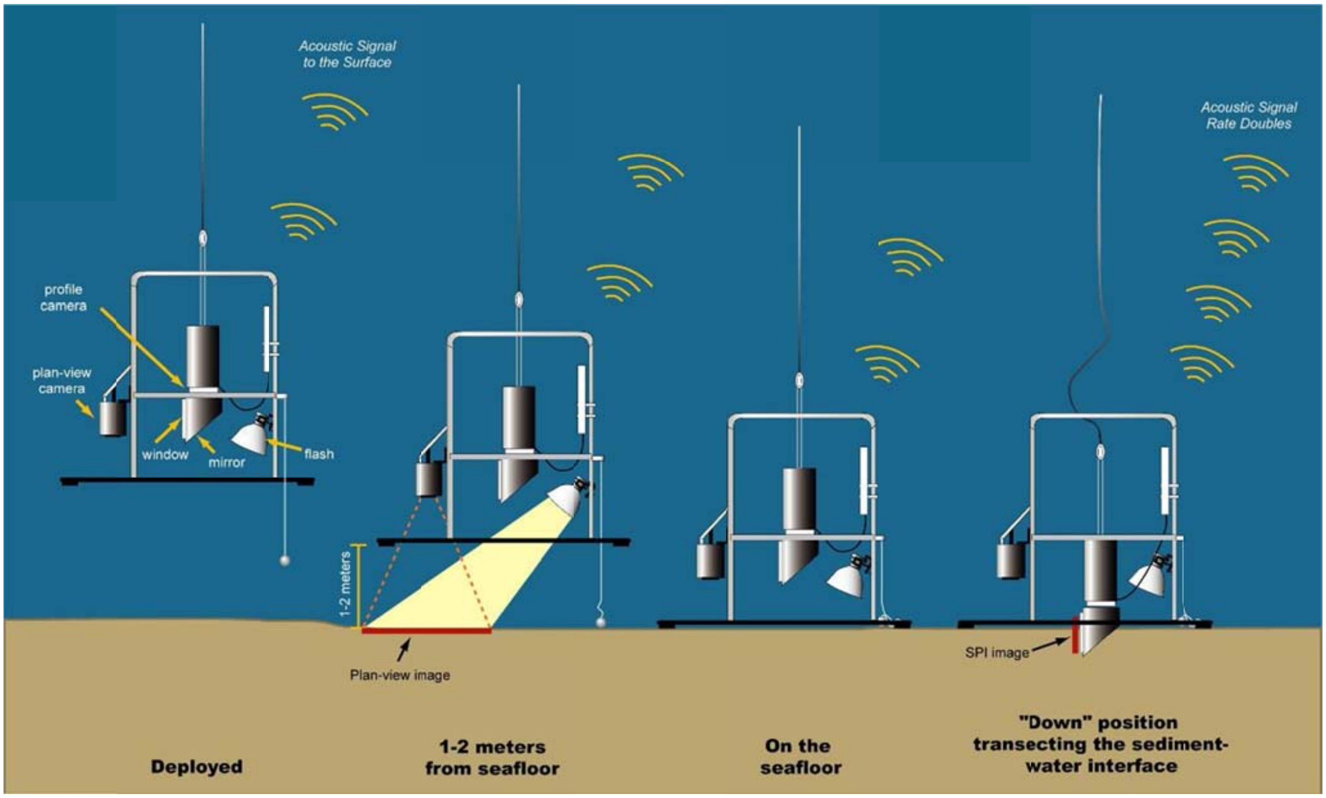


Figure 2-6. Operation of the combined Ocean Imaging Model 3731 sediment-profile and Model DSC-6000 plan-view cameras

about 1 to 5 m apart on the seafloor, the estimated distance between the successive drops of the camera while the vessel maintained its position at each station's target coordinates using the DGPS navigation system.

Two types of adjustments to the SPI camera system were made in the field to control the penetration depth into the sediment: 1) raising or lowering a set of "stop collars" on the camera frame, and 2) adding or subtracting lead weights. Electronic software adjustments also were made to control the settings of the Nikon®D200 digital camera. Camera settings (f-stop, shutterspeed, ISO equivalents, digital file format, color balance, etc.) were selected through a water-tight USB port on the camera housing and Nikon Capture® software. For the August 2010 survey, the camera settings were as follows: ISO-equivalent 640, shutter speed 1/250, f = 8.0, white balance set to flash, color mode Adobe RGB, sharpening none, noise reduction off, and storage in raw (NEF) format (3872 x 2592). Details of the camera settings for each raw digital image were recorded in the associated parameters file embedded in the electronic image file.

Test exposures of the Kodak® Color Separation Guide (Publication No. Q-13) were made on deck at the beginning and end of each survey to verify that all internal electronic systems were working to design specifications and to provide a color standard against which final images could be checked for proper color balance. After deployment of the camera at each station, the frame counter was checked to ensure that the requisite number of replicates had been obtained. In addition, a prism penetration depth indicator on the camera frame was checked to verify that the optical prism had actually penetrated the bottom to a sufficient depth. If images were missed or the penetration depth was insufficient, the camera frame stop collars were adjusted and/or weights were added or removed, and additional replicate images were taken. Changes in prism weight amounts, the presence or absence of mud doors, and frame stop collar positions were recorded for each replicate image.

Each image was assigned a unique time stamp in the digital file attributes by the camera's data logger and cross-checked with the time stamp in the navigational system's computer data file. In addition, the field crew kept redundant written sample logs. Images were downloaded periodically to verify successful sample acquisition and/or to assess what type of sediment/depositional layer was present at a particular station. Digital image files were renamed with the appropriate station name immediately after downloading as a further quality assurance step. Computer-aided analysis of the resulting images provided a set of standard measurements that enabled comparison between different locations and different surveys.

2.3.2 Sediment-Profile Image Analysis

Following completion of field operations, the digital profile images were analyzed using Bersoft Image Measurement® software version 3.06 (Bersoft, Inc.). The images were first adjusted in Adobe Photoshop® by using the levels command to expand the available pixels to their maximum light and dark threshold range; no other image adjustments were performed. Pixel width, used to measure linear distance and area, was calibrated within the image analysis software by measuring 1-cm gradations from the Kodak® Color Separation Guide. This calibration information was applied to all the sediment-profile images analyzed. Linear and area measurements were recorded as number of pixels and converted to scientific units by using the calibration information.

Measured parameters were recorded on a Microsoft Excel® spreadsheet. Dr. Joseph Germano reviewed all of the image analysis data as an independent quality assurance/quality control check of the measurements before final interpretation was performed. At each station, the measured values for the three replicate images were averaged for the purpose of mapping. The image analysis consisted of measuring the following standard set of parameters:

Sediment Grain Size: The sediment grain size major mode and range were estimated visually from the images using a grain-size comparator at a similar scale. Results were reported using the phi scale. A table that allows for conversion among different grain size scales is provided in Appendix A.

Dredged Material Presence and Thickness: The recognition of dredged material in the SPI images was based on the presence of anomalous sedimentary materials within an area of ambient sediment. In general, dredged material typically is characterized by its unique topographic roughness, color, grain size, sorting, shell content, optical reflectance, fabric, and/or compaction compared to ambient sediments.

Penetration Depth: The depth to which the camera penetrated into the seafloor was measured to provide an indication of the sediment density or bearing capacity. The penetration depth can range from a minimum of 0 cm (no penetration on hard substrata) to a maximum of 20 cm (full penetration on very soft substrata).

Small-Scale Surface Boundary Roughness: Surface boundary roughness is a measure of the vertical relief of features at the sediment-water interface in each sediment-profile image, and was determined by measuring the vertical distance between the highest and lowest points of the sediment-water interface. The surface boundary roughness (sediment surface relief) measured over the width of sediment-profile images typically ranges from 0 to 4 cm, and may be related to physical structures (e.g., ripples, rip-up structures, mud clasts) or biogenic features (e.g., burrow openings, fecal mounds, foraging depressions). Biogenic roughness typically changes seasonally and is related to the interaction of bottom turbulence and bioturbation.

Apparent Redox Potential Discontinuity (aRPD) Depth: In general, the aRPD provides an estimate of the depth to which sediment geochemical processes are primarily aerobic or oxidative; below this layer such processes are anaerobic or reducing. The term apparent is used because no actual measurements are made of porewater chemistry or redox potential (Eh). Given the complexities of iron and sulfate reduction-oxidation chemistry, it is assumed that the lighter, reddish brown color tones of surface and near-surface sediments in SPI images indicate an oxidative, or at least not intensely reducing, geochemical state, in contrast to underlying anoxic sediments exhibiting darker (typically gray or black) coloration (Diaz and Schaffner 1988, Rosenberg et al. 2001). This is in accordance with the classical concept which associates the RPD layer depth with sediment color (Fenchel 1969, Lyle 1983, Vismann 1991).

To determine the depth of the aRPD layer in each sediment-profile image, the area of lighter colored sediment observed at and just below the sediment-water interface was digitized and measured. This area (in cm^2) was divided by the width of the image to estimate the average aRPD layer depth for the image. In general, it has been demonstrated that the aRPD depth can be a reliable indicator of benthic habitat disturbance from physical factors (e.g., dredged material disposal, erosion, trawling), low dissolved oxygen, and/or excessive organic enrichment (Rhoads and Germano 1986, Diaz and Shaffner 1988, Valente et al. 1992, Nilsson and Rosenberg 2000).

Because the determination of the aRPD requires discrimination of the optical contrast between oxidized and reduced particles, it is difficult, if not impossible, to make this measurement in well-sorted sands of any size that have little to no silt or organic matter in them. At stations in the HARS study area where homogenous sandy sediments occurred, the measured SPI parameters were largely limited to grain size, prism penetration depth, and boundary roughness. In general, aRPD depths in such clean, light-colored sands cannot be determined with conventional flash photography.

Infaunal Successional Stage: The widely accepted model for marine infaunal succession predicts that macrobenthic invertebrates belonging to specific functional groups will appear sequentially with time following a physical seafloor disturbance or with increasing distance along an organic enrichment gradient (McCall 1977; Pearson and Rosenberg 1978; Rhoads and Boyer 1982; Rhoads and Germano 1982, 1986). The continuum of change in animal communities after a disturbance or along an organic enrichment gradient has been divided subjectively into four stages, numbered 0 to 3 (Figure 2-7).

Stage 0, indicative of a sediment column that is largely devoid of macrofauna, occurs immediately following a physical disturbance or in close proximity to an organic enrichment source. Stage 1 is the initial community of tiny, densely populated polychaete assemblages that can appear within days following a disturbance. In the absence of any repeated disturbances over the following weeks to months, the initial tube-dwelling suspension or surface-deposit feeding taxa are followed by burrowing, head-down deposit-feeders that rework the sediment deeper and deeper over time and mix oxygen from the overlying water into the sediment. Stage 2 is the start of the transition to head-down deposit feeders, while Stage 3 is the mature, equilibrium community of deep-dwelling, head-down deposit feeders that typically develops, in the absence of disturbance, over time periods of months to years in soft muddy sediments (Figure 2-7).

The animals in the later-appearing communities (Stage 2 or 3) are larger, have lower overall population densities (10 to 100 individuals per m^2), and can rework the sediments to depths of 3 to 20 cm or more. These animals “loosen” the sedimentary fabric and increase the water content in the sediment, thereby lowering the sediment shear strength; and actively recycle nutrients because of the high exchange rate with the overlying waters resulting from their burrowing and feeding activities.

A successional stage was assigned to each SPI image based on the observation of one or more of the features depicted in the models of Figure 2-7. Specifically, if the sediment column was uniformly black and there was no visible evidence of macrofauna, Stage 0 was assigned.

Stage 1 was assigned based on the observation of dense aggregations of small, tube-dwelling, "pioneering" or opportunistic polychaetes at the sediment surface. The presence of small amphipods or bivalves occurring just below the sediment-water interface was considered indicative of Stage 2 in the HARS images.

Stage 3 was assigned based on the presence of larger head-down deposit-feeding "equilibrium" taxa. In general, Stage 3 organisms rarely are seen in images, but the distinct feeding chambers or "voids" that develop at depth near their head ends serve as visible evidence of their presence. Bioturbation by these deposit-feeders can significantly aerate the sediment and increase aRPD depths to several centimeters.

In dynamic estuarine and coastal environments, it is simplistic to assume that benthic communities always progress completely and sequentially through all four stages in accordance with the idealized conceptual model depicted in Figure 2-7. Various combinations of the four basic successional stages are possible. For example, small surface-dwelling Stage 1 or 2 organisms can occur at the same time and place with Stage 3 organisms, resulting in the assignment of "Stage 1 on 3" or "Stage 2 on 3." In the August 2010 HARS survey, Stage 1 on 3 was assigned to any image showing high numbers of small polychaetes at or near the sediment surface, along with evidence of Stage 3 organisms occurring at depth within the sediment column. (Such evidence consisted of one or more distinctly active subsurface feeding voids and/or the presence of large deep-dwelling polychaetes.) Stage 2 on 3 was assigned to any image showing abundant amphipods or small bivalves at or just below the sediment surface, along with one or more distinctly active, subsurface feeding voids.

If an image showed abundant Stage 1 polychaete tubes along with just a few amphipods or small bivalves at or near the sediment surface, it was designated as a transitional "Stage 1 going to Stage 2" category. Similarly, an image showing amphipod tubes or small bivalves at the sediment surface and one or two small and indistinct feeding voids at depth was given a "Stage 2 going to 3" designation.

While the successional dynamics of invertebrate communities in muddy sediments have been well documented, these dynamics are not well known in sand and coarser sediments. Subsequently, the insights gained from sediment-profile imaging technology regarding biological community structure and successional patterns in sandy and coarse-grained bottoms are fairly limited. As a result, any images from the August 2010 HARS survey that had predominantly sandy sediments were considered to have an "indeterminate" successional stage.

2.3.3 Sediment Plan-View Image Acquisition and Analysis

Images of the sediment surface were also collected at each station, using a second camera mounted on the sediment-profile camera frame. An Ocean Imaging Systems Model DSC6000 plan-view underwater camera system was attached to the Model 3731 camera frame and used to collect downward-looking (i.e., horizontal or "plan-view") photographs of the seafloor surface (Figure 2-6). The plan-view system consisted of a Nikon® D-90 camera encased in a titanium housing, a 24-VDC autonomous power pack, a 500W strobe, a bounce trigger, and two Ocean

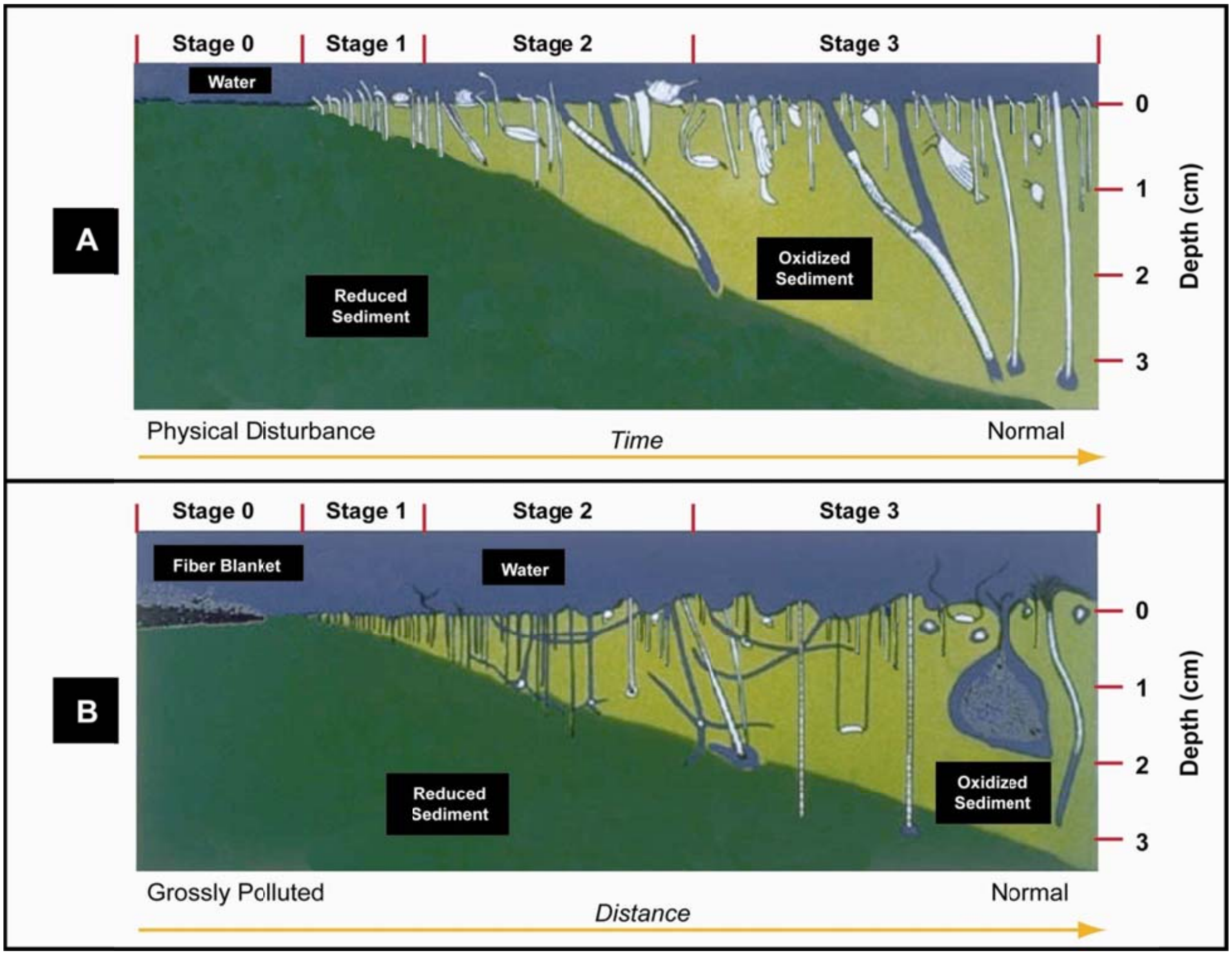


Figure 2-7. Models from Rhoads and Germano (1982) of soft-bottom benthic community response to physical disturbance (top panel) or organic enrichment (bottom panel)

Imaging Model 400-37 Deep Sea Scaling lasers. As the frame containing the profile and plan-view camera systems was lowered to the seafloor, the weight attached to the bounce trigger contacted the seafloor and triggered the plan-view camera just prior to the frame contacting the bottom. The length of the stainless steel trigger cable was adjusted for changing conditions in water clarity within the site; the scaling lasers projected two red dots separated by a constant distance (26 cm) regardless of the length of the trigger cable. The field of view for the plan-view images ranged from approximately 0.3 m^2 to 0.7 m^2, depending on the length of the trigger wire.

All plan-view images were collected as 12-megapixel raw Nikon Exchange Format (*.nef) files and converted to compressed (*.jpeg [Joint Photographic Experts Group]) files after the survey. The images were color-adjusted in Adobe Photoshop® by using the levels commands. The images were analyzed using Bersoft Image Measurement® software version 3.06 (Bersoft, Inc.). Pixel width, used to measure linear distance and area, was calibrated separately for each image using the laser dots as the calibration standard. The analysis consisted of recording information about sediment type and the presence/absence of sedimentary features such as bedforms, infauna, burrows, tubes, tracks, epifauna, mud clasts, and debris. Following analysis, the measurements were check independently by Dr. Joseph Germano.

2.4 Sediment Toxicity Testing

2.4.1 Collection of Sediment Toxicity Samples

Samples of surface sediment for toxicity testing were collected at each of the 75 stations shown in Figure 2-2 using a stainless steel, 0.1 m^2 Van Veen grab sampler. Upon arrival at the target station, the grab sampler was set in an open position and lowered to the seafloor on a stainless steel winch wire. Upon reaching the bottom, a trigger device caused the bucket to close and retain a surface sediment sample. The grab sampler was raised on the winch wire and placed on a stand secured to the deck of the survey vessel. The grab was deployed one or more times at each station within a 5-m radius of the target coordinates listed in Table 2-1.

After retrieving the grab sampler, acceptability of the sediment sample was determined. A grab was considered acceptable if the bucket was at least half full and the sediment surface in the bucket appeared to be intact, with no evidence of disturbance or washout. Grabs showing disturbance of the sediment surface or those containing an insufficient volume of sediment were determined to be unacceptable and rejected, resulting in redeployment of the sampler at the station. Sampling continued at each station until either an acceptable sample was obtained or a decision was made to move to another station because the widespread presence of rocks prevented a sample from being obtained. The time of collection and geographic position of each sample were recorded both in the field logbook and by the navigation system.

If the grab was deemed acceptable, a small subsample of the top 2 to 4 cm was placed into a precleaned jar and archived for chemical analyses. The remaining sediment was placed into a large heavy-duty plastic bag; which was sealed with a tie wrap, labeled, and placed on ice. At most of the stations, the contents of a single grab provided sufficient volume for the subsequent toxicity testing and grain size analysis. Seventy-five samples were collected during the field survey for toxicity testing and grain size analysis. Following collection, the sediment samples were delivered to the Aqua Survey, Inc. (ASI) testing facility in Flemington, New Jersey.

2.4.2 Laboratory Methods for Sediment Toxicity Testing

ASI conducted the toxicity testing on the sediment grab samples between 1 September and 24 November 2010. Sediment toxicity was evaluated using the standard 10-day acute test with the marine amphipod *Ampelisca abdita*, a representative benthic species, in accordance with the following documents:

- ASTM E1367-03 *Standard Test Method for Measuring the Toxicity of Sediment-Associated Contaminants with Estuarine and Marine Invertebrates*;

- USEPA and USACE. 1991. *Evaluation of Dredged Material Proposed for Ocean Disposal – Testing Manual* (Green Book). EPA-503/8-91/001;

- USACE New York District. *Guidance for Performing Tests on Dredged Material Proposed for Ocean Disposal.* December 1992;

- T. Davies, D. Davis and J. Elmore. 1993. Memorandum to EPA Regional Ocean Dumping Coordinators, EPA Regional Wetland Coordinators, and Corps of Engineers Regulatory and Civil Works Elements. *Technical Panel Recommendations Concerning Use of Acute Amphipod Tests in Evaluation of Dredged Material*. New York District, U.S. Army Corps of Engineers, New York, NY.

The sediment samples were transferred under chain of custody and received for toxicity testing by ASI on 1 September 2010; all samples were logged in and assigned unique sample numbers and stored at 4°C prior to testing. The *A. abdita* used in testing were field-collected by ASI personnel on multiple dates in the vicinity of Atlantic Highlands, New Jersey. Control sediment was collected from the amphipod collection site at the time of initial organism collection (7 September 2010). Test organisms were held and acclimated to test temperature and salinity for 2 to 8 days prior to testing.

The initial total ammonia (as nitrogen) level in the porewater of each sediment sample was measured, and any samples that exceeded the USEPA-specified threshold of 20 mg/L (see Davies et al. 1993, cited above) underwent pretest purging to reduce the total ammonia in the porewater to below the 20 mg/L threshold. Subsequent testing of these samples was conducted under static renewal conditions; testing of samples which did not exceed the initial threshold was conducted under static conditions. The 75 samples were divided into 12 rounds of testing, with a separate control for each round.

Twenty-four hours before the tests were initiated, five replicate exposure chambers for each sample were set up, each containing 175 ml of sediment and 925 ml of overlying water. Twenty organisms were added to each replicate exposure chamber on the following day. Water quality parameters (temperature, salinity, dissolved oxygen [DO], pH, and total ammonia, as nitrogen) for each treatment were monitored daily.

A Standard Reference Toxicant test, using cadmium chloride as the toxicant, was run for each batch of organisms. The reference toxicant data were entered into the ToxCalc program based on currently accepted methods for calculating an LC_{50}. The LC_{50} values for the *A. abdita* used in the testing fell within the 95% confidence limits of the control chart. Analysis of variance (ANOVA) was performed to compare survival of organisms in the test samples to the survival of organisms in the control for each respective round of testing. Additional details regarding Quality Assurance/Quality Control (QA/QC) procedures employed during the toxicity testing are provided in ASI's technical report (Aqua Survey, Inc. 2010) and in their Quality Assurance Plan (Aqua Survey, Inc. 2008).

2.4.3 Sediment Toxicity Data Analysis

To standardize results for comparisons among the four previous sediment toxicity surveys of 1994, 2000, 2002, and 2005; all test sediment survival rates were normalized to their respective control sediment survival rate. To calculate the normalized values, the following equation was used:

Normalized % survival = [(% survival in test sediment)/(% survival in control sediment)] * 100

In the 1994 study conducted by USEPA Region 2, the collected samples were split into two groups and tested at two different facilities: the USEPA Region 2 laboratory in Edison, New Jersey, and the Battelle Ocean Sciences facility in Sequim, Washington (Battelle 1996). In the testing of samples at the Battelle facility, a single control sample was employed, and a mean organism survival of 90.7% for this sample was used to normalize the results for the test samples. In the testing performed at the USEPA facility, the mean survival rate for the single control sample that was utilized was 100% (Battelle 1996). In the previous sediment toxicity surveys of 2000, 2002, and 2005; the testing was performed at ASI in smaller groupings, with one control for each group. The percent survival for each sample was normalized to its respective control.

Once all samples were normalized to their respective control, toxicity (yes or no) was determined based on two criteria. A sediment sample was considered toxic if 1) its mean control-normalized survival was <80%, and 2) its mean nonnormalized survival was significantly different from the mean control survival (based on an ANOVA at the 0.05 significance level). For the 1994 data compiled by Battelle and the USEPA, statistical analysis was completed using ANOVA with Dunnett's Test ($\alpha=0.05$) and ANOVA with Bonferroni/Dunn's test ($\alpha=0.05$) (Battelle 1996). Samples from 1994 were considered toxic if there was <80% survival.

2.5 Benthic Community Analysis

2.5.1 Benthic Sample Collection

A single sediment grab sample was obtained for benthic community analysis at each of 20 of the 90 SPI stations. This included eleven stations located in PRA 1 and nine reference stations located in the wider HARS area outside of PRA 1 (Figure 2-2). The stations were selected by reviewing the profile images in the field, which revealed the presence of several different types of benthic habitats within PRA 1. Benthic grab samples were then obtained at up to four stations for each habitat type, both within PRA 1 and at the reference stations outside of PRA 1 (Table 2-2). This provided the ability to examine the potential influence of not only location (inside or outside of PRA 1) but also habitat type on benthic community composition.

The single grab sample taken at each station was collected using a stainless steel, 0.04 m^2 Young-modified van Veen grab sampler having a maximum penetration depth of 12 cm. Upon arrival at the target station, the grab sampler was set in the open position and lowered to the seafloor on a stainless steel winch wire. Upon reaching the bottom, the device was retrieved, causing the bucket to close and retain a surface sediment sample. The grab sampler then was raised on the winch wire and placed on a stand secured to the deck of the survey vessel.

After retrieving the grab sampler, the acceptability of the sediment sample was determined. An acceptable grab was characterized as having relatively level, intact sediment over the entire area of the grab, and generally a sediment depth at the center of at least 7 cm. Grabs showing disturbance of the sediment surface or those containing an insufficient volume of sediment were determined to be unacceptable and rejected, resulting in redeployment of the sampler at the station until an acceptable sample was obtained. The time of collection and geographic position of the sample were recorded both in the field logbook and by the navigation system.

Once a grab sample was determined to be acceptable, the contents were transferred to a sieve having a 0.5-mm mesh size. The sieve was placed on a sieve table, and a gentle flow of water was washed over the sample. Extreme care was taken to ensure that no sample was lost over the side of the sieve while agitating or washing the sample. After all of the fine material had been washed through the sieve, the organisms and any remaining material (e.g., shells, wood, rock fragments, etc.) were placed into a labeled 1-L wide-mouth plastic container. The sample was then preserved using a 5% buffered formalin solution with Rose Bengal added to stain the organisms. Once the cap was secured, the contents were mixed by inverting the container several times. All samples were delivered by overnight mail to Barry A. Vittor and Associates, Inc. (BVA) of Mobile, Alabama, for detailed benthic analysis (sorting, enumeration and identification to Lowest Practicable Identification Level [LPIL]).

2.5.2 Benthic Sample Processing

At the BVA laboratory, the contents of each benthic sample were examined under a dissecting microscope, and the preserved specimens identified and counted. Individual organisms

Table 2-2.

Number of Benthic Grab Stations Allocated to Each Habitat Type in PRA-1 and in the Reference Area Outside of PRA-1

Habitat Type	No. of Stations in PRA-1	No. of Reference Stations
Muddy sand	4	3
Sand over mud	2	3
Clean fine sand	4	3
Mixed mud/sand/gravel	1	0
TOTAL	11	9

were removed from each sample and placed in vials labeled by major taxonomic group. Taxonomists with a specialization within each major taxonomic group proceeded to identify the preserved organisms to the LPIL. Quality Assurance and Control procedures (QA/QC) associated with the benthic taxonomic analyses are described in the laboratory's Quality Assurance Project Plan (Barry A. Vittor & Associates, Inc. 2010).

2.5.3 Benthic Data Statistical Analysis

The raw benthic community data received from the laboratory consisted of a standard species list showing the number of individuals of each taxon collected in the single grab sample at each station. Since the Van Veen grab sampled a 0.04 m^2 area of the bottom, the raw sample counts were multiplied by 25 to express abundance on a standard "per m^2" basis. Analysis of the benthic community data included both univariate and multivariate statistical approaches to determine similarities and differences between the two station groups (i.e., PRA 1 stations versus reference stations).

2.5.3.1 Univariate Statistics

A number of standard univariate statistics were used to summarize the benthic community data for the two station groups, including calculation of the average organism density (number of individuals per m^2) per station, average number of taxa per station, and the percentage breakdown of abundance by taxa for each station group. Additional analyses were performed to calculate species richness, diversity, and evenness index values for each station.

Species richness was determined using Margalef's index (d), which provides a measure of the number of species (S) present for a given number of individuals (N) according to the following equation:

$$d = (S\text{-}1)/\log_2 N$$

Diversity was calculated using the Shannon-Weiner (H') index:

$$H' = -\Sigma i \; p_i (\log_e p_i)$$

where p_i is the proportion of the total count arising from the *ith* species.

Equitability, the evenness of the species distribution, was determined using Pielou's evenness index (J'):

$$J' = H' \text{ (observed)}/ H' \text{ max}$$

where H' max is the maximum possible diversity which would be achieved if all species were equally abundant = $\log_2 (S)$.

The univariate statistics each provide a measure of a single community attribute (e.g., species richness, diversity, evenness) and can be compared between groups using box-and-whisker plots. Box-and-whisker plots (also called boxplots) are used to illustrate the distribution of the data, providing information about the location and spread of the data as well as skewness. They are especially useful when several boxplots are placed side-by-side. Each boxplot has a shaded or colored rectangle that shows the spread of values between the 1st and 3rd quartiles (i.e., the 25th and 75th percentiles). The height of this box is the interquartile range (IQR) which is simply the value of the 3rd quartile minus the value of the 1st quartile. The line inside the box indicates the median; the outer brackets (the "whiskers") are drawn to the nearest value not beyond a standard span from the quartiles; points outside the whiskers are possible extreme values and are shown as single lines. The standard span is 1.5 times the IQR from the nearest quartile. This standard span is a reasonable boundary to contain most (e.g., at least 90%) of the data from a normal (Gaussian) distribution.

2.5.3.2 Multivariate Statistics

Multivariate statistical techniques involve looking at the benthic community structure as a whole when trying to discern spatial patterns or when comparing among different stations (Clarke 1999). The terms "benthic community structure" and "benthic community composition" used herein refer to the concept of looking simultaneously at both the taxa that are present and their relative numbers when comparing different stations to each other.

Using R software (R development Core Team 2010), two independent but complementary multivariate techniques were used to evaluate both the among-station and among-group patterns in overall benthic community structure: hierarchical clustering and nonmetric multidimensional scaling (nMDS). Each of these techniques serves to describe the similarities between stations and, if possible, to classify the stations into groups having mutually similar benthic community structure. As explained in more detail below, the techniques differ in the type of graphical display produced.

Clustering and nMDS are nonparametric exploratory techniques that require few or no assumptions about the data to provide insight into the data structure. Data transformations do play the important role in these techniques of defining the balance between contributions from common versus rarer species in the measure of similarity among stations. In the present analysis, a decision was made to apply a fourth root transformation to the species abundance data to down-weight the contribution of the numerically dominant taxa while increasing the contribution of the rarer and/or less abundant taxa in assessing the degree of similarity among stations.

Only the 27 taxa representing the "numerical dominants" (i.e., those comprising 90% of the total abundance) were used in the cluster analysis; each of the 158 nondominant taxa represented less than 10% of the abundance in any given sample. Prior to performing the clustering, the abundance values were fourth-root transformed, and a matrix was then constructed consisting of Bray-Curtis similarity index values (Bray and Curtis 1957) calculated between each possible pair of stations (i.e., pairwise comparisons). The Bray-Curtis similarity metric is considered to be the most robust and powerful metric for abundance data (Faith et al. 1987, Faith et al. 1991). Hierarchical agglomerative clustering with "complete" or "farthest neighbor" linkage was then performed on the Bray-Curtis similarity matrix. "Agglomerative" methods start out with each station in a separate group. At each stage the two most similar clusters are combined to form one bigger cluster. For complete or farthest neighbor linkage, the distance between two clusters is the distance between the two farthest points in those clusters. Representation of the results uses a tree diagram or dendrogram, with the y-axis representing the full set of stations and the x-axis representing the Bray-Curtis similarity level at which two stations or groups are considered to have fused.

Nonmetric multidimensional scaling (nMDS) attempts to provide an ordination, or "map," of the stations such that distances between stations on the map reflect corresponding similarities or dissimilarities in community structure. Stations that fall in close proximity to one another on the map have similar community structure, while those that are farther apart have dissimilar structure (e.g., few taxa in common or the same taxa at different levels of abundance). Like the cluster analysis, nMDS ordination (Kruskal and Wish 1978) was performed on the matrix of Bray-Curtis similarity index values derived from the fourth-root-transformed abundance data. The two-dimensional nMDS plot provides a simple and compelling visual representation of the closeness of the benthic community structure (i.e., species composition and abundance) between any two stations or station groups.

The algorithm used to create the two-dimensional nMDS plot was Kruskal's nMDS (isoMDS function in R) which attempts to find the two-dimensional ordination that most closely matches the original ordination pattern by minimizing "stress." Stress is a measure of the goodness-of-fit of the regression between the distance values in the original observed ordination and those in the nMDS ordination. From an initial configuration, the nMDS algorithm uses an iterative searching approach, where points in the nMDS plot are nudged and stress recalculated, until stress reaches a local minimum. The stress formula used was Kruskal's f-stress (or stress formula 1; Kruskal and Wish 1978). Essentially, the nMDS algorithm tries to maximize the rank correlation between the observed pairwise distances and the nMDS pairwise distances. A smaller stress value (e.g., <10%) indicates that the nMDS ordination is a good representation of the original pairwise relationships between samples. The smaller the stress, the better the representation. Generally, stress values under 10% are considered "good" and values over 15% are considered "poor."

3.0 RESULTS

A complete set of image analysis results is provided in Appendices B (for the profile images) and C (plan-view images). The following section (section 3.1) presents the results of the postremediation monitoring effort in PRA 1; the goal of this monitoring was to characterize baseline conditions and assess benthic recolonization status within this area following the completion of remediation activities. The results of the general HARS monitoring effort are presented in section 3.2; that effort involved sampling at stations in the other PRAs as well as in areas outside the HARS boundary.

3.1 Postremediation Monitoring in PRA 1

3.1.1 Physical Sediment Characteristics Determined From Images

Physical sediment characteristics within PRA 1 were evaluated through analysis of both the profile and plan-view images. The profile images revealed that surface sediments at the majority of stations consisted of very fine to fine sand (Table 3-1 and Figure 3-1). Of the fifteen stations within PRA 1, eleven stations had a grain size major mode of either 3 to 2 phi (fine sand) or 4 to 3 phi (very fine sand)(Table 3-1). At Stations 2010-05, 2010-07, and 2010-08 located along the eastern side of PRA 1, the fine sand was relatively free of silt/clay (Figure 3-2). Such "clean" fine sand also characterized Station 2010-10 located in the northern half of PRA 1 (Figure 3-3). At many of the other stations within PRA 1, there was silt/clay mixed with the sand (Figure 3-4). The sediment at these stations was described as "muddy fine sand" (Figure 3-3).

Distinctive sand-over-mud layering was observed at Station 2010-01 located in the northwest corner and at Station G-1200 located along the southern boundary of PRA 1 (Figures 3-1, 3-3, and 3-5). Station 2010-04 was the only station within PRA 1 that was characterized by fine-grained sediment (i.e., muddy dredged material) having a major mode of >4 phi (Figures 3-1 and 3-3). At this station, the profile images showed distinct layering of two different types of fine-grained dredged material, with a surface layer of soft, brown mud overlying red clay at depth (Figure 3-6). A mixture of coarse sand and gravel was observed at Station 2010-06 located near the southeastern corner of PRA 1 (Figures 3-1, 3-3 and 3-7).

The analyzed results of the plan-view images were consistent with the SPI characterization of several different sediment types present within PRA 1 (Figure 3-8). These included rippled fine sand (Figure 3-9), muddy fine sand (Figure 3-10), and mixed sand/gravel (Figure 3-7). At Station 2010-03 located near the western boundary of PRA 1, both the profile and plan-view images showed muddy sand interspersed with a few large rocks, indicating variability in sediment types at this location (Figure 3-11).

All of the stations located within PRA 1 had surface sediment consisting of dredged material (Figure 3-12) that extended from the sediment surface to below the imaging depth of the profile camera, resulting in the measured dredged material thickness being indicated with a "greater than" sign in Table 3-1. A distinction was made between remediation material and historical or "relict" material for the purpose of mapping spatial distribution. Remediation

Table 3-1.

Summary of SPI Results for the 2010 Stations in PRA 1

Station	Grain Size Major Mode (phi)	Penetration Mean (cm)	Boundary Roughness (cm)	Mean aRPD (cm)	Mean Dredged Material Thickness (cm)	Avg. No. Feeding Voids	Successional Stages Present in each of 3 Replicates		
4	3 to 2	4.0	2.5	2.7	>4.0	0	2	2 going to 3	2 going to 3
7	4 to 3	2.3	1.0	1.5	>2.3	0	ind	2 on 3	2 on 3
11	3 to 2	3.2	1.2	1.9	>3.2	0	2	2	2 going to 3
E0800	4 to 3	4.3	1.8	3.1	>4.3	0	1 on 3	ind	ind
G-1200	4 to 3/>4	14.3	1.1	3.0	>14.3	0.7	1 on 3	1 on 3	1 on 3
2010-01	4 to 3/>4	19.9	1.2	3.6	>20.5	0.3	3	3	1 on 3
2010-02	3 to 2	9.4	0.8	2.1	>9.4	0	ind	ind	ind
2010-03	3 to 2	2.0	2.2	0.6	>2.0	0	ind	ind	ind
2010-04	>4	15.8	0.8	3.2	>15.8	2.3	2 on 3	2 on 3	2 on 3
2010-05	3 to 2	5.0	1.4	ind	>5.0	0	ind	ind	ind
2010-06	0 to -6	4.2	1.4	ind	>4.2	0	ind	ind	ind
2010-07	3 to 2	3.9	1.5	ind	>3.9	0	ind	ind	ind
2010-08	3 to 2	3.2	0.9	ind	>3.2	0	ind	ind	ind
2010-09	>4 to 3	5.4	0.7	2.7	>5.4	1.0	1 on 3	1 on 3	1 on 3
2010-10	3 to 2	3.0	1.7	ind	>3.0	0	ind	ind	ind

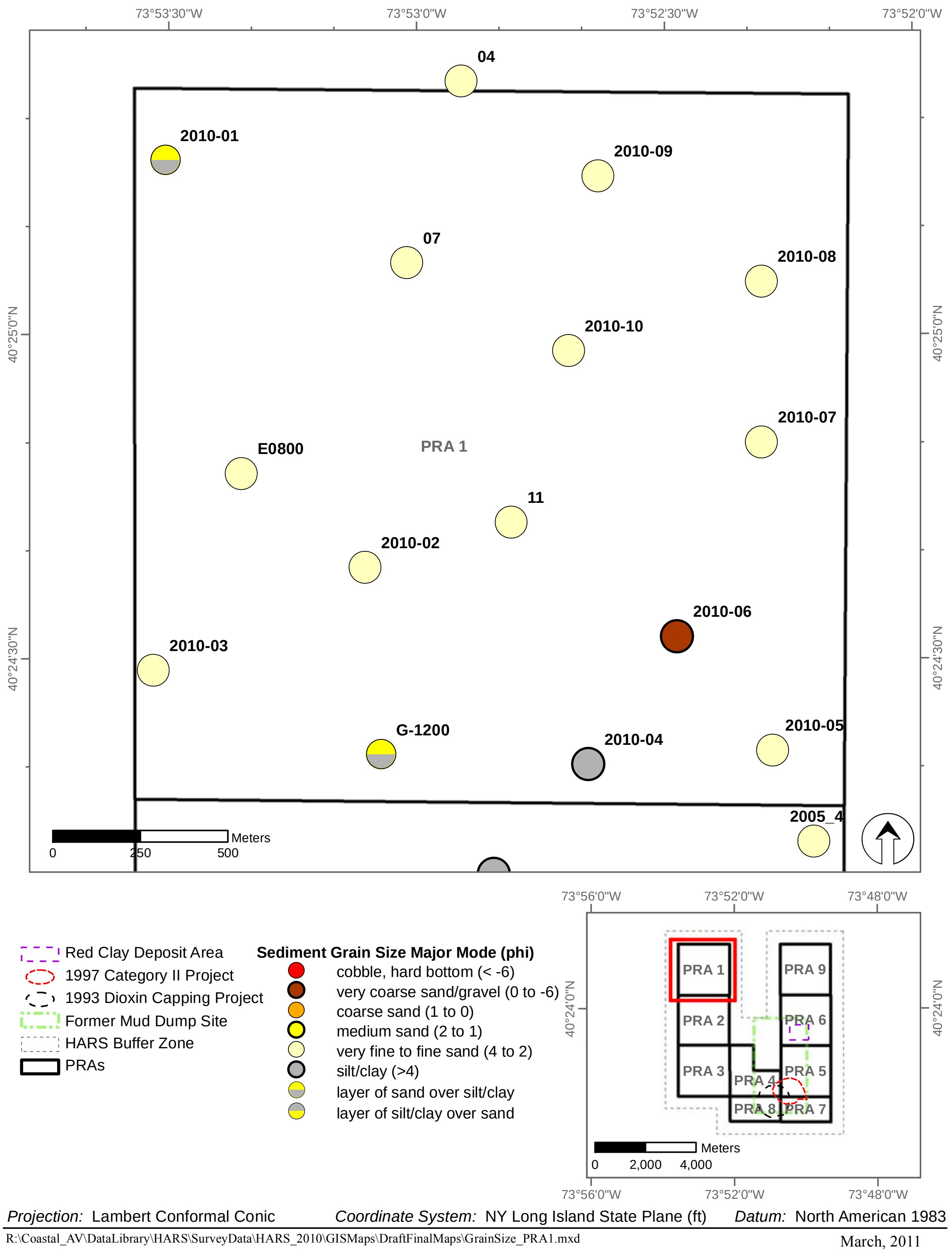


Figure 3-1. Grain size major mode (in phi units) at the stations within PRA 1, based on analysis of profile images

Figure 3-2. Profile image from PRA 1 Station 2010-07 illustrating fine sand (3 to 2 phi) that is relatively free of fine grained sediment (referred to as "clean" fine sand)

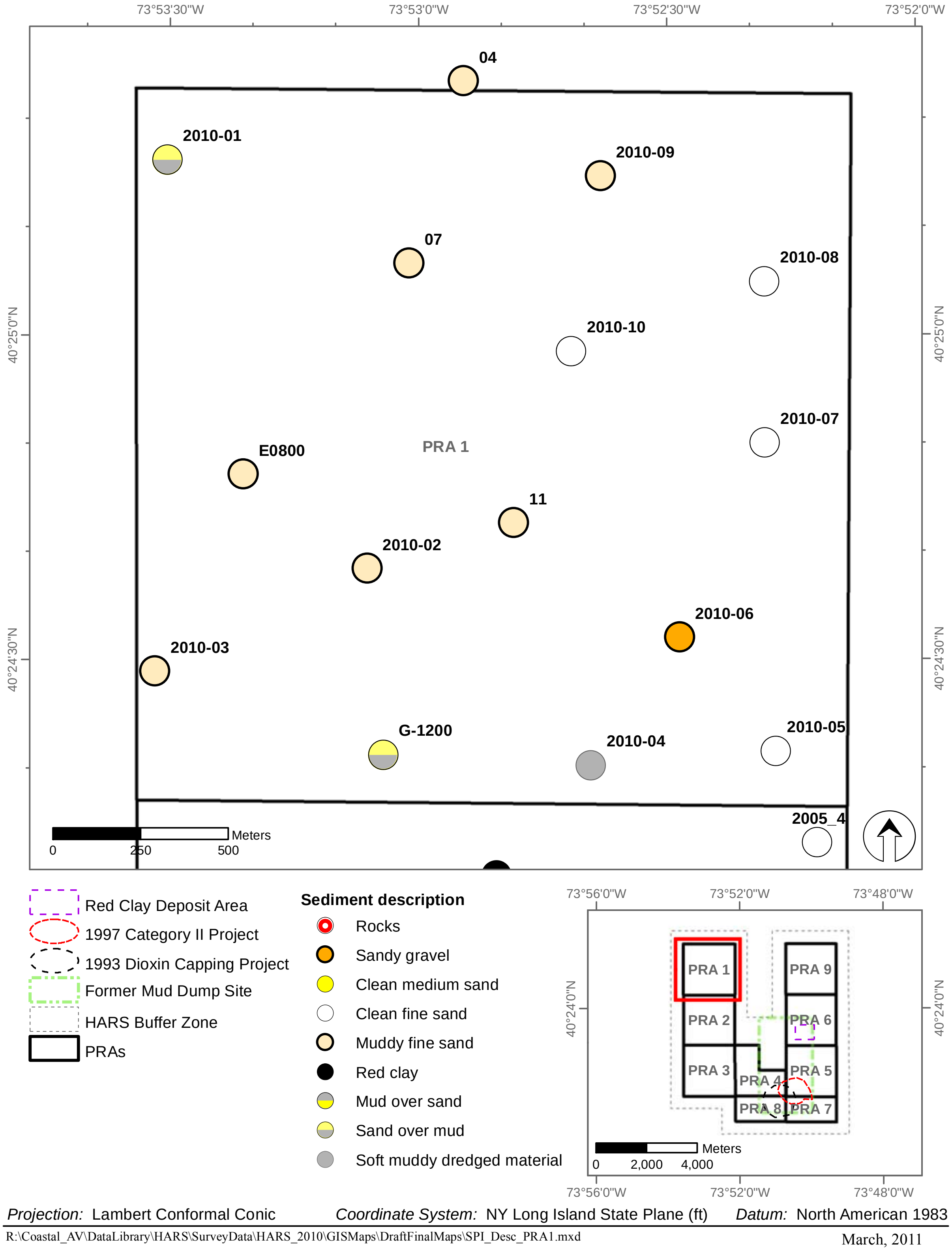


Figure 3-3. Sediment descriptions at the PRA 1 stations, based on analysis of profile images

Figure 3-4. Profile image illustrating muddy fine sand at Station 2010-02 within PRA 1. A surface layer of brown silt/clay, with numerous large worm tubes, overlies fine sand at depth.

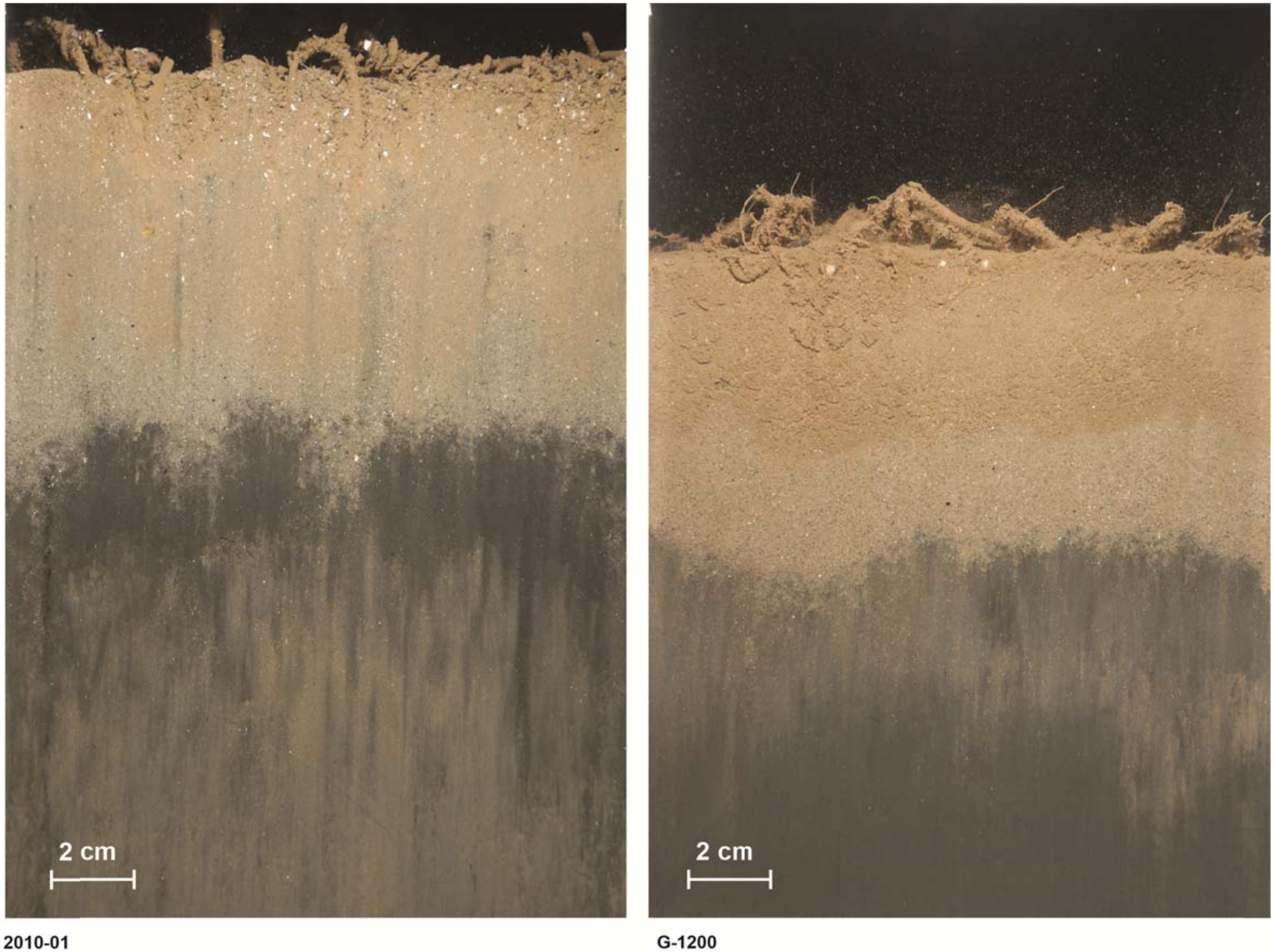


Figure 3-5. Profile images showing distinctive sand-over-mud layering at PRA 1 Stations 2010-01 (left) and G-1200 (right). The surface sand layer has a thickness of 9 cm in the left image and 7 cm in the right image. In both images, large worm tubes are present at the sediment surface.

Figure 3-6. Profile image from PRA 1 Station 2010-04 showing layering of two types of fine-grained remediation material: a surface layer of light brown mud over red clay at depth. Both types of material have a grain size major mode of >4 phi.

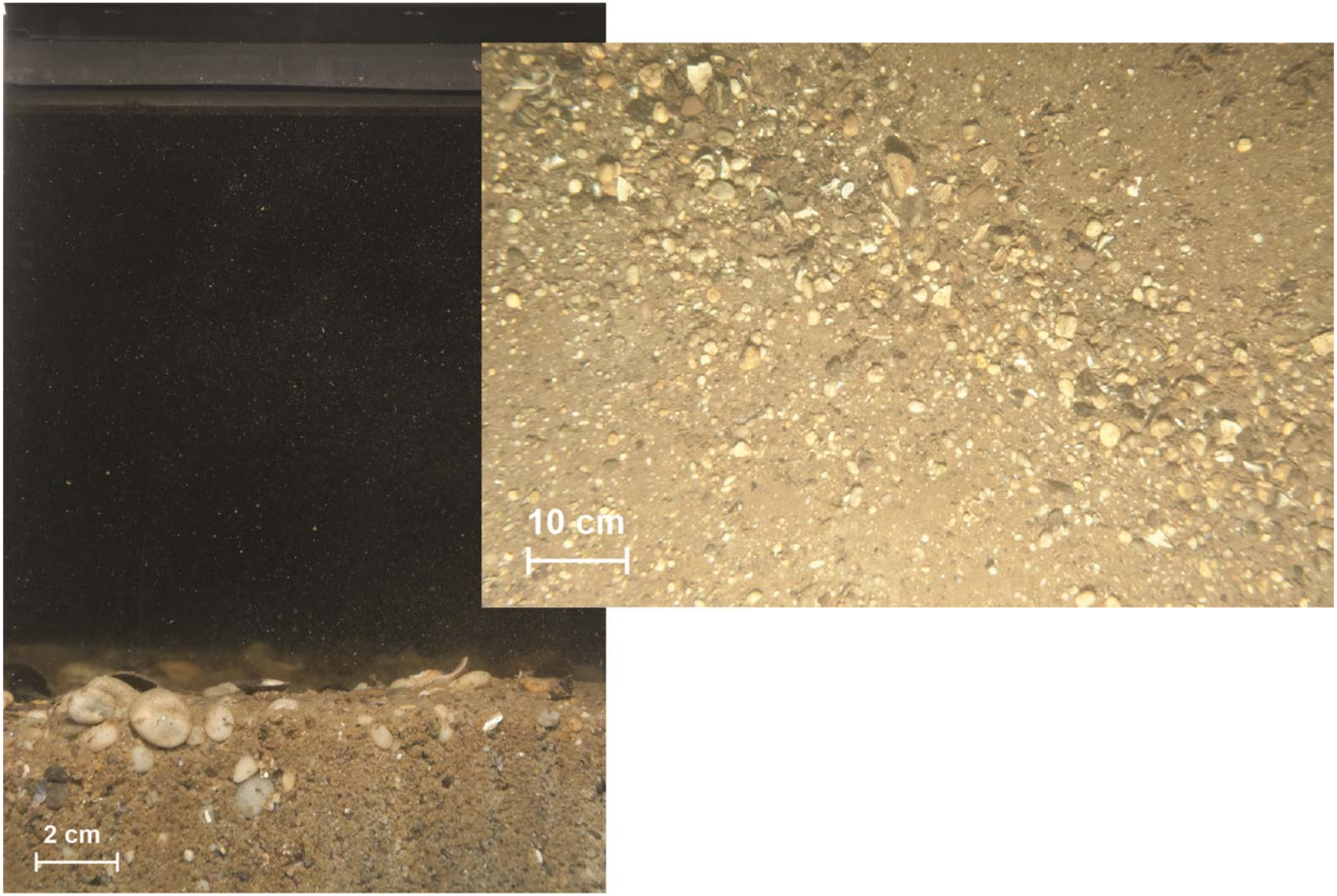
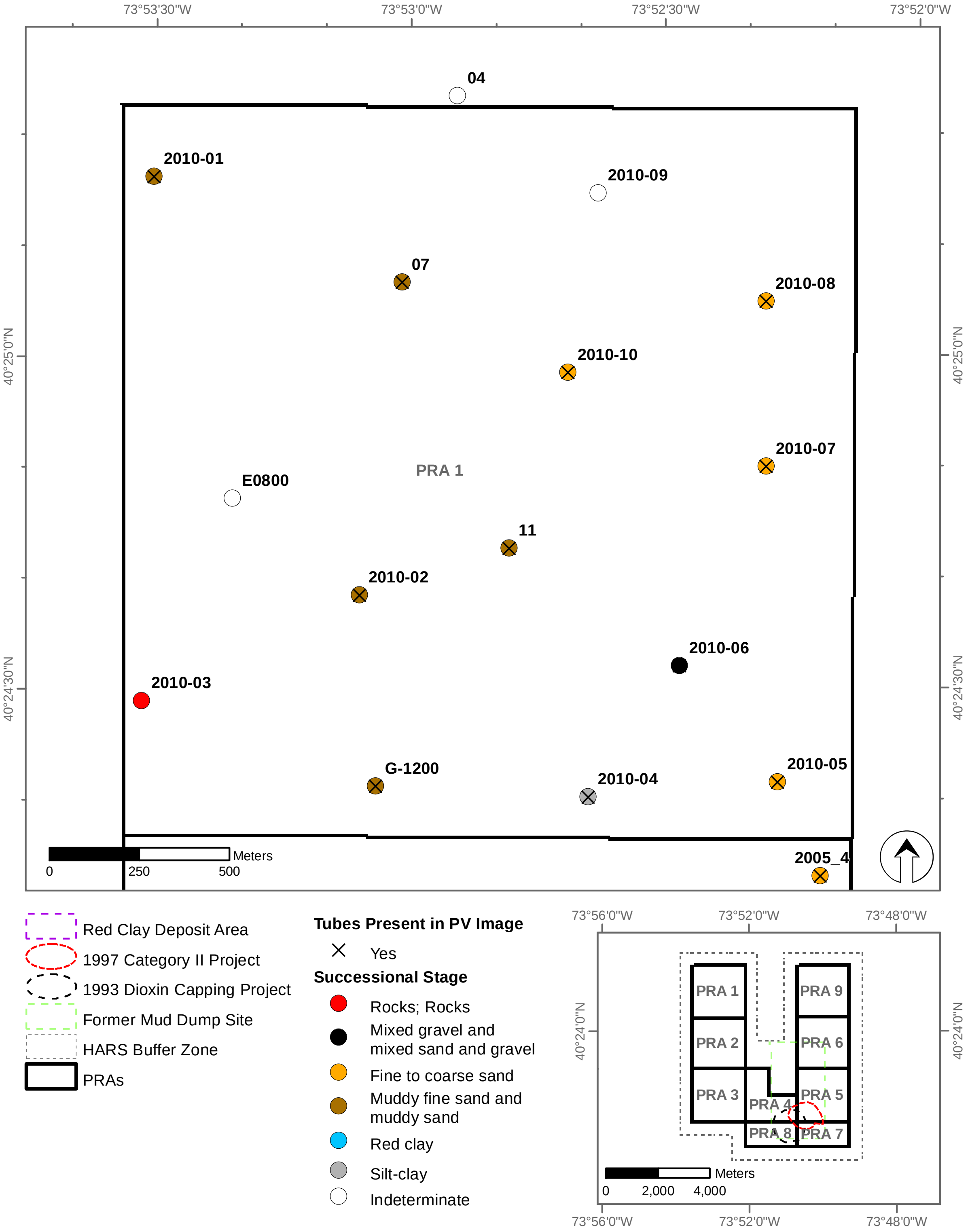


Figure 3-7. Profile and associated plan-view images showing a mixture of coarse sand and gravel at PRA 1 Station 2010-06.



Projection: Lambert Conformal Conic *Coordinate System:* NY Long Island State Plane (ft) *Datum:* North American 1983

C:\Users\marie\Documents\HARS\DraftFinalMaps\SPI_PV_Desc_PRA1.mxd February, 2011

Figure 3-8. Sediment descriptions at the PRA 1 stations, based on analysis of plan-view images

Figure 3-9. Plan-view image providing an example of rippled fine sand at PRA 1 Station 2010-05. Numerous large brown worm tubes are also visible among the sand ripples on the sediment surface.

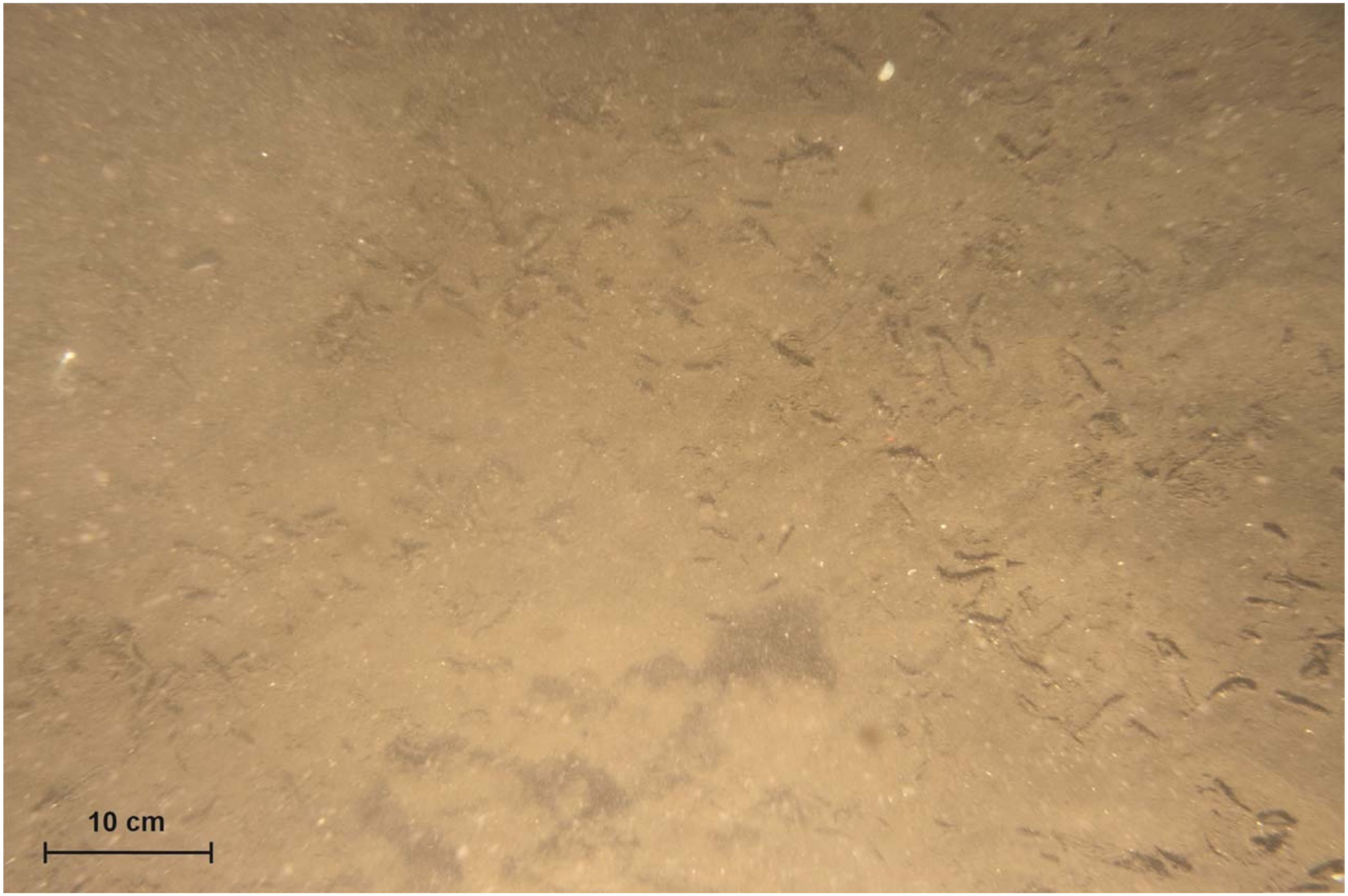


Figure 3-10. Plan-view image providing an example of muddy fine sand at PRA 1 Station 2010-02. Large worm tubes are also visible on the sediment surface.

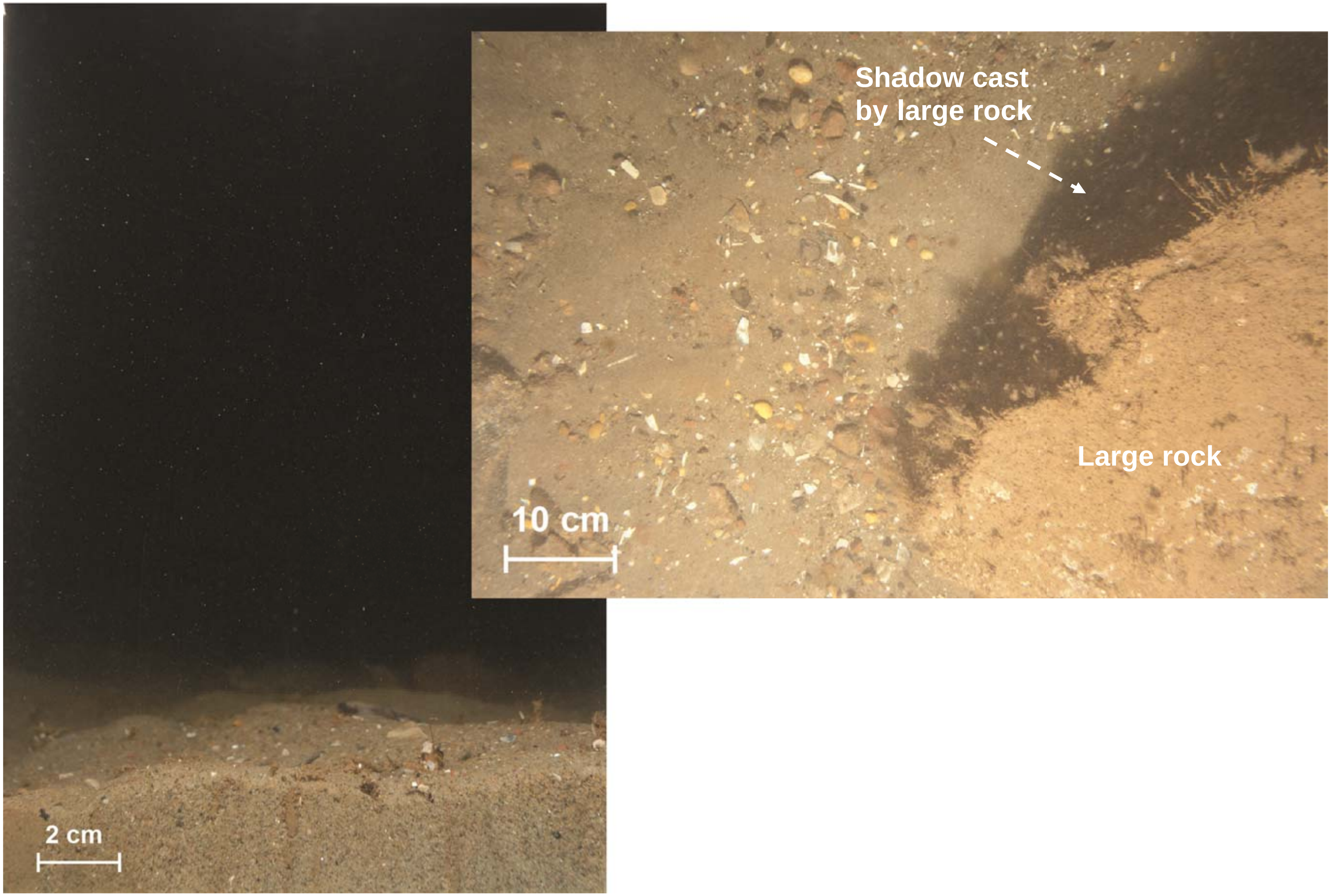
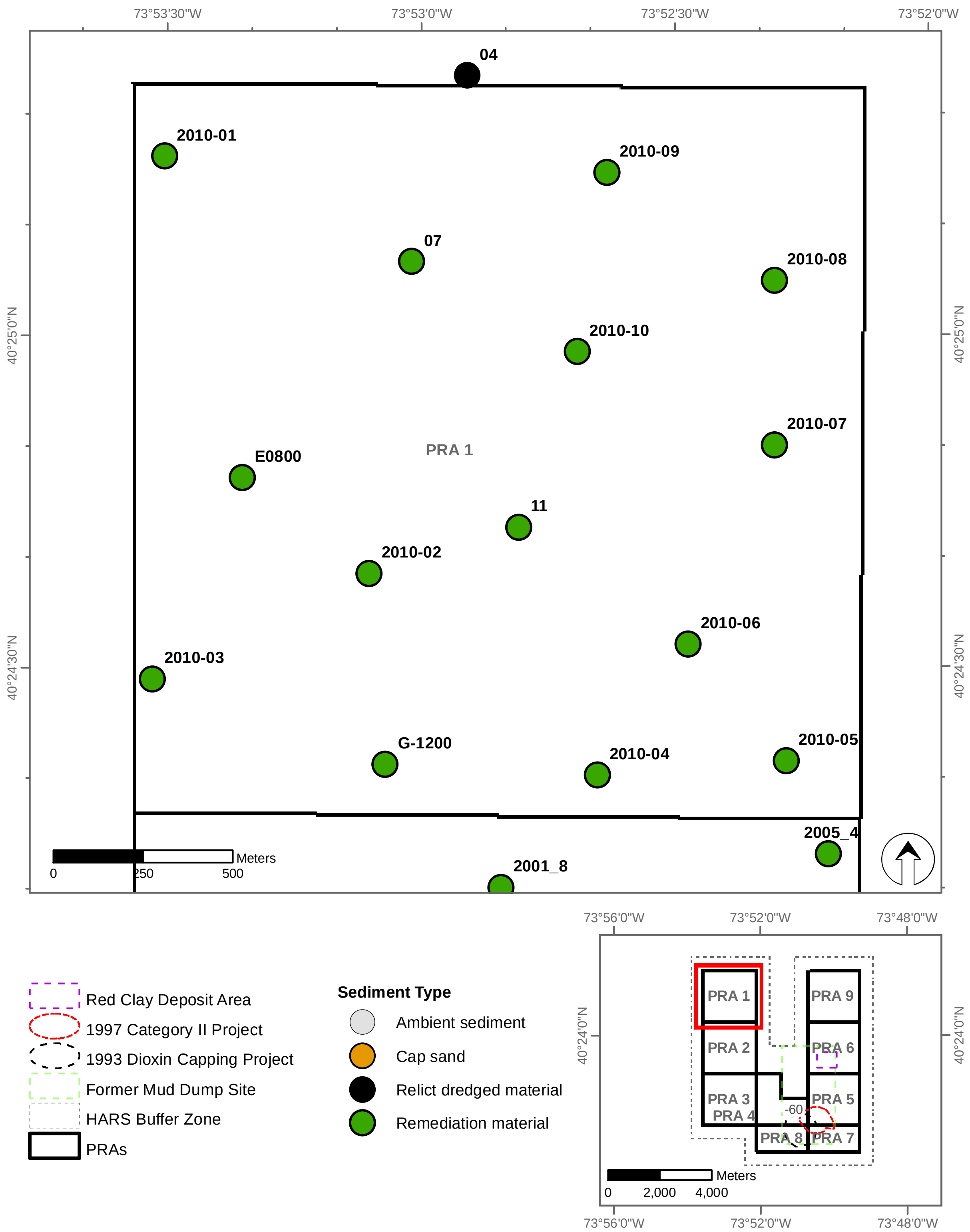


Figure 3-11. Evidence of small-scale spatial variability in sediment types at PRA 1 Station 2010-03: the profile image shows muddy fine sand, while the plan-view image shows a large rock and sand mixed with gravel.



Projection: Lambert Conformal Conic *Coordinate System:* NY Long Island State Plane (ft) *Datum:* North American 1983

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February, 2011

Figure 3-12. Spatial distribution of remediation material and relict dredged material in PRA 1 material, defined here as any dredged material placed at the HARS since its designation in September 1997, was observed at all of the stations in PRA 1 except Stations 04 and 2010-09 (Figure 3-12). These two stations, located in the extreme northern part of PRA 1, were characterized by sandy relict dredged material (Figure 3-12). Remediation material was not placed in this area due to the presence of two shipwreck buffer zones. As shown in Figure 3-3, the remediation material in PRA 1 consisted of diverse sediment types, including silt/clay (e.g., Figure 3-6), fine sand (e.g., Figures 3-2 and 3-4), gravel (e.g., Figure 3-7), and rocks (Figure 3-11). Not surprisingly, the mapped distribution of the remediation material on the seafloor in PRA 1 corresponds closely to the barge placement points depicted in Figure 1-3.

The average prism penetration depths within PRA 1 varied widely, from 2.0 cm at Station 2010-03 to 19.9 cm at Station 2010-01 (Table 3-1 and Figure 3-13). These wide ranges reflect the diversity of sediment types. In general, higher penetration occurred at stations with fine-grained remediation material, while lower camera penetration was associated with fine sand and gravel.

Average small-scale boundary roughness values at the stations within PRA 1 ranged from 0.7 to 2.5 cm (Table 3-1 and Figure 3-14). At many of the sandy stations, the surface relief was of physical origin, due to the presence of ripples (e.g., Figure 3-9). At many of the stations with soft muddy sediments, the surface roughness was due to biological activity, often denoted by presence of large worm tubes at the sediment surface (e.g., Figure 3-5).

3.1.2 Sediment Grain Size Analysis

As indicated previously, the grain size distribution and moisture content of surface sediments were determined concurrent with the sediment toxicity testing at 75 stations. Fine sand was the dominant grain size fraction at almost all of the PRA 1 stations (Table 3-2 and Figure 3-15). Exceptions included Station 2010-04, which was dominated by silt/clay, and Stations E0800 and 2010-06, which had substantial amounts of coarse sand and gravel. Silt/clay fractions greater than 30% were found at Stations G-1200 and 2010-01, both of which had sand-over-mud stratigraphy in the profile images (Table 3-2 and Figure 3-15). In general, the grain size analysis results in PRA 1 are consistent with the results of the profile imaging; both showed that sand was the dominant sediment type at the PRA 1 stations. Sediment percent moisture at these stations was found to range from 15.2% to 34.7% (Table 3-2).

3.1.3 Biological Conditions Determined From Images

Average aRPD depths at the PRA 1 stations ranged from 0.6 cm to 3.6 cm (Table 3-1 and Figure 3-16). The majority of the stations (9 of 15) had aRPD depths of 1.5 cm or greater, indicating a moderate to high degree of surface sediment reworking (Figure 3-17). The relatively shallow aRPD of 0.6 cm at Station 2010-03 was due to the presence of reduced remediation material (Figure 3-18). The aRPD was indeterminate at five of the PRA 1 stations due to the presence of homogenous sand lacking any redox color contrast.

Table 3-2.

Sediment Grain Size and Moisture Content for the Stations in PRA 1

		% Sand				% Fines		
Station	**% Gravel**	**% Coarse**	**% Medium**	**% Fine**	**Total Sand**	**% Silt**	**% Clay**	**% Moisture**
04	0	0	17.4	74.7	92.1	2.2	5.7	23.6
07	0	0.1	0.4	90.5	91	5.7	3.3	24.8
11	0	1.8	37.8	55.2	94.8	0.7	4.5	22.1
E0800	23.2	14.3	19.5	37.1	70.9	3.6	2.3	26.7
G-1200	0	0.2	6.6	54.7	61.5	26.6	11.9	29.2
2010-01	1.3	0.3	1.9	64	66.2	20.4	12.1	34.7
2010-02	0.4	0.2	18.8	77.4	96.4	0.2	3	22.2
2010-03	0	0	6.9	90.7	97.6	2.4		23
2010-04	0	0	2.4	35.7	38.1	44.9	17	31.3
2010-05	0	0.1	5.3	92.1	97.5	2.5		19.4
2010-06	9.7	25.3	31.3	26.8	83.4	3.6	3.3	15.2
2010-07	0.2	0	1.6	95.9	97.5	2.3		22.5
2010-08	0	0.3	8.2	88.1	96.6	1.1	2.3	20.5
2010-09	0	0	6.3	69.5	75.8	17.6	6.6	25.5
2010-10	0	0	3.6	94	97.6	2.4		24.3

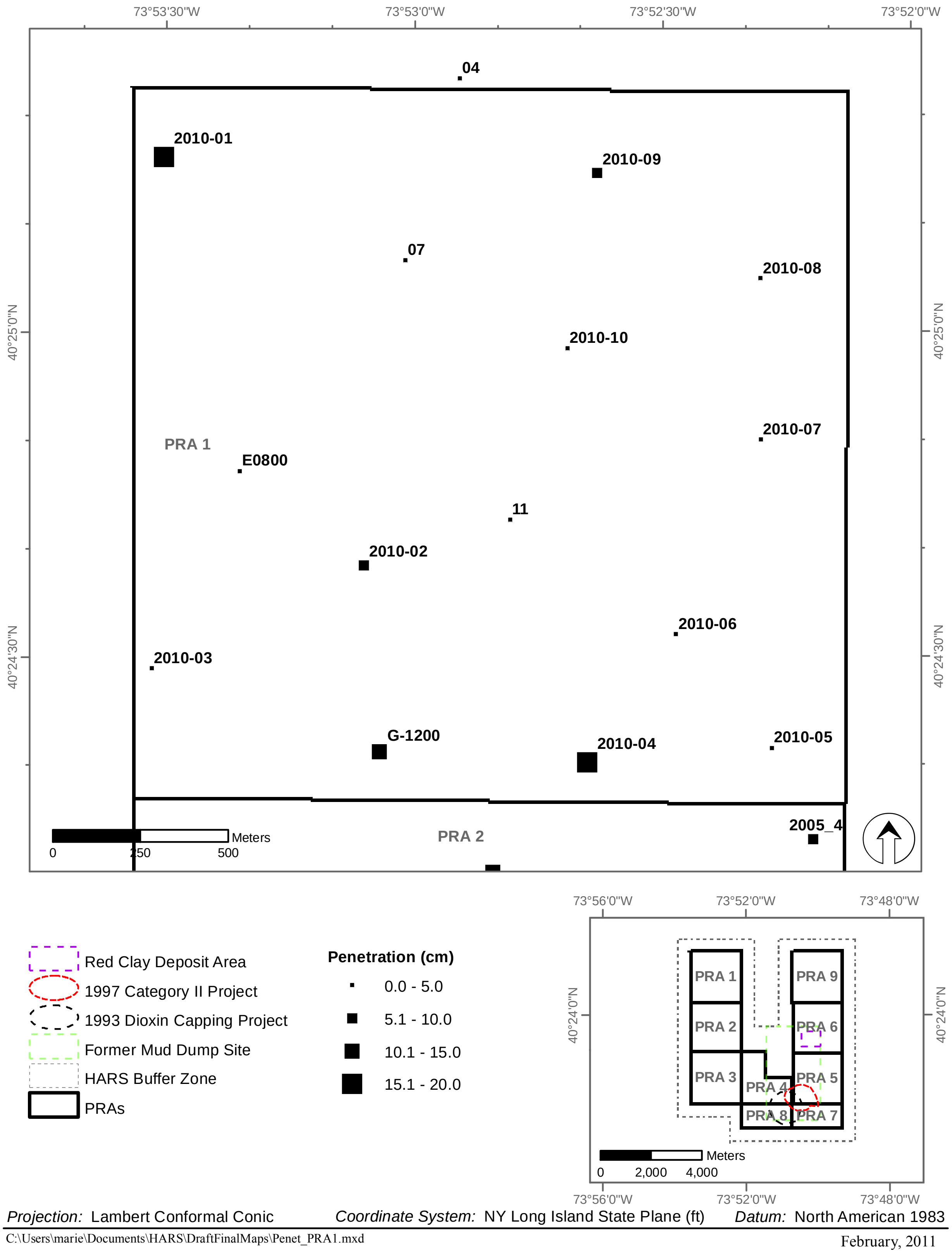


Figure 3-13. Average prism penetration depths (cm) at the PRA 1 stations

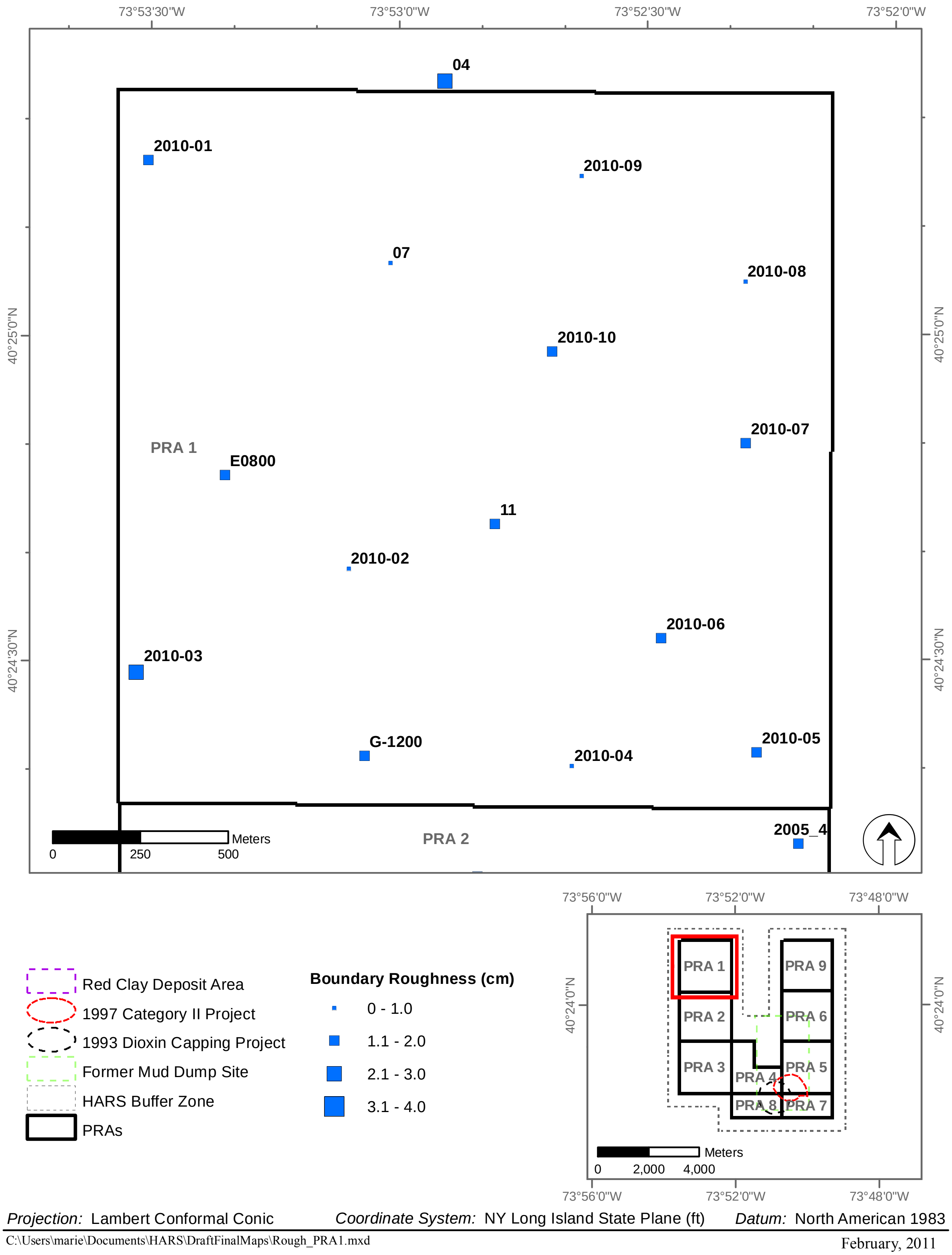


Figure 3-14. Average boundary roughness values (cm) at the PRA 1 stations

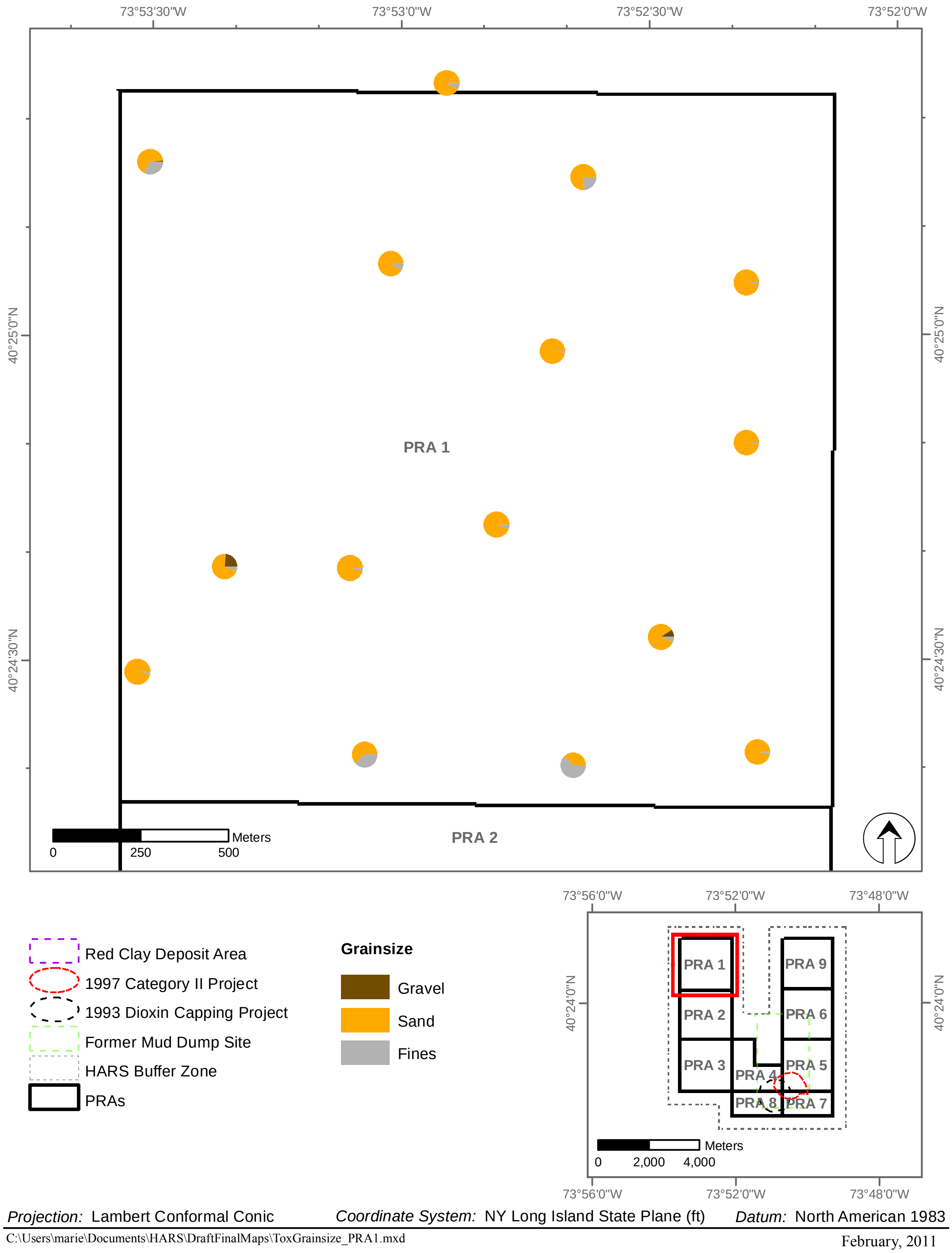


Figure 3-15. Grain size distribution (determined by laboratory analysis) of surface sediments in PRA 1

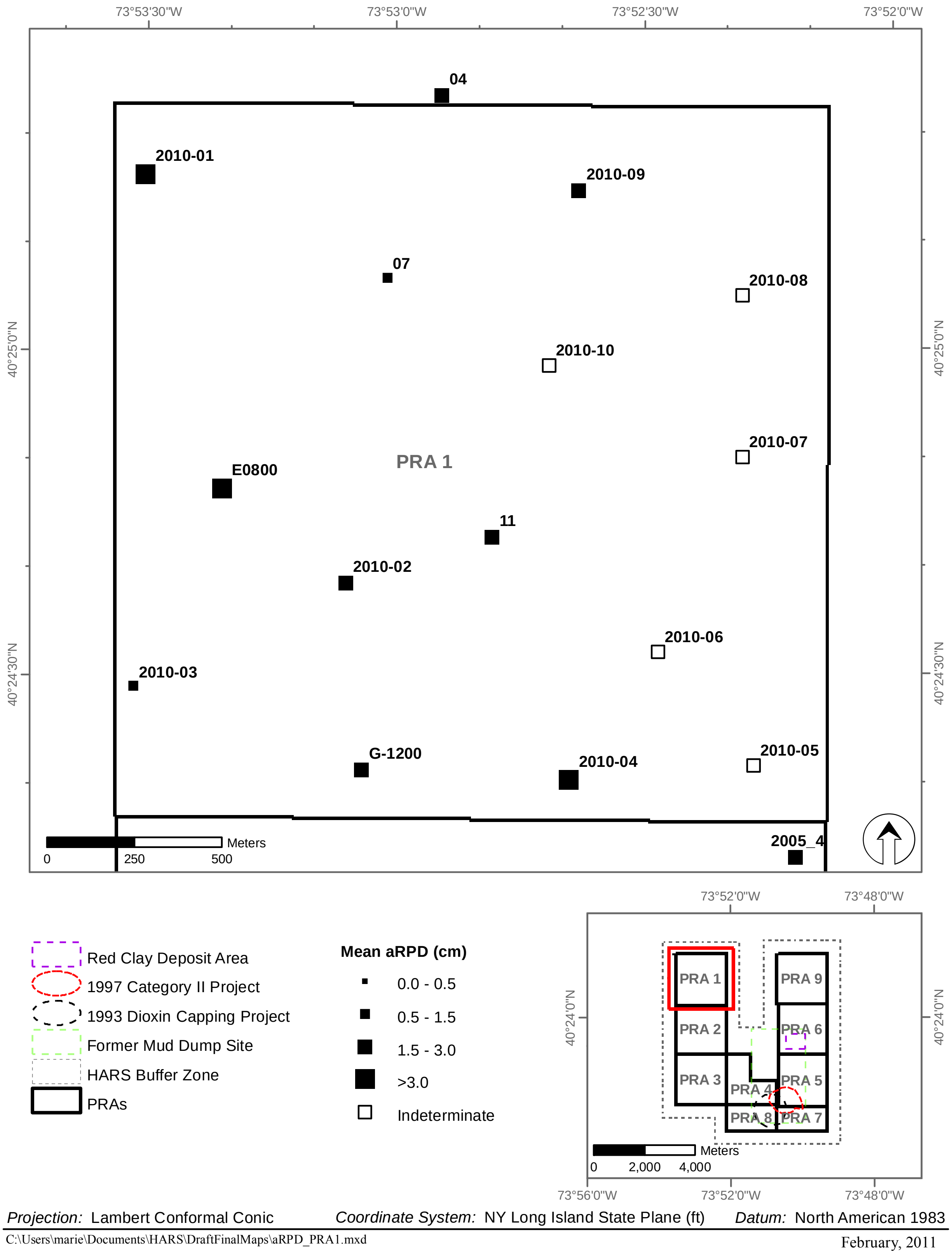


Figure 3-16. Average aRPD values (cm) at the PRA 1 stations

Figure 3-17. Profile image from PRA 1 Station 2010-01 showing a relatively deep aRPD of 4.8 cm

Figure 3-18. Profile image from PRA 1 Station 2010-03 showing dark (reduced), sandy dredged material with a relatively shallow aRPD depth of 0.6 cm

At 8 of the 15 stations in PRA 1, there was evidence of an advanced successional stage (Stage 2 or 3) in at least one replicate profile image (Table 3-1 and Figure 3-19). Specifically, the profile images from Stations 4 and 11 showed either Stage 2 or Stage 2 going to 3, while Stations 7 and 2010-04 had Stage 2 on 3 (Table 3-1 and Figure 3-20). Stage 1 on 3 occurred at Stations E0800, G-1200, and 2010-09 (Table 3-1 and Figure 3-21). At the remainder of the stations in PRA 1, the successional stage was considered indeterminate due to the presence of sand.

Although a successional stage was not assigned at many of the sandy stations, these stations nonetheless were characterized by relatively large, thick worm tubes at the sediment surface (e.g., Figures 3-4, 3-5, 3-9, 3-10 and 3-22). In general, these tubes were several centimeters long, relatively thick; and appeared to be constructed of brown mud or sand, mucous, and, in some cases, shell fragments. These surface worm tubes were present at all fifteen of the stations located in PRA 1 (Figure 3-23).

3.1.4 Benthic Community Analysis

A table showing the number of individuals of each taxon per m^2 at each of the 20 stations is provided in Appendix D. Overall, a total of 185 taxa were identified at the 20 stations. For the 11 stations within PRA 1, there were 18 taxa among the numerical dominants, defined as those cumulatively representing 90% of the total abundance (Table 3-3). The bivalve *Ennucula tenuis* (smooth nut clam) was the single most abundant species, accounting for over 59.4% of the total abundance (Table 3-3). Other relatively abundant taxa included the amphipod *Unciola irrorata* and a number of polychaetes, including Polynoidae (lowest practical identification level, or LPIL), *Asabellides oculata, Polygordius* (LPIL), *Mediomastus* (LPIL), and *Glycera* (LPIL)(Table 3-3). Sixty-one percent of the numerical dominants were annelids (almost all polychaetes and one oligochaete), 22% were bivalve mollusks, and 17% were crustaceans (Table 3-3).

At the nine reference stations, there were a total of 23 taxa comprising the numerical dominants (Table 3-4). As at the PRA 1 stations, the bivalve *Ennucula tenuis* was the single most abundant species, accounting for 60.7% of the total abundance (Table 3-4). The numerical dominants also included two species of amphipod (*Ampelisca abdita* and *Pseudunciola obliquua*) and several polychaetes (*Polygordius* [LPIL], *Levinsenia gracilis, Asabellides oculata, Monticellina baptisteae*, and Cirratulidae [LPIL]). Overall, 74% of the numerical dominants at the nine reference stations were annelids (almost all polychaetes and one oligochaete), 4% were bivalve mollusks, and 22% were crustaceans (Table 3-4).

Eight of the numerically dominant taxa at the PRA 1 stations were also among the numerical dominants at the reference stations. These included the bivalve *Ennucula tenuis*, the amphipod *Unciola irrorata*, oligochaetes of the family Tubifidae, and the polychaetes *Asabellides oculata*, *Polygordius* (LPIL), *Glycera* (LPIL), *Levinesnia gracilis* and *Aricidea catherinae* (Tables 3-3 and 3-4). Univariate statistical analyses showed that average abundance was markedly higher at the reference stations (28,336 individuals/m^2) than at the PRA 1 stations (15,289 individuals/m^2) (Table 3-5 and Figure 3-24). This difference was due mainly to

Table 3-3.

Numerically Dominant Benthic Taxa at the Eleven Stations in PRA 1

Group	**Taxon**	**Percent of Total Abundance**
Mollusk (bivalve)	*Ennucula tenuis*	59.4%
Annelid (polychaete)	Polynoidae (LPIL*)	5.7%
Annelid (polychaete)	*Asabellides oculata*	4.4%
Annelid (polychaete)	*Polygordius* (LPIL)	3.1%
Crustacean (amphipod)	*Unciola irrorata*	2.7%
Annelid (polychaete)	*Mediomastus* (LPIL)	2.5%
Annelid (polychaete)	*Glycera* (LPIL)	2.4%
Annelid (oligochaete)	Tubificidae (LPIL)	1.9%
Mollusk (bivalve)	*Tellina* (LPIL)	1.2%
Annelid (polychaete)	Capitellidae (LPIL)	1.0%
Crustacean (isopod)	*Edotia montosa*	0.9%
Crustacean (ostracod)	*Pellucistoma* (LPIL)	0.9%
Mollusk (bivalve)	*Tellina agilis*	0.7%
Mollusk (bivalve)	*Pitar morrhuanus*	0.7%
Annelid (polychaete)	*Glycera robusta*	0.7%
Annelid (polychaete)	*Levinsenia gracilis*	0.6%
Annelid (polychaete)	*Aricidea catherinae*	0.6%
Annelid (polychaete)	Ampharetidae (LPIL)	0.6%

*Lowest practical identification level

Table 3-4.

Numerically Dominant Benthic Taxa at the Nine Reference Stations

Group	Taxon	Percent of Total Abundance
Mollusk (bivalve)	*Ennucula tenuis*	60.7%
Annelid (polychaete)	*Polygordius* (LPIL*)	8.2%
Crustacean (amphipod)	*Ampelisca abdita*	3.4%
Crustacean (amphipod)	*Pseudunciola obliquua*	1.8%
Annelid (polychaete)	*Levinsenia gracilis*	1.6%
Annelid (polychaete)	*Asabellides oculata*	1.5%
Annelid (polychaete)	*Monticellina baptisteae*	1.3%
Annelid (polychaete)	Cirratulidae (LPIL)	1.2%
Annelid (oligochaete)	Tubificidae (LPIL)	1.2%
Annelid (polychaete)	*Clymenella torquata*	1.2%
Annelid (polychaete)	Maldanidae (LPIL)	1.0%
Annelid (polychaete)	*Cossura soyeri*	0.9%
Annelid (polychaete)	*Glycera* (LPIL)	0.8%
Annelid (polychaete)	*Tharyx acutus*	0.8%
Annelid (polychaete)	*Scoletoma hebes*	0.7%
Annelid (polychaete)	*Aphelochaeta marioni*	0.6%
Crustacean (amphipod)	*Unciola irrorata*	0.6%
Annelid (polychaete)	*Aphelochaeta* (LPIL)	0.5%
Crustacean (ostracod)	*Eusarsiella zostericola*	0.5%
Crustacean (ostracod)	*Pellucistoma* (LPIL)	0.5%
Annelid (polychaete)	*Aricidea catherinae*	0.4%
Annelid (polychaete)	*Ninoe nigripes*	0.4%
Annelid (polychaete)	*Dipolydora caulleryi*	0.4%

*Lowest practical identification level

Table 3-5.

Summary Benthic Statistics for PRA 1 and Reference Stations

	PRA 1	Reference
Average abundance (individuals/m^2)	15,289	28,336
Average number of taxa	36	39
Average Shannon-Weiner diversity (H')	2.1	2.0
Average Margalef's species richness (d)	5.8	6.0
Average Pielou evenness (J')	0.6	0.6

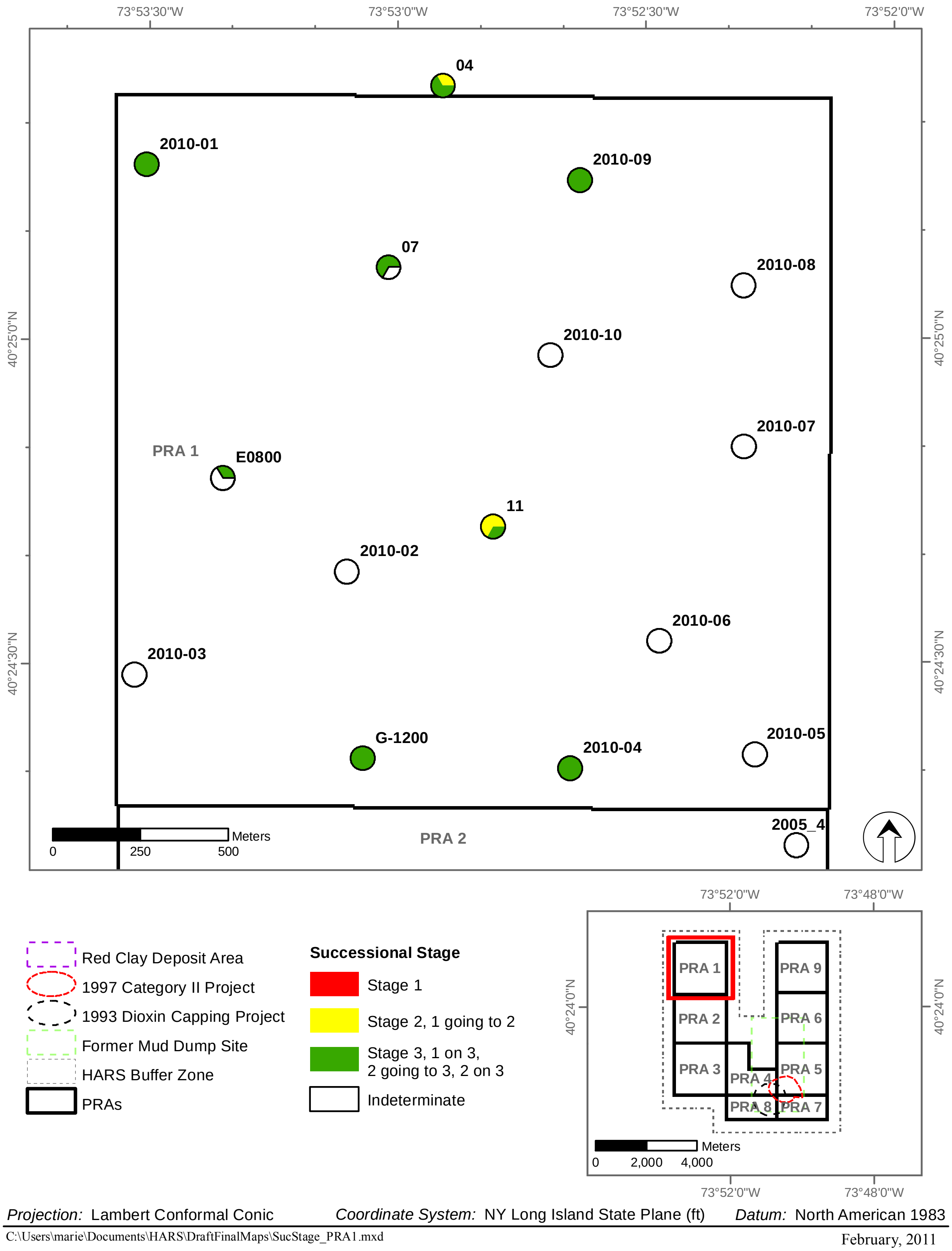


Figure 3-19. Infaunal successional stages at the PRA 1 stations

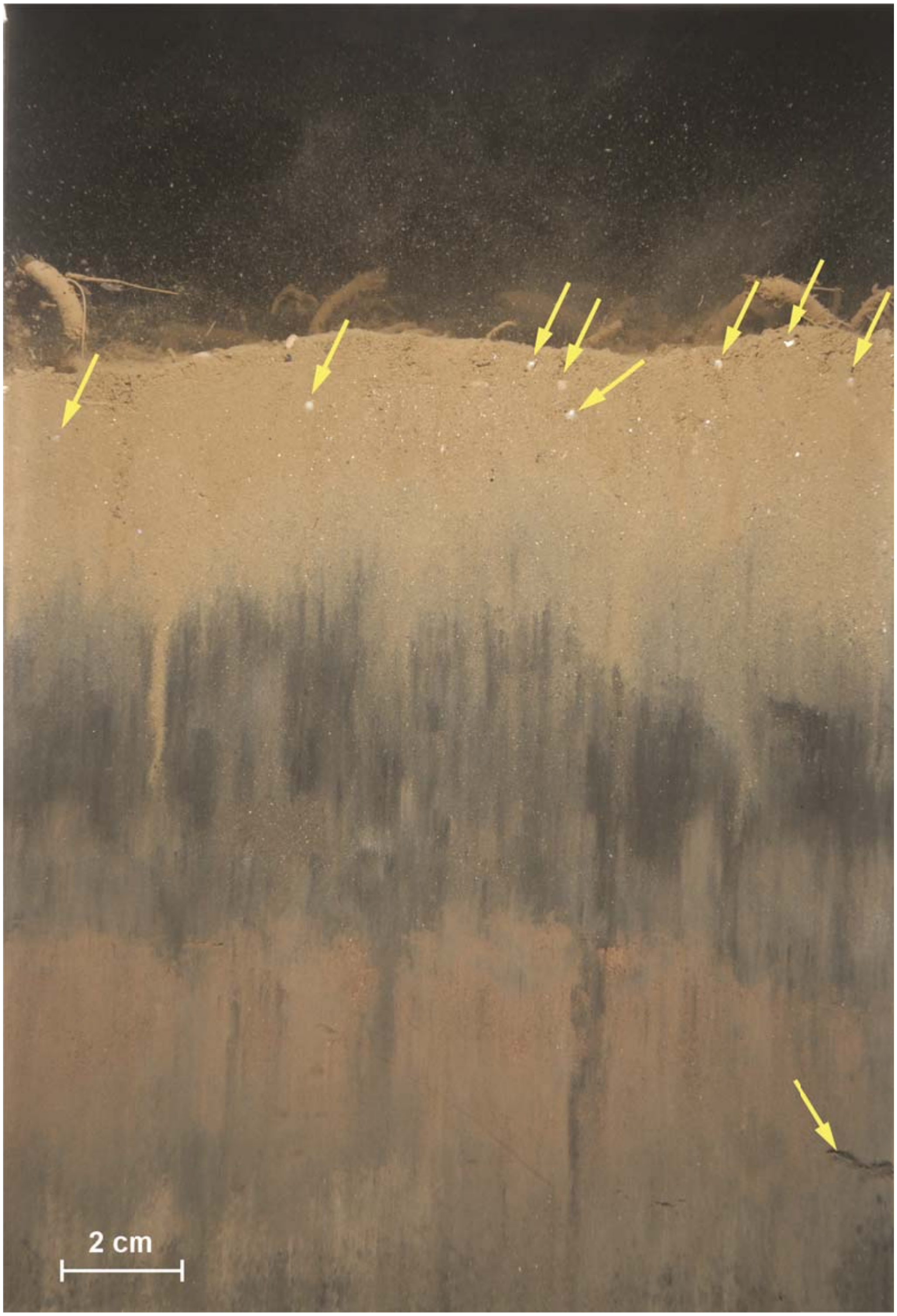


Figure 3-20. Profile image from PRA 1 Station 2010-04 illustrating Stage 2 on 3. Small, white, Stage 2 bivalves are visible just below the sediment surface (upper arrows) and a subsurface Stage 3 feeding void is visible in the lower right corner (lower arrow). This image also shows layering of two different types of remediation material: a surface layer of brown mud overlies red clay at depth.

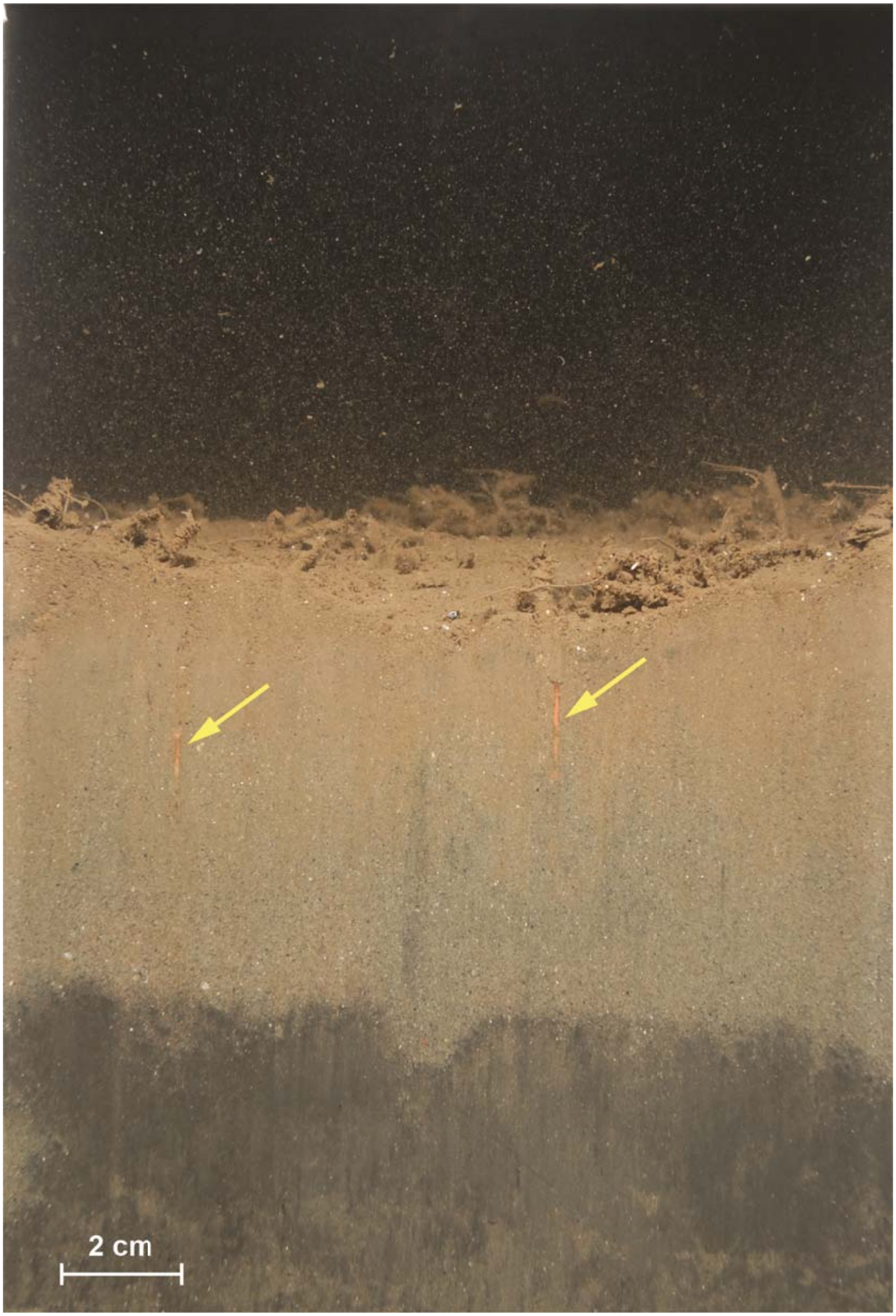


Figure 3-21. Profile image from PRA 1 Station G-1200 illustrating Stage 1 on 3: dense Stage 1 polychaete tubes occur at the sediment surface, while two larger Stage 3 polychaetes associated with surface worm tubes (arrows) occur at depth.

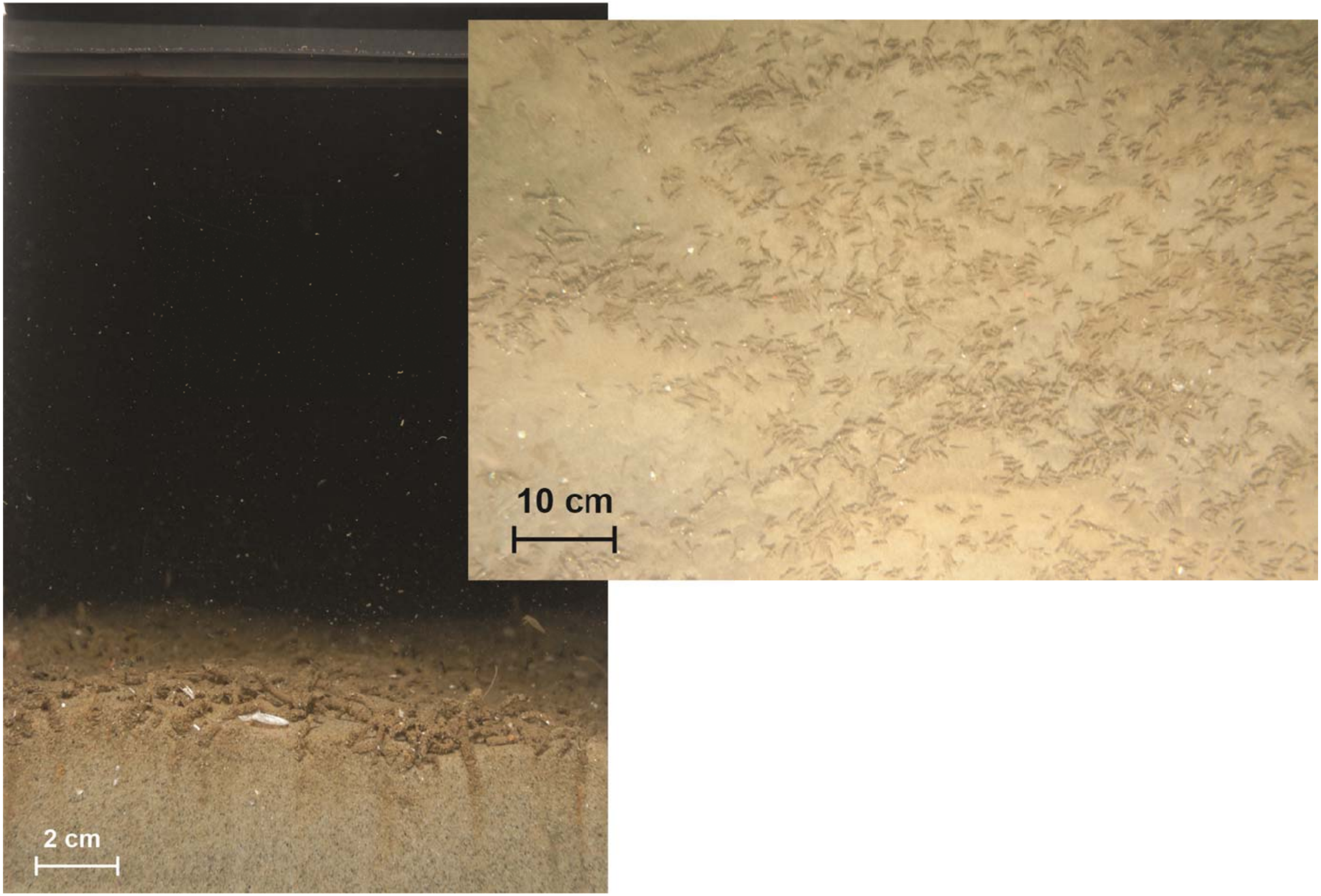


Figure 3-22. Profile and plan-view images from PRA 1 Station 2010-10 showing a dense assemblage of relatively large, brown worm tubes occurring at the surface of homogenous, clean fine sand

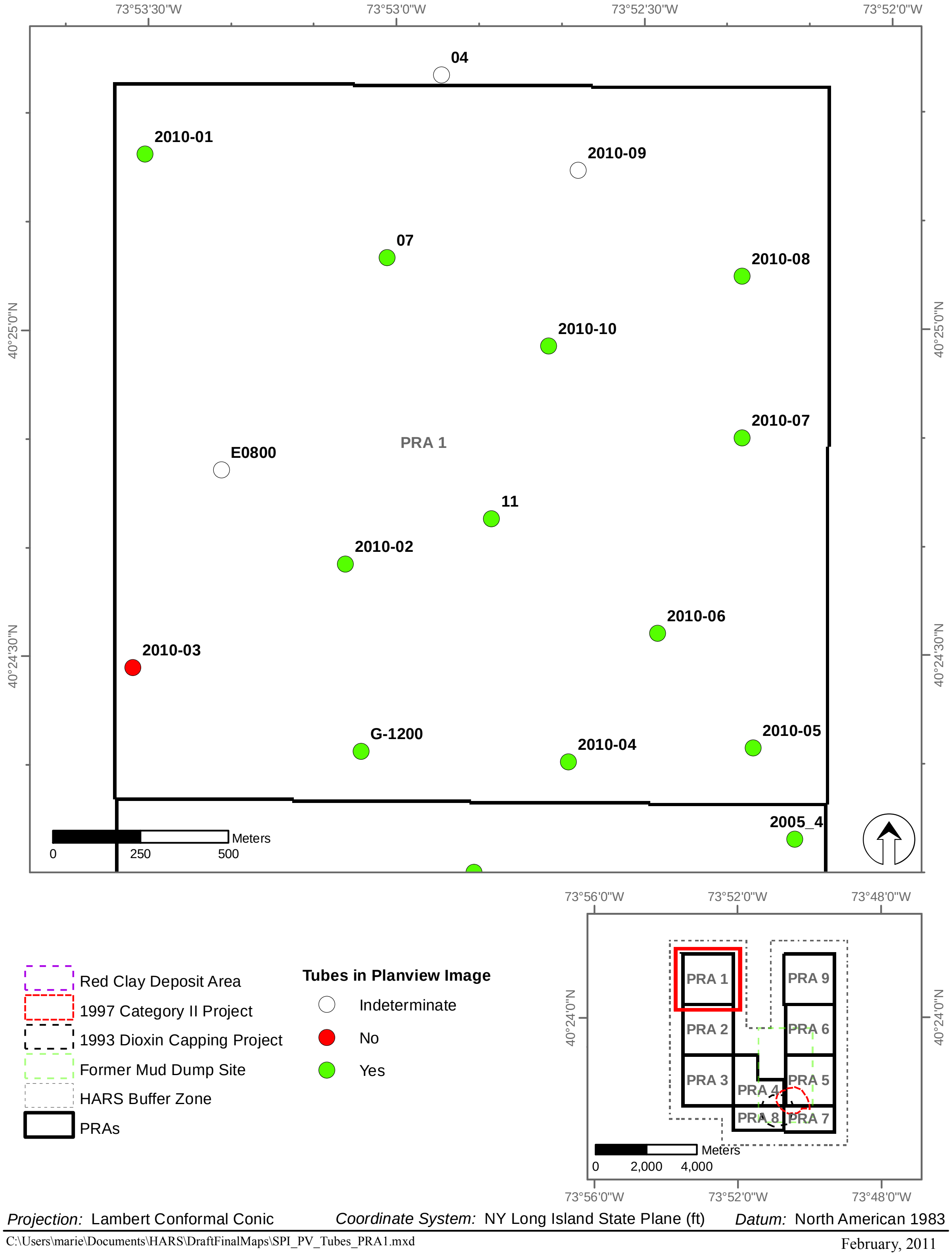


Figure 3-23. Stations in PRA 1 where profile images showed worm tubes at the sediment surface

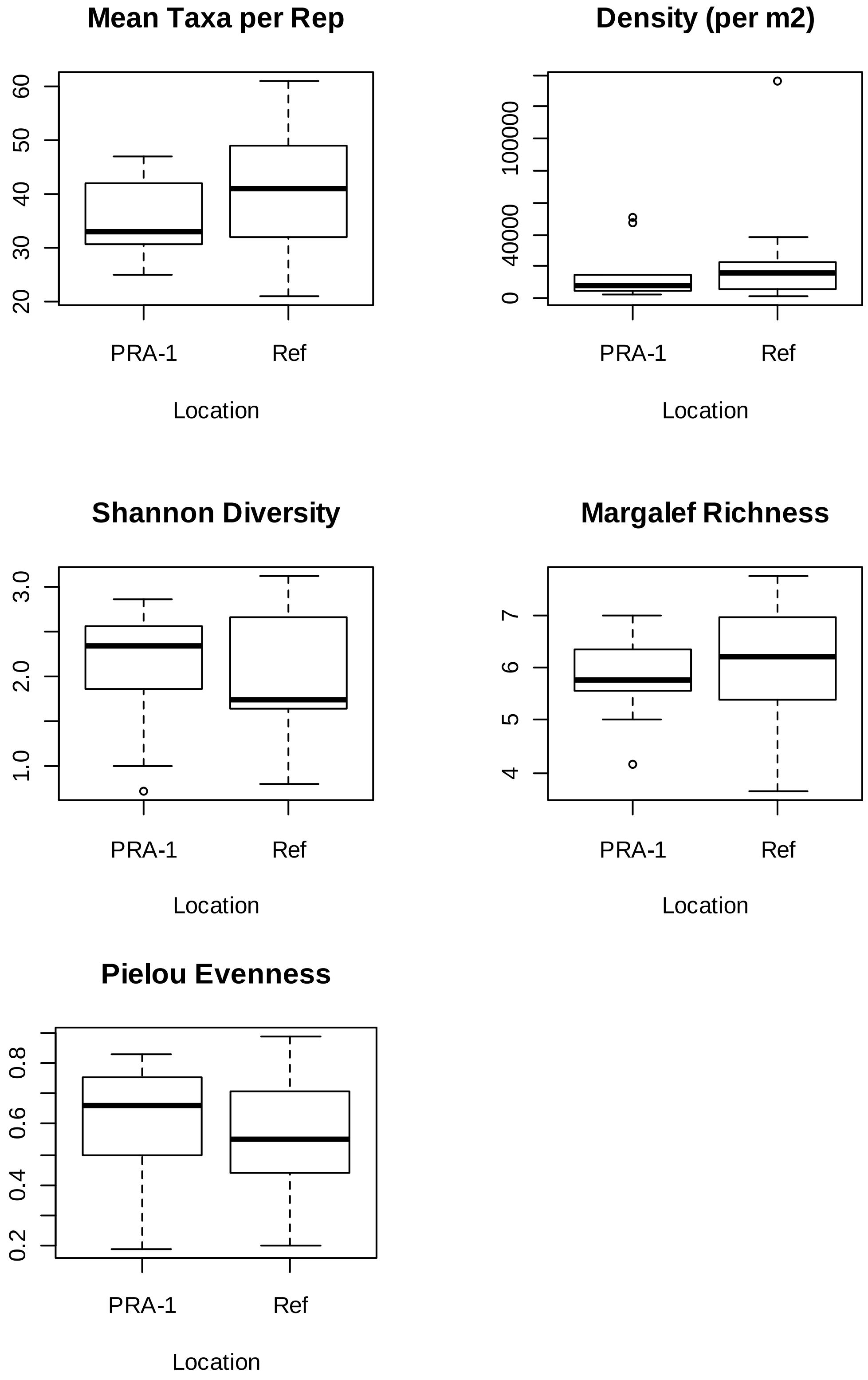


Figure 3-24. Box plots summarizing various benthic community parameters at the PRA 1 stations versus the reference stations

extremely high numbers of the bivalve *Ennucula tenuis* at a single reference station (Station 40). Although the reference stations had a slightly higher average number of taxa (39 versus 36), the average diversity, species richness, and evenness values were roughly comparable between the PRA 1 and reference stations (Table 3-5 and Figure 3-24).

Multivariate statistical analyses were performed to examine the degree of similarity among the 20 stations in terms of overall benthic community composition. Of particular interest was whether the remediation activities in PRA 1 had resulted in a benthic community that was markedly different from the reference community. In the cluster analysis dendrogram, there were three groups of stations that could be distinguished at the 0.52 level (Table 3-6 and Figure 3-25). Group A consisted of three reference stations (Stations 2, 9, and 40) and three PRA 1 stations (Stations E0800, 2010-01 and G-1200). Four of the six stations in this group had the "sand over mud" habitat type, while one had muddy sand and one had mixed mud/sand/gravel (Figure 3-25). Of the three groups, Group A had the highest total abundance, highest abundance of the numerically dominant taxa, and highest average species richness (49.5 species per station). In addition, biomass was well above average for both Mollusca and Annelida.

Group B was comprised of four reference stations (Stations 1, 17, 20 and 24) and five PRA 1 stations (Stations 2010-03, 2010-05, 2010-07, 2010-08 and 2010-10). Seven of the nine stations in Group B had the "clean fine sand" habitat type, while one station had muddy sand and one station had sand over mud (Figure 3-25). The Group B stations had the lowest biomass, lowest species richness, and lowest average total abundance of the three groups. Group B also had very low average abundance of the dominant species (*Ennucula tenuis*). In contrast, Group B had higher than average abundances of the isopod *Edotia montosa* and the polychaetes *Asabellides oculata* and *Glycera* (LPIL).

There were five stations in Group C: two reference stations (Stations 31 and 34) and three PRA 1 stations (Stations 7, 2010-02, and 2010-06). All five of the stations in this group had the "muddy sand" habitat type (Figure 3-25). This group was characterized by intermediate abundances overall and for many of the dominant species, as well as intermediate species richness. Group C also had higher average abundances of *Polygordius* (LPIL), *Tubificidae* (LPIL), and *Tellina agilis* than the other groups.

The 2-dimensional nMDS plots provide an alternate way to examine the degree of similarity in benthic community composition among the stations (Figure 3-26). These plots do not show any particularly tight or distinct station clusters. In the plot on the left side of Figure 3-26, however, there is a loose and inconsistent grouping of stations according to habitat type, with the "clean fine sand" stations all occurring together on the far left side of the plot, most of the "muddy sand" stations falling in the middle, and most of the "sand over mud" stations falling on the right side. This plot suggests a moderate degree of association between habitat type and community composition. In general, the sand-over-mud stations on the right side of the plot had higher species richness and higher abundance (particularly of the dominant species *Ennucula tenuis*), and lower diversity and equitability, than the stations on the left side. The stations with clean fine sand on the left side of the nMDS plot had relatively low abundance and species richness but higher diversity and equitability.

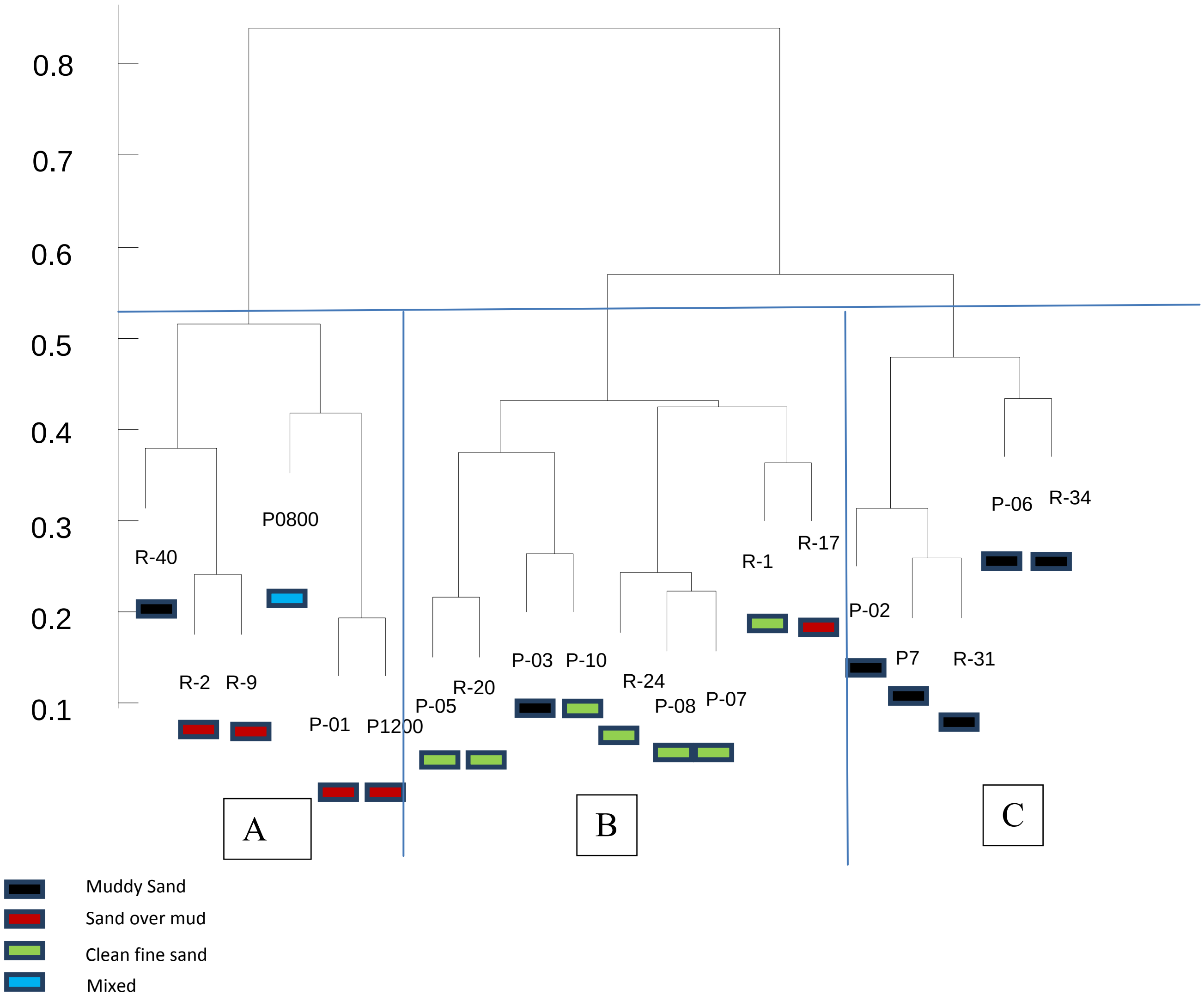


Figure 3-25. Cluster analysis dendrogram based on Bray-Curtis similarity in benthic community structure. The station labels shown on the dendrogram are abbreviated; they can be cross-referenced against the full station names in Table 3-6.

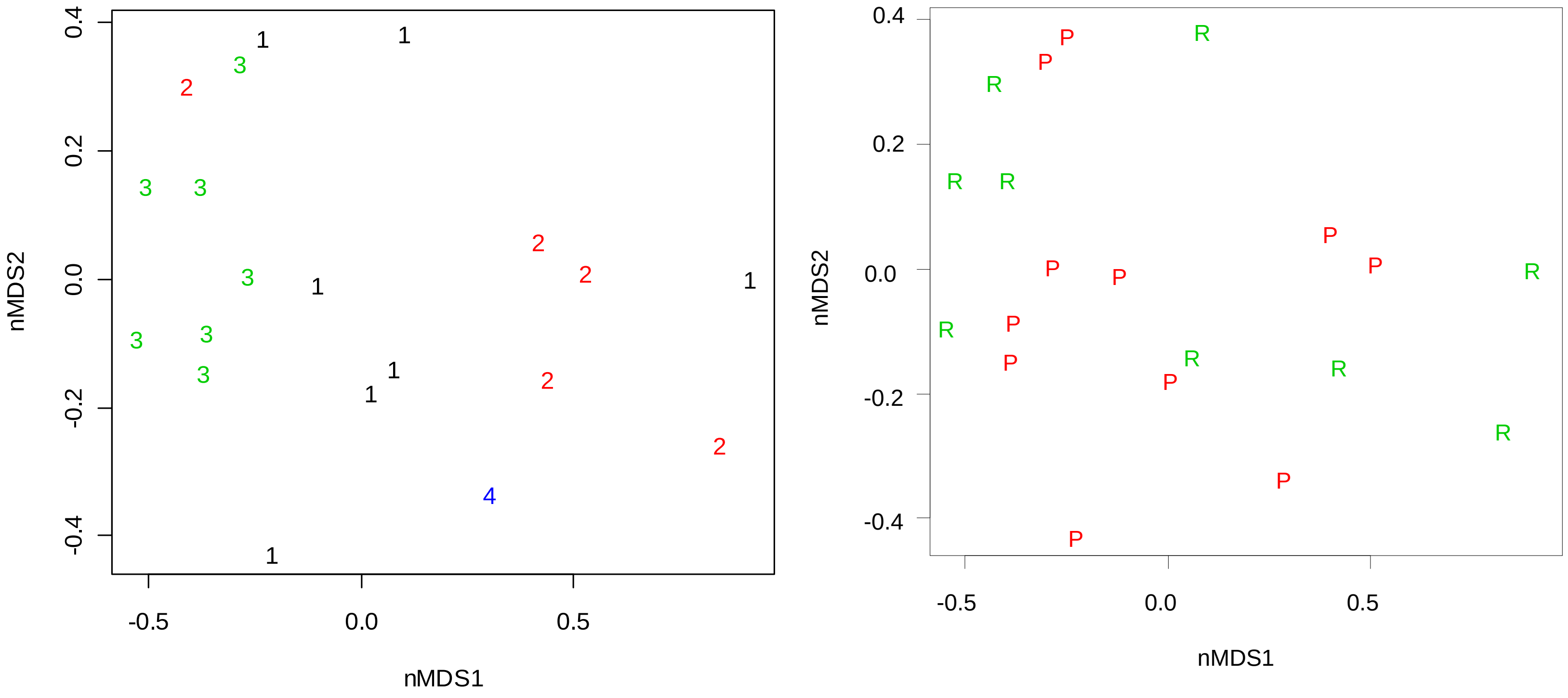


Figure 3-26. Two-dimensional nMDS plots based on Bray-Curtis similarity in benthic community structure. The plot on the left has the stations identified by habitat type (1 = muddy sand; 2=sand over muddy dredged material; 3=clean fine sand; 4=mixed mud/sand/gravel). The same plot is shown on the right, with the stations identified by location (P=PRA 1 stations and R=Reference stations).

The plot on the right side of Figure 3-26 is the same as the left, except the stations are coded according to location (PRA 1 versus Reference). This plot clearly shows a lack of any station clusters based on location and suggests that there was just as much variability in community structure among the stations in PRA 1 as there was among the reference stations. Taken together, the nMDS plots in Figure 3-26 indicate that for a given habitat type, benthic community composition within PRA 1 was comparable to that found at the reference stations. In other words, the stations with clean fine sand tended to have somewhat similar community structure, and this group included both PRA 1 and reference stations. The stations with muddy sand and sand-over-mud likewise formed groups that were somewhat distinct in terms of community structure, and both groups included a mix of PRA 1 and reference stations.

3.1.5 Evaluation of Sediment Toxicity

In the laboratory, the 75 sediment toxicity samples were divided into 12 unequal groups. Each of the resultant 12 rounds of testing had its own control. The samples from the 15 stations in PRA 1 were tested in a number of different rounds; the resulting percent survival values are expressed both in absolute terms and as a percentage of the respective control survival (Table 3-7).

The control-normalized percent survival at the PRA 1 stations ranged from 86% to 104% (Table 3-7). On this basis, the sediment at all fifteen of the stations was designated as nontoxic (Figure 3-27). Although statistical testing showed that the absolute percent survival of 82% at Station 2010-07 was significantly less than the control survival, the normalized percent survival of 86% at this station failed to meet both of the criteria required to declare the sediment toxic (i.e., less than 80% normalized survival *and* statistically different from the control).

3.2 General HARS Monitoring

3.2.1 Physical Sediment Characteristics

The general HARS monitoring stations were all located outside of PRA 1 and can be divided into two groups: 1) those located outside the HARS boundary, and 2) those located within the HARS boundary (i.e., within PRAs 2 through 9). Almost all of the stations located outside the HARS boundary were characterized by sand, principally very fine (4 to 3 phi) to fine (3 to 2 phi) sand, but also including medium sand (2 to 1 phi) at several stations (Table 3-8 and Figures 3-28 and 3-29). At some stations, the sand was relatively clean, while at other stations there were varying amounts of silt/clay mixed with the sand. Hence, the sediment at most of the stations outside of the HARS boundary was described as either “clean fine sand” or “muddy fine sand” (Figure 3-30). At Stations 2 and 3, there was distinct sand-over-mud layering (Figure 3-31).

At the stations located within PRAs 2 through 9, there was a diversity of sediment types ranging from silt/clay (>4 phi) to cobble (< -6 phi) (Figure 3-28). In PRAs 2, 3 and 5, much of the fine-grained, >4 phi sediment consisted of red clay (Figure 3-30). Specifically, red clay was observed at Stations 2002-10 and 2001-6 located in the northern part of PRA 2, at Stations 27

Table 3-6.

Station Abbreviations Used in the Cluster Analysis Dendrogram, with Habitat Code and Habitat Type for Each Station

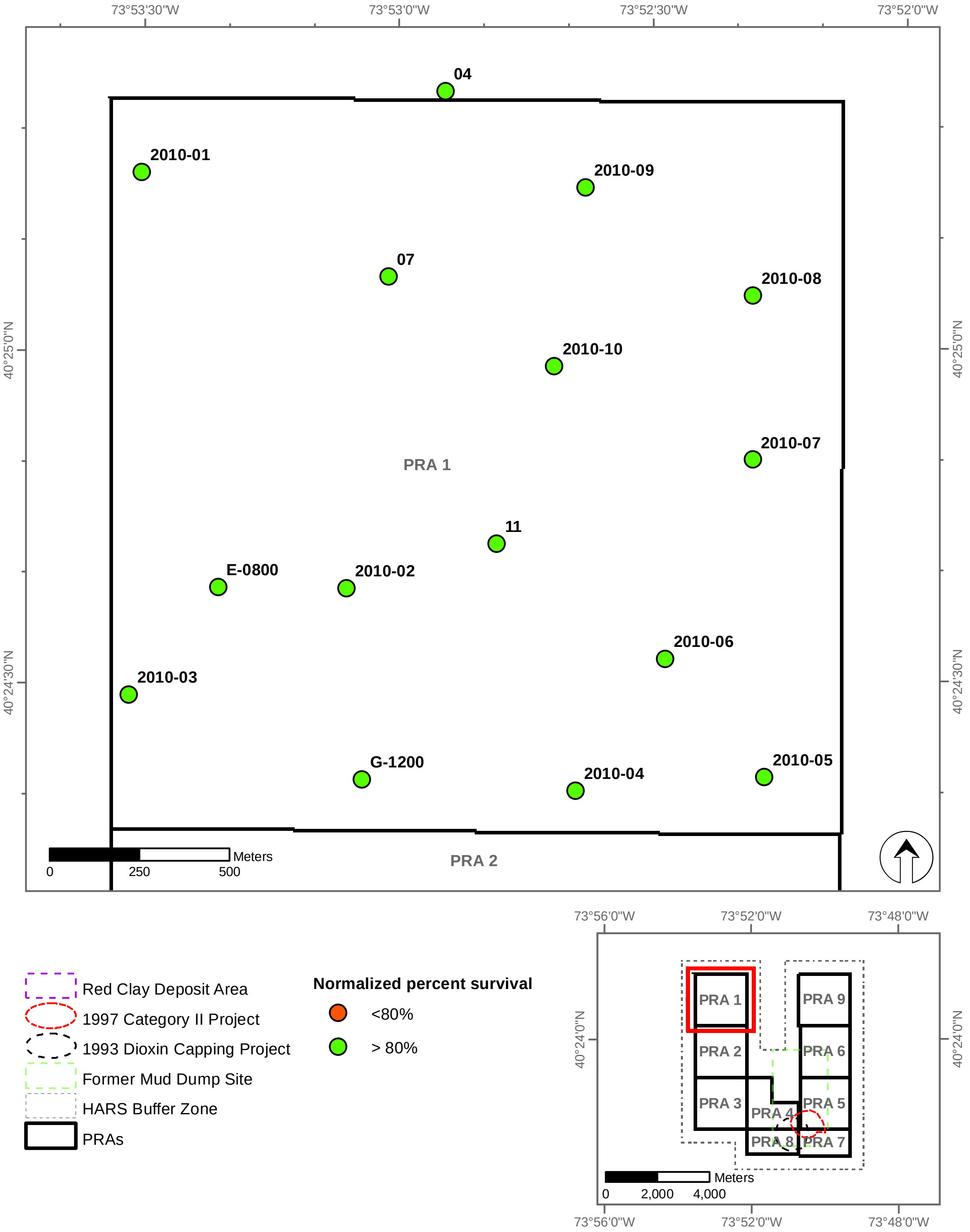
Location	Station	Abbreviated Station ID in Dendrogram	Habitat Code	Habitat Type
PRA-1	2010-03	P-03	1	Muddy sand
PRA-1	2010-01	P-01	2	Sand over mud
PRA-1	7	P7	1	Muddy sand
PRA-1	2010-10	P-10	3	Clean fine sand
PRA-1	2010-08	P-08	3	Clean fine sand
PRA-1	2010-07	P-07	3	Clean fine sand
PRA-1	2010-06	P-06	1	Muddy sand
PRA-1	2010-05	P-05	3	Clean fine sand
PRA-1	G-1200	P1200	2	Sand over mud
PRA-1	2010-02	P-02	1	Muddy sand
PRA-1	E0800	P0800	4	Mixed mud/sand/gravel
Ref	20	R-20	3	Clean fine sand
Ref	24	R-24	3	Clean fine sand
Ref	34	R-34	1	Muddy sand
Ref	31	R-31	1	Muddy sand
Ref	1	R-1	3	Clean fine sand
Ref	2	R-2	2	Sand over mud
Ref	9	R-9	2	Sand over mud
Ref	17	R-17	2	Sand over mud
Ref	40	R-40	1	Muddy sand

Table 3-7.

Sediment Toxicity Testing Results for Stations in PRA 1

Station	% Survival	Normalized % Survival
Round 1		
Control	95%	
2010-03	89%	94%
2010-08	96%	101%
2010-07	82% *	86%
2010-05	90%	95%
2010-02	86%	91%
E0800	89%	94%
Round 2		
Control	94%	
2010-10	83%	88%
Round 4		
Control	93%	
11	97%	104%
Round 7		
Control	97%	
07	96%	99%
Round 9		
Control	96%	
04	95%	99%
2010-06	94%	98%
Round 10		
Control	99%	
2010-04	98%	99%
Round 11		
Control	97%	
G-1200	98%	101%
Round 12		
Control	97%	
2010-01	98%	101%
2010-09	97%	100%

* Statistically significant compared to the control ($\alpha = 0.05$)



Projection: Lambert Conformal Conic *Coordinate System:* NY Long Island State Plane (ft) *Datum:* North American 1983

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February, 2011

Figure 3-27. Results of sediment toxicity testing for the stations in PRA 1

Table 3-8.

Summary of SPI Results for the General HARS Monitoring Stations

Station	Grain Size Major Mode (phi)	Penetration Mean (cm)	Boundary Roughness (cm)	Mean aRPD (cm)	Mean Dredged Material Thickness (cm)	Avg. No. Feeding Voids	Successional Stages Present in each of 3 Replicates		
1	3 to 2	6.4	1.6	ind	0	0	ind	ind	ind
2	4 to 3/>4	15.7	2.2	3.5	>15.7	3.7	1 on 3	1 on 3	1 on 3
3	4 to 3/>4	15.3	1.8	3.6	>15.3	2.7	1 on 3	1 on 3	1 on 3
5	3 to 2	7.3	2.3	ind	0	0	ind	ind	ind
6	2 to 1	7.4	2.0	ind	0	0	ind	ind	ind
8	3 to 2	4.8	1.7	ind	0	0	ind	ind	ind
9	4 to 3	11.0	1.1	3.1	>11.0	2.7	1 on 3	1 on 3	1 on 3
10	>4	10.9	0.8	1.9	>10.8	1.0	1 on 3	1 on 3	1 on 3
12	3 to 2	5.5	1.1	ind	0	0	ind	ind	ind
13	3 to 2	6.8	2.1	2.8	0	0	ind	ind	ind
14	>4	11.4	1.8	1.6	>11.4	1.7	2 going to 3	1 on 3	1 on 3
15	4 to 3	2.0	0.6	2.7	>6.1	3.0	ind	1 on 3	ind
16	3 to 2	4.1	3.0	ind	0	0	ind	ind	ind
17	3 to 2/>4	13.5	2.1	3.1	>13.5	0.7	1 on 3	1 on 3	1 on 3
18	>4	13.0	0.9	1.9	>13.0	0	1 on 3	1 on 3	1 on 3
19	4 to 3	5.2	0.7	2.7	>5.2	0.3	1 on 3	1 on 3	1 on 3
20	3 to 2	6.5	2.3	ind	0	0	ind	ind	ind
22	3 to 2/>4	14.5	1.0	ind	>14.5	1.0	1 on 3	ind	1 on 3
24	3 to 2	8.2	2.6	ind	0	0	ind	ind	ind
25	0 to -6	2.9	1.5	ind	0	0	ind	ind	ind
26	3 to 2	5.9	1.7	2.2	>5.9	2.3	ind	2 going to 3	2 going to 3
27	>4	15.1	1.0	2.6	>15.1	3.0	1 on 3	1 on 3	1 on 3

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Table 3-8., continued

Summary of SPI Results for the General HARS Monitoring Stations

Station	Grain Size Major Mode (phi)	Penetration Mean (cm)	Boundary Roughness (cm)	Mean aRPD (cm)	Mean Dredged Material Thickness (cm)	Avg. No. Feeding Voids	Successional Stages Present in each of 3 Replicates		
28	>4	13.4	1.0	5.1	>13.4	1.0	2 on 3	2 on 3	2 on 3
29	>4	17.9	0.8	2.7	>17.9	3.0	2 on 3	2 on 3	2 on 3
30	>4	19.3	0.6	1.2	>20.6	1.0	3	3	1 on 3
31	4 to 3	3.6	0.7	ind	0	0	ind	ind	ind
32	4 to 3	4.6	0.8	1.5	>6.4	0	2 going to 3	ind	2
33	0 to -6	1.6	0.2	2.1	>4.8	0	2	ind	ind
34	2 to 1	4.7	1.1	1.4	0	0	2 going to 3	2 going to 3	2
35	2 to 1	7.2	1.1	ind	0	0	ind	ind	ind
36	4 to 3	6.7	0.7	2.6	0	0	2 on 3	2 going to 3	2 going to 3
37	3 to 2	5.4	2.4	ind	0	0	ind	ind	ind
38	3 to 2	5.7	2.2	ind	0	0	ind	ind	ind
39	3 to 2	4.4	1.0	ind	0	0	ind	ind	ind
40	1 to 0	5.6	2.6	ind	0	0	ind	ind	ind
42	4 to 3	5.3	1.2	ind	0	0	ind	ind	ind
43	4 to 3	4.0	0.7	ind	0	0	ind	ind	ind
44	2 to 1	5.2	1.4	ind	0	0	ind	ind	ind
45	3 to 2	4.7	0.9	1.5	0	0	ind	ind	ind
46	>4-3	14.3	0.7	2.4	>14.3	1.3	2 on 3	2 on 3	2 on 3
49	3 to 2	0.6	1.6	ind	0	0	ind	ind	Ind
97_00_4	3 to 2	3.6	1.2	ind	>3.6	0	ind	ind	ind
97_00_6	3 to 2	3.5	1.6	ind	>3.5	0	ind	ind	ind
97_00_9	>4	3.2	1.8	ind	>3.2	1.3	2 going to 3	1 going to 2	1 on 3

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Table 3-8., continued

Summary of SPI Results for the General HARS Monitoring Stations

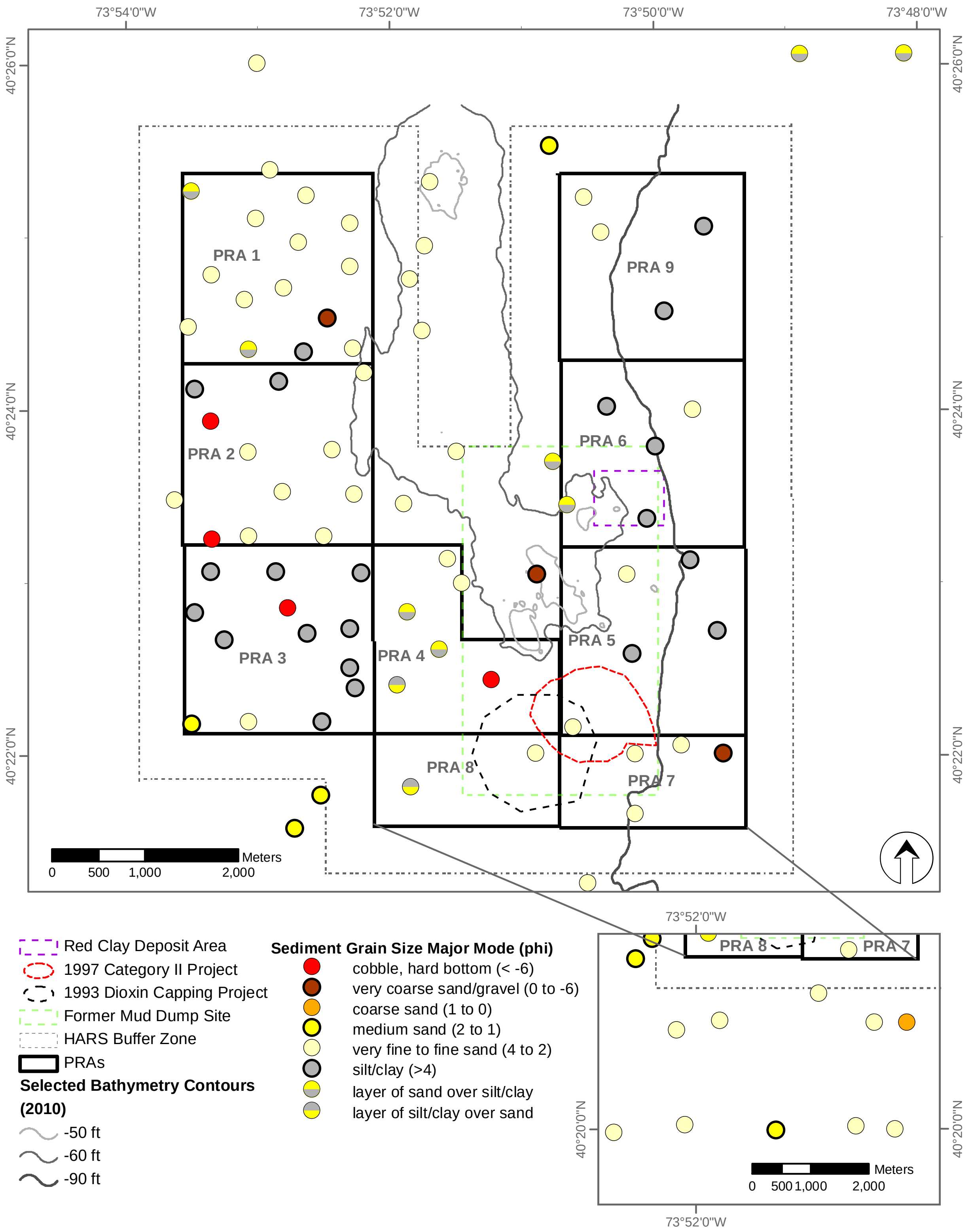
Station	Grain Size Major Mode (phi)	Penetration Mean (cm)	Boundary Roughness (cm)	Mean aRPD (cm)	Mean Dredged Material Thickness (cm)	Avg. No. Feeding Voids	Successional Stages Present in each of 3 Replicates		
2001_2	>4	19.3	1.1	3.0	>19.3	2.0	2 on 3	2 on 3	2 on 3
2001_3	>4	15.2	0.7	3.2	>15.2	1.7	2 on 3	2 on 3	2 on 3
2001_5	3 to 2	5.2	1.4	ind	>5.2	0	ind	ind	ind
2001_6	>4	7.4	1.8	1.6	>7.4	3.0	1 on 3	1 on 3	1 on 3
2001_8	>4	10.3	1.4	2.8	>10.3	2.0	1 on 3	1 on 3	1 on 3
2002_1	3 to 2	4.0	3.7	ind	>4.0	0.0	ind	ind	ind
2002_4	3 to 2/>4	12.8	1.4	ind	>12.8	0.3	1 on 3	ind	1 on 3
2002_9	3 to 2	4.0	1.4	ind	>4.0	0	ind	ind	ind
2002_10	3 to 2	4.9	1.4	ind	>4.9	0	ind	ind	ind
2003-10	>4	5.5	2.0	ind	>5.5	0	2 going to 3	ind	2 going to 3
2003_5	>4	12.5	1.3	1.1	>12.5	2.7	1 on 3	1 on 3	1 on 3
2004_2	>4	7.8	3.6	2.6	>7.8	1.7	1 on 3	ind	1 on 3
2004_6	2 to 1/>4	8.3	1.1	3.5	>8.2	0	1 on 3	ind	ind
2004_9	<-6	0.0	0.0	ind	0	0	ind	ind	ind
2005_4	4 to 3	5.2	1.8	2.3	>5.2	0	ind	ind	ind
2010-11	< -6	0.0	0.0	ind	0	0	ind	ind	ind
2010-12	3 to 2	5.9	3.0	ind	0	0	ind	ind	ind
2010-13	<-6	1.3	0.2	0.3	>4,0	0	1 going to 2	ind	ind
2010-14	3 to 2	4.6	1.8	ind	>4.6	0	ind	ind	ind
2010-15	>4	16.2	1.2	2.0	>16.2	2.3	2 on 3	2 on 3	2 on 3
2010-16	>4	14.1	3.9	1.6	>14.1	1.3	1 going to 2	1 on 3	1 on 3
2010-17	<-6	0.9	0.9	1.7	>2.6	0	ind	ind	2 going to 3

continued on following page

Table 3-8., continued

Summary of SPI Results for the General HARS Monitoring Stations

Station	Grain Size Major Mode (phi)	Penetration Mean (cm)	Boundary Roughness (cm)	Mean aRPD (cm)	Mean Dredged Material Thickness (cm)	Avg. No. Feeding Voids	Successional Stages Present in each of 3 Replicates		
2010-18	>4	7.8	2.1	3.4	>8.1	1.5	2 going to 3	1 on 3	1 on 3
2010-19	4 to 3	2.9	1.3	1.0	>2.9	0	ind	ind	ind
L1200	3 to 2	4.1	1.1	ind	>4.1	0	ind	ind	ind
NOREMED_1	2 to 1	4.4	0.8	ind	>4.4	0	ind	ind	ind
NOREMED_2	>4	11.0	0.6	2.4	>11.0	0	2 on 3	2 on 3	2 going to 3
NOREMED_3	3 to 2	1.2	1.3	ind	0	0	ind	ind	ind
NOREMED_4	>4/2 to 1	8.3	1.2	0.4	>8.3	0	1 on 3	1 on 3	1 on 3
NOREMED_5	>4	19.5	1.7	2.4	>19.5	2.3	1 on 3	1 on 3	1 on 3
P2800	>4/3 to 2	11.4	1.7	1.7	>11.4	0	1 on 3	ind	2 going to 3



Projection: Lambert Conformal Conic *Coordinate System:* NY Long Island State Plane (ft) *Datum:* North American 1983

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Figure 3-28. Grain size major mode (in phi units) at the general HARS monitoring stations

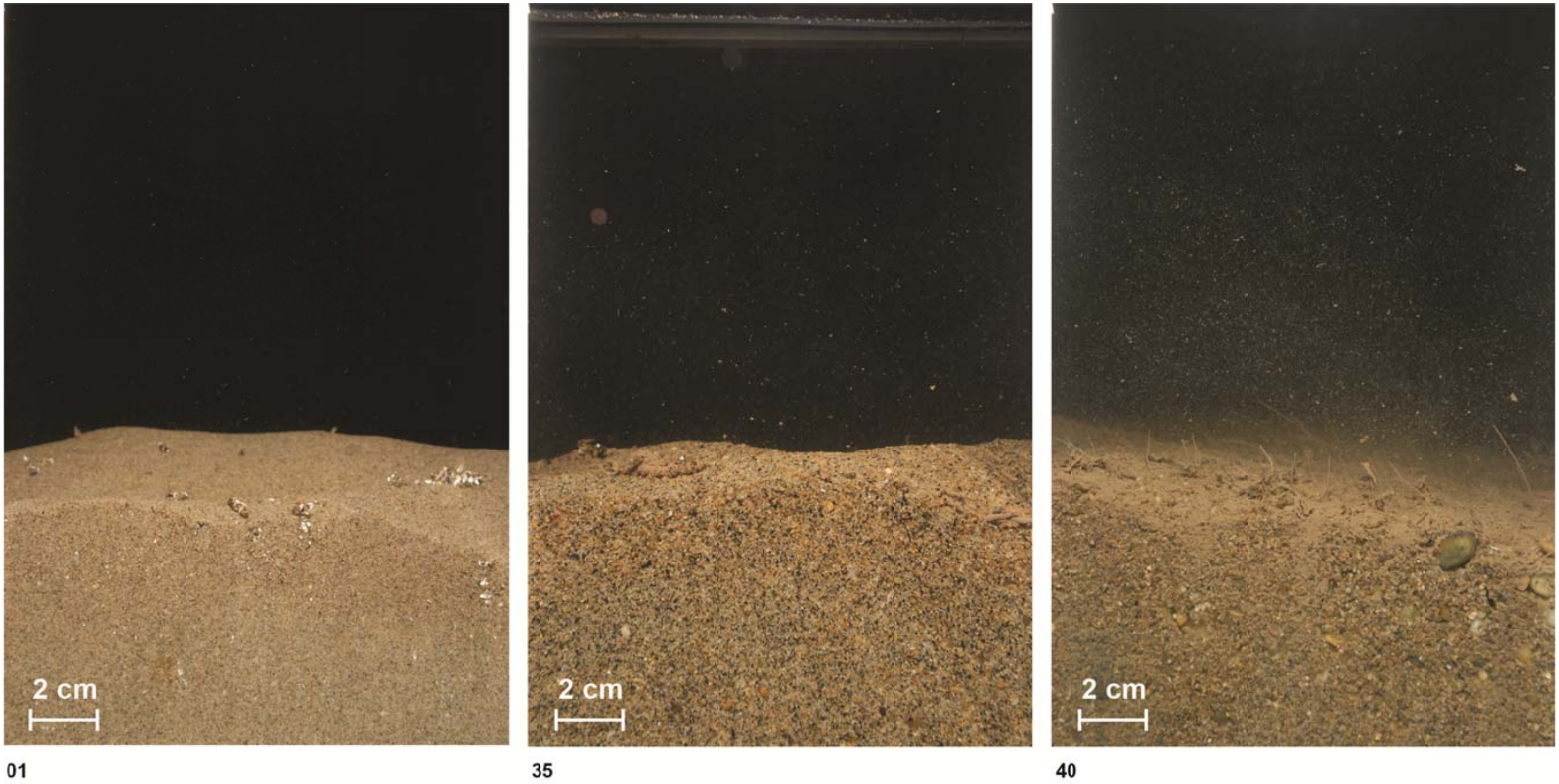

Figure 3-29. Profile images providing examples of the different types of ambient sand found at stations located outside the HARS boundary: fine sand at Station 01 (left), medium sand at Station 35 (center), and coarse sand at Station 40 (right)

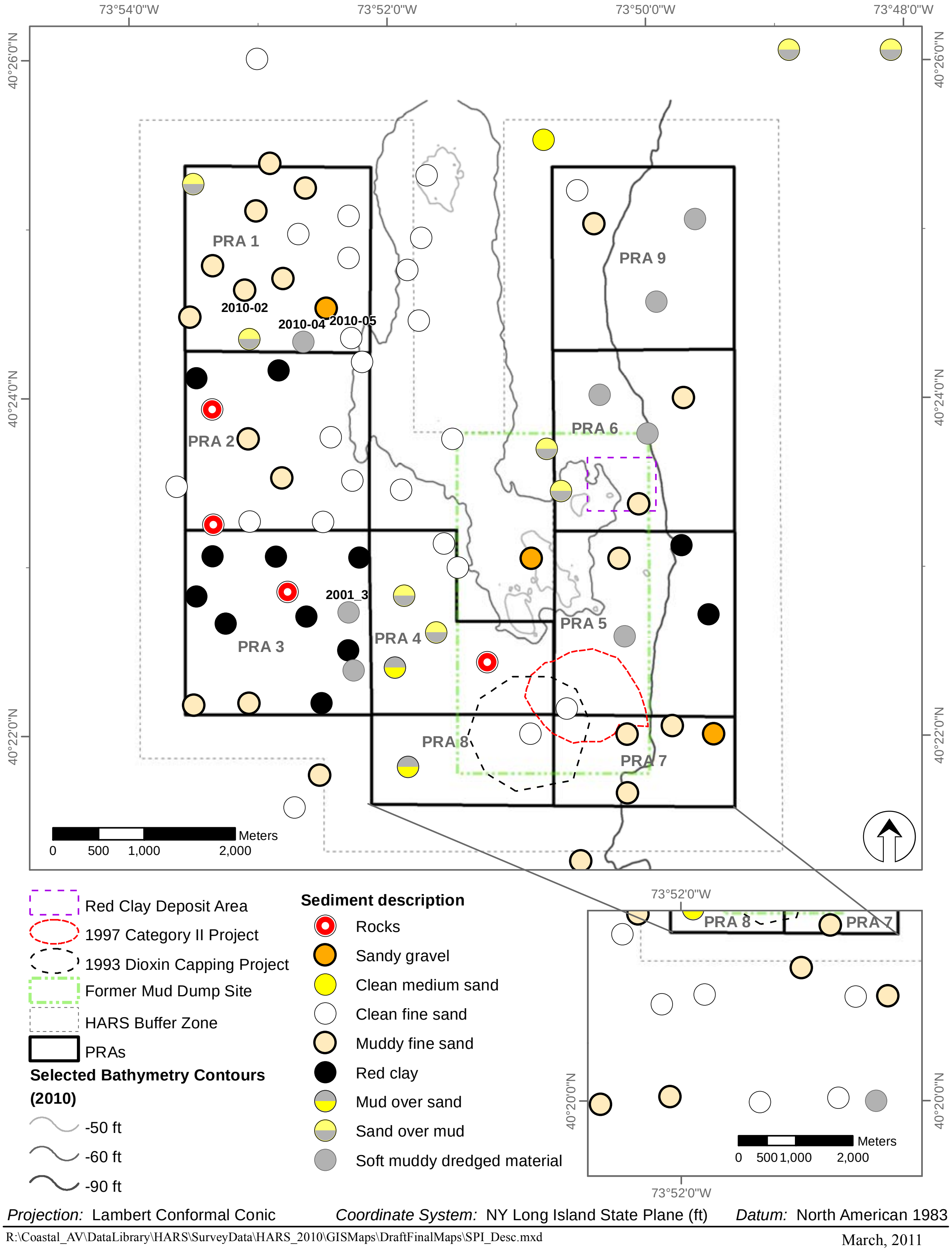

Figure 3-30. Sediment descriptions at the general HARS monitoring stations based on analysis of profile images

Figure 3-31. Profile image illustrating sand-over-mud layering at Station 03. Similar layering characterized nearby Station 02.

and NOREMED-5 in PRA 5, and at many of the stations throughout PRA 3 (Figures 3-30 and 3-32). At many of the stations within PRAs 6 and 9, the fine-grained sediment consisted of soft, muddy, relict dredged material (Figures 3-30 and 3-33). Rocks were found at a few stations, including Stations 2010-11 and 2010-13 in PRA 2, Station 2010-17 in PRA 3, and Station 2004-9 in PRA 4 (Figures 3-30 and 3-34).

The surface sediments at the general HARS monitoring stations were also characterized based on analysis of the plan-view images (Figure 3-35). These results echoed the SPI characterization in showing that a variety of different sediment types were present throughout the area. Among the different sediment types observed in the plan-view images were rippled fine sand, muddy fine sand, mixed gravel, red clay, and rocks (Figures 3-35, 3-36, and 3-37).

At almost all of the stations located within the nine PRAs, the surface sediments consisted of dredged material (Figure 3-38) that extended from the sediment surface to below the imaging depth of the profile camera, resulting in the measured dredged material thickness being indicated with a “greater than” sign in Table 3-8. In mapping the spatial distribution of the dredged material, a distinction was made between remediation material and historical or “relict” material. Remediation material, defined here as any dredged material placed at the HARS (based on disposal logs) since its designation in September 1997 (Figure 1-3), was observed at almost all of the stations in PRAs 2, 3, and 4, as well as at Station NOREMED-4 in PRA 8 and at Stations NOREMED-5, 26, and 27 in PRA 5 (Figure 3-38). As indicated in Figure 3-30, the remediation material consisted of diverse sediment types, including fine sand, red clay, gravel, and rocks. Stations 04 and 2010-09, located in the extreme northern part of PRA 1, were characterized by relict dredged material; remediation material was not placed in this area due to the presence of two shipwreck buffer zones.

At the stations located within PRAs 5, 6, 7, and 9 on the eastern side of the HARS, the surface sediments consisted of relict dredged material resulting from past disposal operations in and around the former Mud Dump Site (Figure 3-38). This material typically consisted of relatively soft, reduced mud (e.g., Figure 3-33). Fine sand, representing the cap material from the 1993 and 1997 capping projects, was observed at Stations 97-00-4 and 97-00-6 (Figure 3-38). The sand observed to the north of the HARS (e.g., Stations 01 and 06), to the south (Stations 34 through 46), and in the no-discharge zone (Stations 05, 08, 12, 13, 16, 20 and 25) was considered to be natural (i.e., “ambient”) New York Bight sediment, based on the location of these stations outside the HARS boundary (Figure 3-38).

Average prism penetration depth values at the general HARS monitoring stations ranged from 0 cm at Station 2004-9 to 19.5 cm at Station NOREMED-5 (Table 3-8 and Figure 3-39). This wide range reflects the diversity of sediment types present both within and outside the HARS boundary. In general, higher penetration occurred at stations with soft red clay or relict muddy dredged material, while lower camera penetration was associated with rocks, gravel, or firm sand.

2003-5

2004-2

Figure 3-32. Profile images from Stations 2003-5 (left) and 2004-2 (right) showing red clay having a grain size major mode of >4 phi

Figure 3-33. Soft, muddy, relict dredged material at Station 18 located near the center of PRA 6

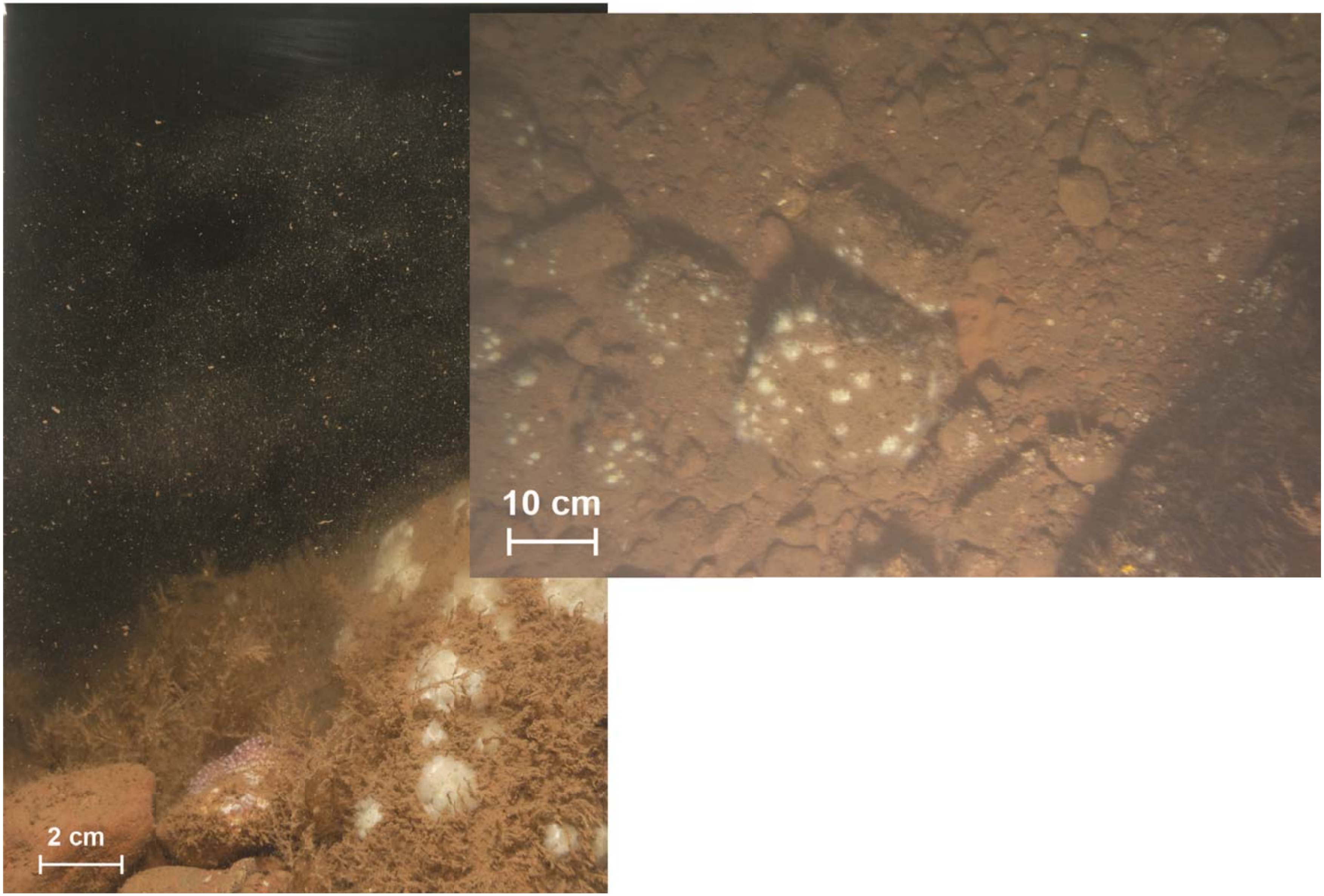

Figure 3-34. Profile and corresponding plan-view images showing rocks covered in epifauna at Station 2004-9 in PRA 4

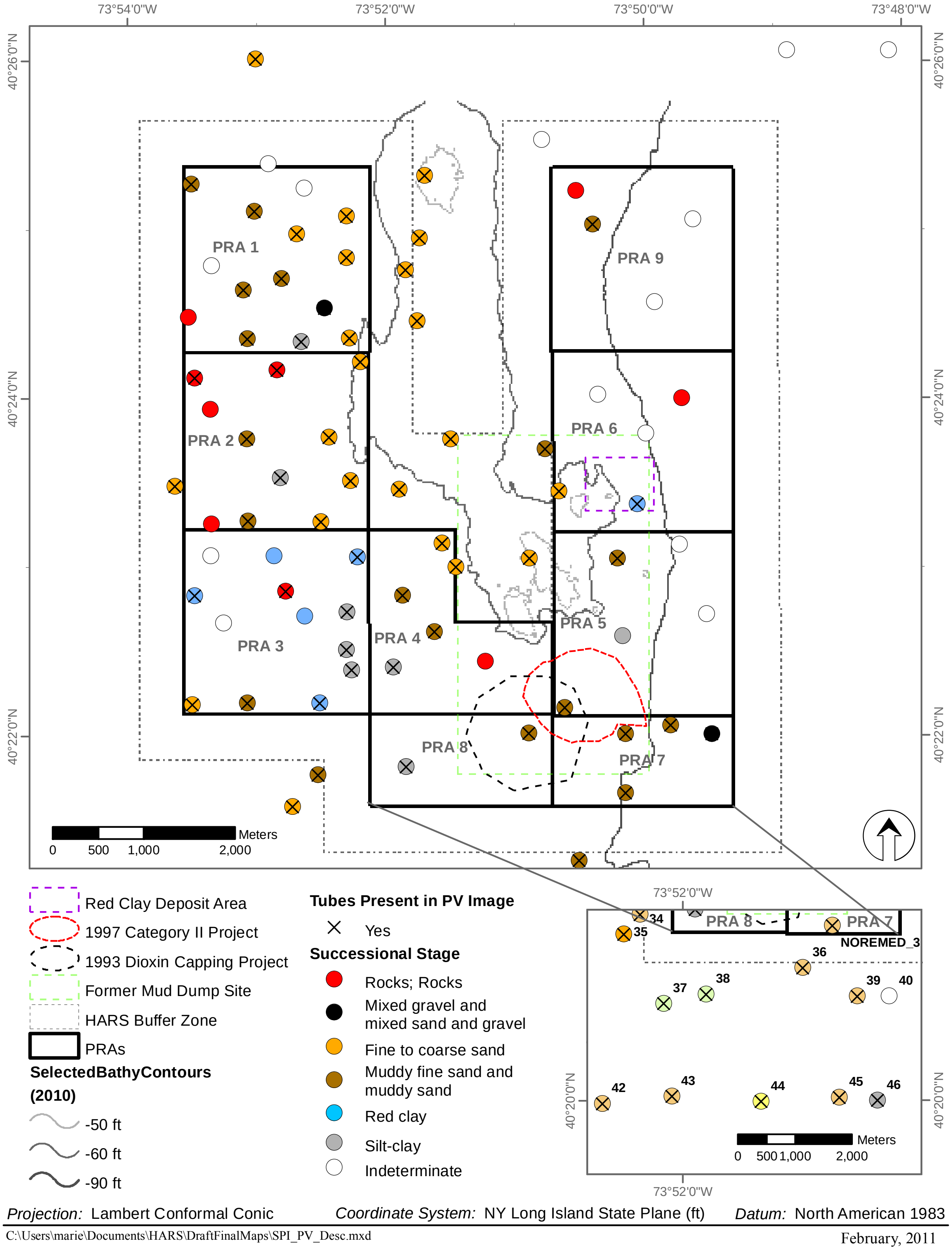

Figure 3-35. Sediment descriptions at the general HARS monitoring stations based on analysis of the plan-view images

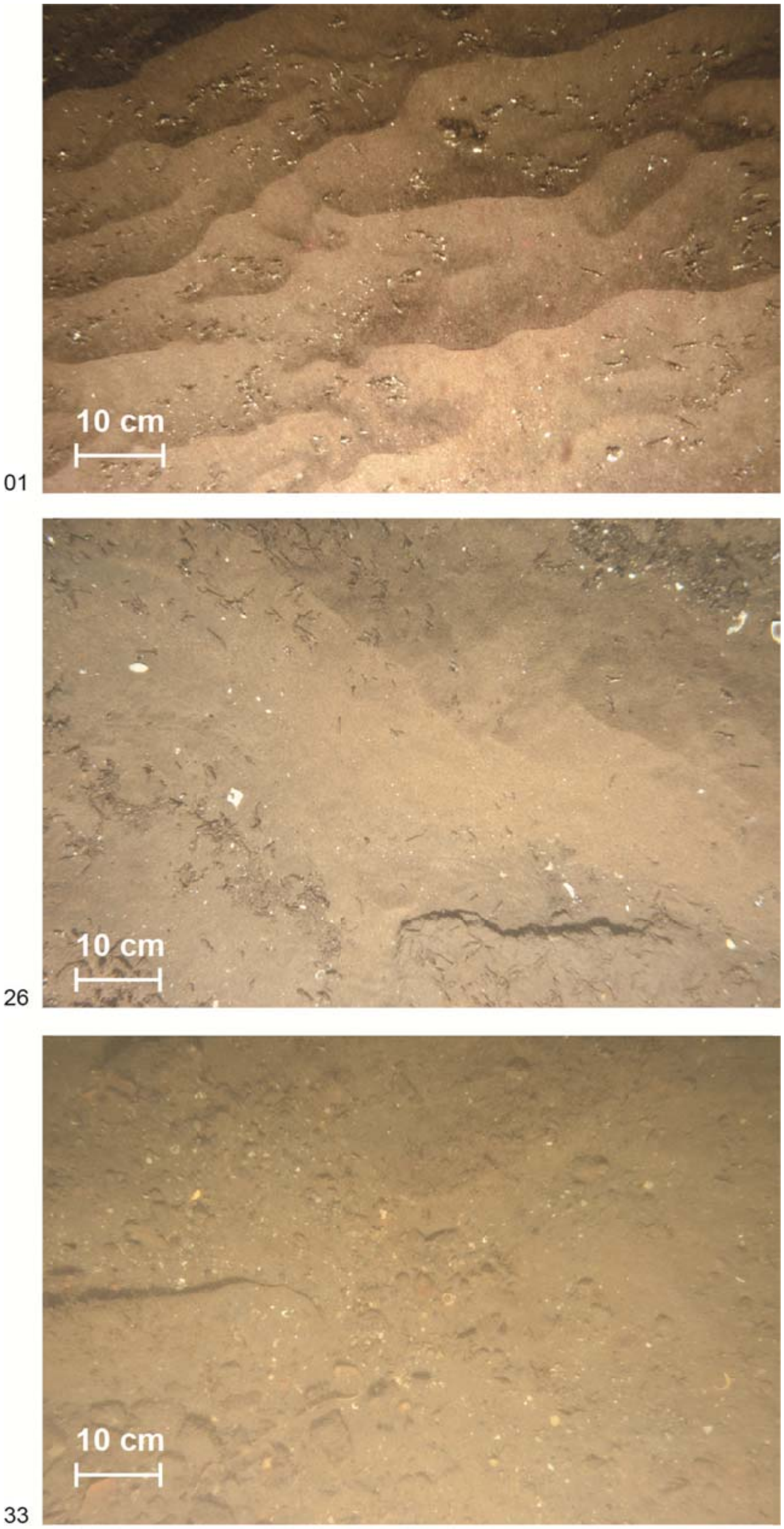

Figure 3-36. Plan-view images illustrating rippled fine sand (top), muddy fine sand (center) and mixed gravel (bottom)

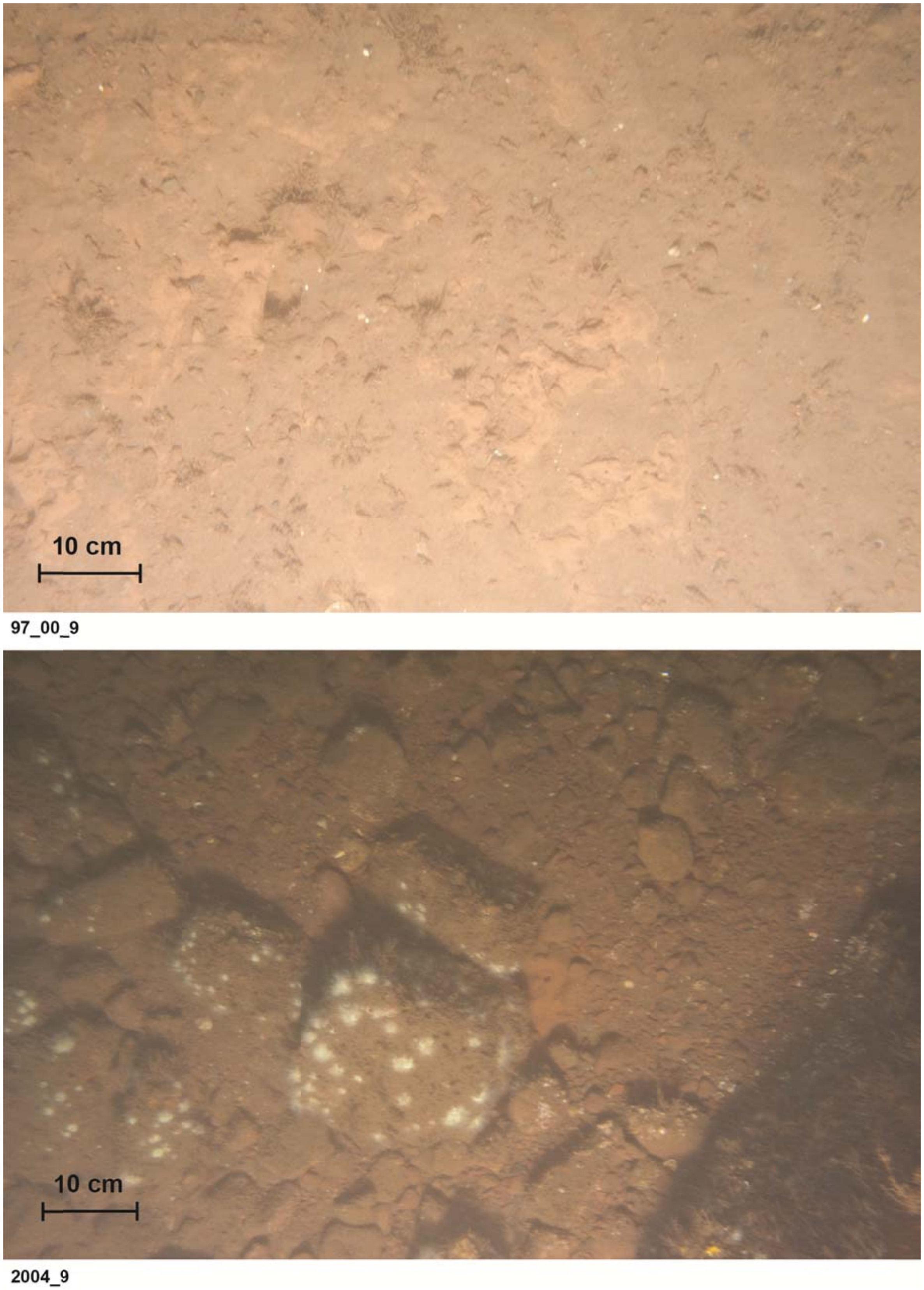

Figure 3-37. Plan-view images illustrating red clay (top) and rocks (bottom)

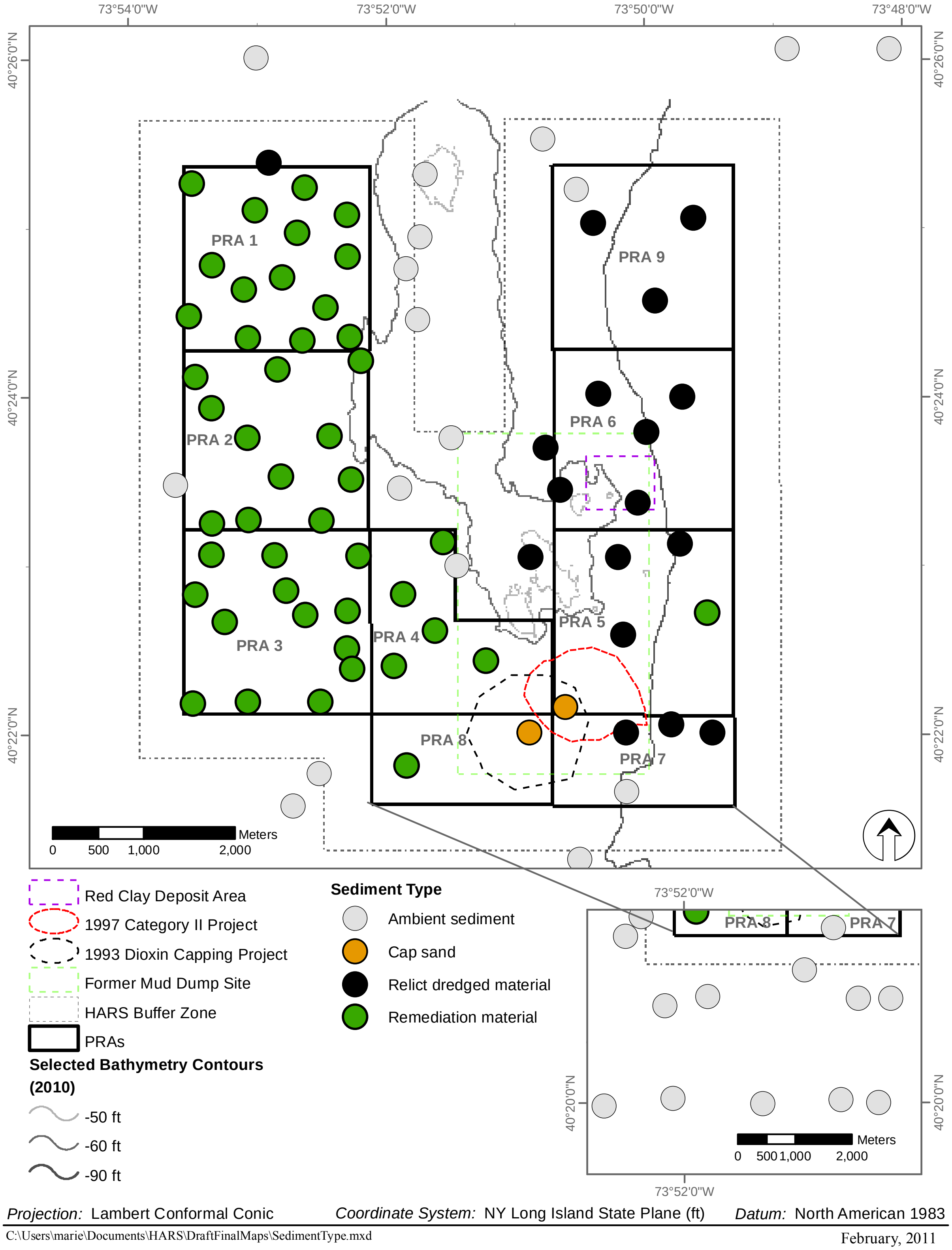

Figure 3-38. Spatial distribution of remediation material, relict dredged material, and ambient sediment at the general HARS monitoring stations

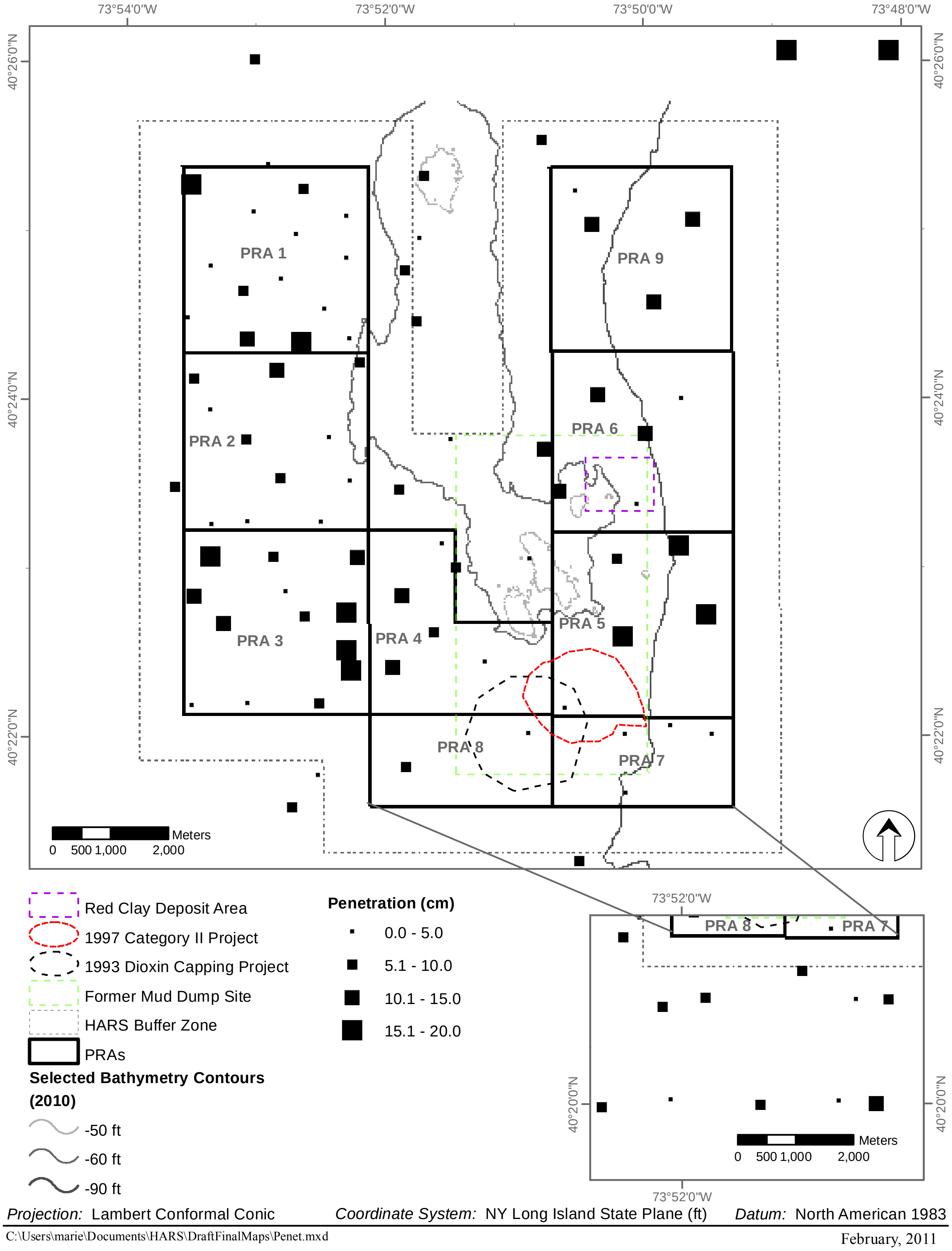

Figure 3-39. Average prism penetration depth values (cm) at the general HARS monitoring stations

Average small-scale boundary roughness values at the general HARS monitoring stations ranged from 0.2 to 3.9 cm (Table 3-8 and Figure 3-40). At many of the sandy stations, the surface relief was of physical origin, due to the presence of ripples (Figure 3-41). At many of the stations with soft muddy sediments, the surface roughness was due to biological activity (Figure 3-42).

3.2.2 Sediment Grain Size Analysis

The laboratory grain size analysis revealed that sand was the dominant grain size fraction at many of the general HARS monitoring stations (Table 3-9 and Figure 3-43). Silt/clay was the dominant at many of the stations in PRA 3 due to the presence of red clay (Figure 3-43). Silt/clay was also relatively abundant at a number of stations in PRAs 5, 6, and 9, reflecting the presence of both red clay and relict muddy dredged material (Figure 3-43). There was generally good agreement between the laboratory grain size analysis and the sediment grain size estimated from the profile image. Sediment percent moisture at the general HARS monitoring stations ranged from 10.9% to 51.6% (Table 3-9).

3.2.3 Biological Conditions and Benthic Recolonization Status

Average aRPD values at the general HARS monitoring stations ranged from 0.3 to 5.1 cm (Table 3-8 and Figure 3-44). The aRPD was indeterminate at many stations due to the presence of sand. Where the aRPD could be determined, the majority of stations had average aRPD depths of 1.5 cm or greater, indicating a moderate to high degree of surface sediment aeration (Figure 3-45). Extremely shallow aRPD depths of 0.3 cm at Station 2010-13 in PRA 2 and 0.4 cm at Station NOREMED-4 in PRA 8 were due to the presence of highly reduced remediation material.

Evidence of advanced Stage 3 succession (e.g., Stage 1 on 3, Stage 2 on 3, or Stage 2 going to 3) was observed at many of the general HARS monitoring stations (Table 3-8 and Figure 3-46). Most of the stations with advanced succession were characterized by fine-grained sediment, either muddy dredged material or red clay (Figures 3-47 and 3-48). Many of the profile images showed relatively large worm tubes at the sediment surface, similar to the images taken at many of the PRA 1 stations that showed the widespread presence of such tubes (Figures 3-49 to 3-52). The worm tubes occurred at varying densities, were composed of a variety of materials (brown mud, red clay, sand, shell fragments), and exhibited a variety of different shapes and sizes (Figures 3-50 to 3-52). At a significant number of the general HARS monitoring stations, the successional stage was considered indeterminate due to the presence of sand.

3.2.4 Evaluation of Sediment Toxicity

As indicated previously, the sediment toxicity samples were divided into twelve rounds of testing, and each round was run with a separate control. The control-normalized percent survival at the general HARS monitoring stations ranged from 81% to 107% (Table 3-10). On this basis, the sediment at all sixty of the stations was designated as nontoxic (Figure 3-53).

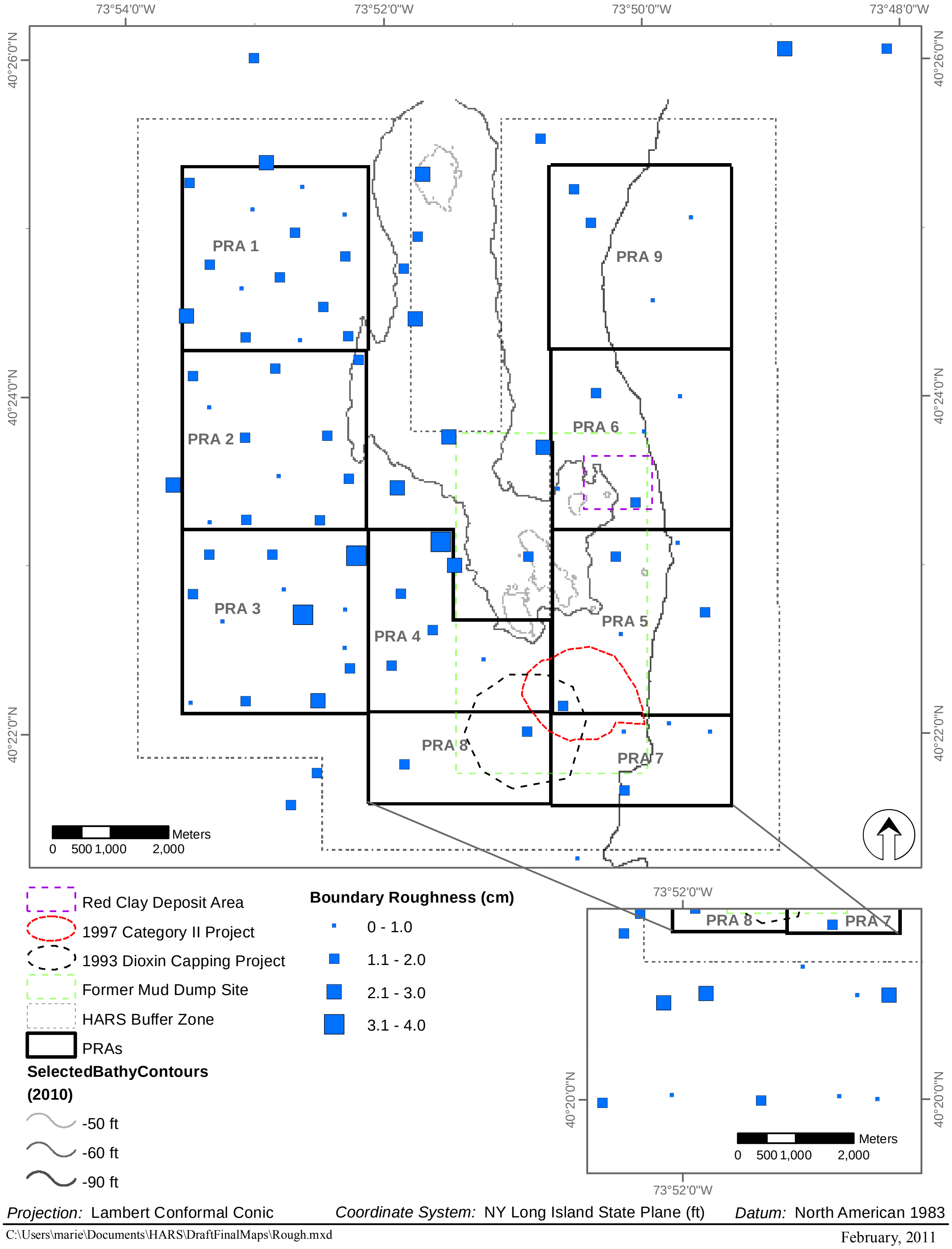

Figure 3-40. Average boundary roughness values (cm) at the general HARS monitoring stations

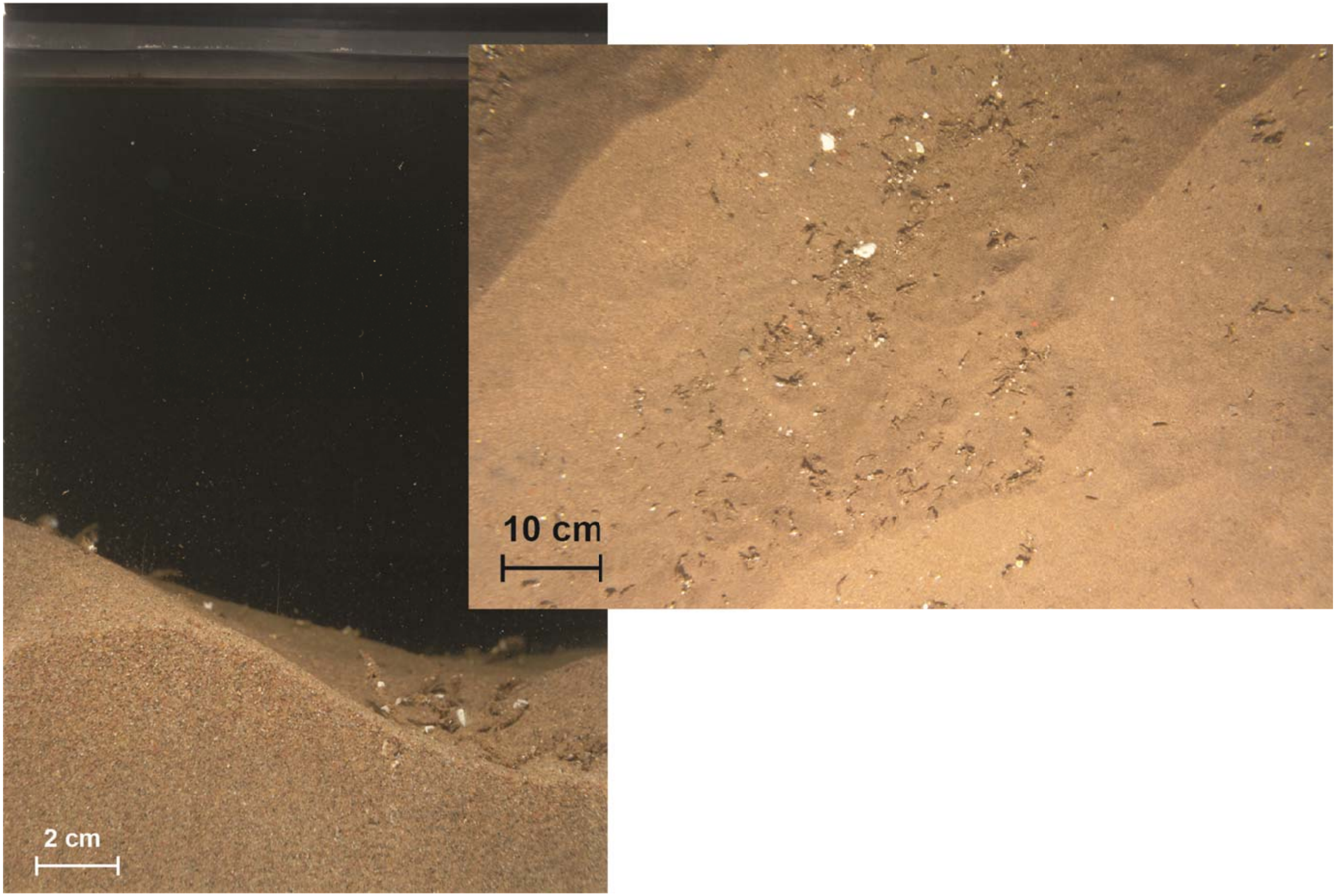

Figure 3-41. Profile and plan-view images from Station 2002-1 illustrating small-scale surface roughness due to the presence of sand ripples

Figure 3-42. The small-scale surface relief in this profile image from Station 2001-2 is of biological origin, due to the presence of dense worm tubes at the sediment surface and to bioturbation by infaunal organisms.

Table 3-9.

Sediment Grain Size and Moisture Content for the General HARS Monitoring Stations

		% Sand				% Fines		
Station	**% Gravel**	**% Coarse**	**% Medium**	**% Fine**	**Total % Sand**	**% Silt**	**% Clay**	**% Moisture**
24	0	0.2	7.6	89	96.8	3.2		24.4
34	0	1.3	49.4	47	97.7	1	1.3	18
31	0	0	2.1	90.2	92.3	4.4	3.3	20.7
01	0	0	5.9	91.8	97.7	0.3	2	24.5
02	6.2	1.9	6.9	56.8	65.6	19.5	8.7	28.6
09	0.9	0.3	7.1	69.7	77.1	14.8	7.2	23.9
17	1.5	0.9	6	63.1	70	15	13.5	32.7
40	25.5	4.9	49.9	13.8	68.6	2.8	3.1	16.8
46	0	1	3.3	40	44.3	40	15.7	41.2
39	0	0.8	4.9	91.6	97.3	0.8	1.9	21.8
45	0	0.3	34.5	62	96.8	0.3	2.9	21.9
44	1.6	1.7	43.2	51.7	96.6	1.8		22.1
43	0	0.2	6.1	89.1	95.4	0.7	3.9	23.7
42	0	0.2	3.6	93.2	97	3.0		24.4
37	0	1.2	54.8	42.5	98.5	1.5		12.9
38	0.9	0.9	37.3	60	98.2	0.9		10.9
36	5.7	0.2	3.3	81.5	85	4.9	4.4	21.6
33	23	15.2	18.4	27	60.6	10.3	6.1	25.3
32	7.5	7.8	22.7	47.1	77.6	8.2	6.7	23.6
30	0	0.2	0.8	24.5	25.5	47.3	27.2	47.8
27	0	0	0.2	1.2	1.4	14.6	84	33.4
26	1	2.2	49.6	39.6	91.4	2.5	5.1	20.3

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Table 3-9., continued

Sediment Grain Size and Moisture Content for the General HARS Monitoring Stations

		% Sand				% Fines		
Station	**% Gravel**	**% Coarse**	**% Medium**	**% Fine**	**Total % Sand**	**% Silt**	**% Clay**	**% Moisture**
25	5.1	5.4	39.9	47.7	93	1.9		19.4
22	33.4	7.7	18.1	36.8	62.6	0.7	3.3	19.1
14	1.1	0.5	11	17.6	29.1	50	19.8	39.7
05	0	0	20	78.2	98.2	1.8		23.2
08	0	0	26.4	72.1	98.5	1.5		23.6
12	0	0	5.4	92.1	97.5	2.5		25.2
13	0	0	6.9	91	97.9	2.1		18
2001-08	35.2	2.5	16.1	18.9	37.5	15.6	11.7	21.3
2010-12	2.7	1.9	50.1	42.9	94.9	2.4		20.6
L-1200	0	0	3.5	90.9	94.4	1.1	4.5	24.3
19	0	0	1.5	77.3	78.8	14.9	6.3	26.7
2010-14	0	0.5	14.4	81.1	96	4.0		22.5
20	0.3	0.3	17.5	79.3	97.1	2.6		22.7
16	0.7	1.2	19.4	76.7	97.3	2.0		23
2002_4	0	0.1	13.1	81.1	94.3	5.7		24
2010-16	0.3	0.1	0.2	4.5	4.8	63.1	31.8	51.6
2010-17	6.3	5.3	6.4	15	26.7	29.2	37.8	29.7
2010-15	7.5	4.4	5.7	22.3	32.4	27.7	32.4	40.9
2003_05	13.9	7.3	15.8	30.6	53.7	13.7	18.7	24.6
28	1.1	0.4	2.8	28.6	31.8	42.9	24.2	41.1
2004_2	3.2	3.3	6.1	9.1	18.5	34.5	43.8	23.3
29	0	0.4	1.7	13.9	16	56.7	27.3	43.8

continued on following page

Table 3-9., continued

Sediment Grain Size and Moisture Content for the General HARS Monitoring Stations

		% Sand				% Fines		
Station	**% Gravel**	**% Coarse**	**% Medium**	**% Fine**	**Total % Sand**	**% Silt**	**% Clay**	**% Moisture**
2004_6	2.5	4	47.7	40.5	92.2	2.3	3	20.3
P2800	0	0.5	31.9	61.5	93.9	2.5	3.6	22.6
2001_2	0	0.3	1.5	17	18.8	57.7	23.5	41.1
2010-18	0	0	2.9	15	17.9	30.7	51.4	33.7
2010-19	0.1	0.1	0.6	95.6	96.3	3.6		26.4
35	2	12.6	61.9	22.1	96.6	1.4		18.7
2002_10	0	0.1	5.2	92.6	97.9	2.1		24.3
NOREMED_5	0.5	1.9	5.3	13.1	20.3	38.2	41	41.7
97_00_9	9	5	16.1	38.2	59.3	11.2	20.5	25
18	0.2	0	1.1	18.3	19.4	61.2	19.2	36.9
NOREMED_2	0.7	0.2	3.1	24	27.3	53.3	18.7	42.8
10	9.2	1.1	9.3	40.9	51.3	27.4	12.1	33.6
49	6.7	6.9	35.6	42.3	84.8	3	5.5	23.3
06	4.6	7.5	70.3	16.4	94.2	1.2		19.9
03	5.9	4	6.7	52.5	63.2	21.5	9.4	31.7
2002_1	0	0	12.2	61.2	73.4	10.1	16.5	27.9

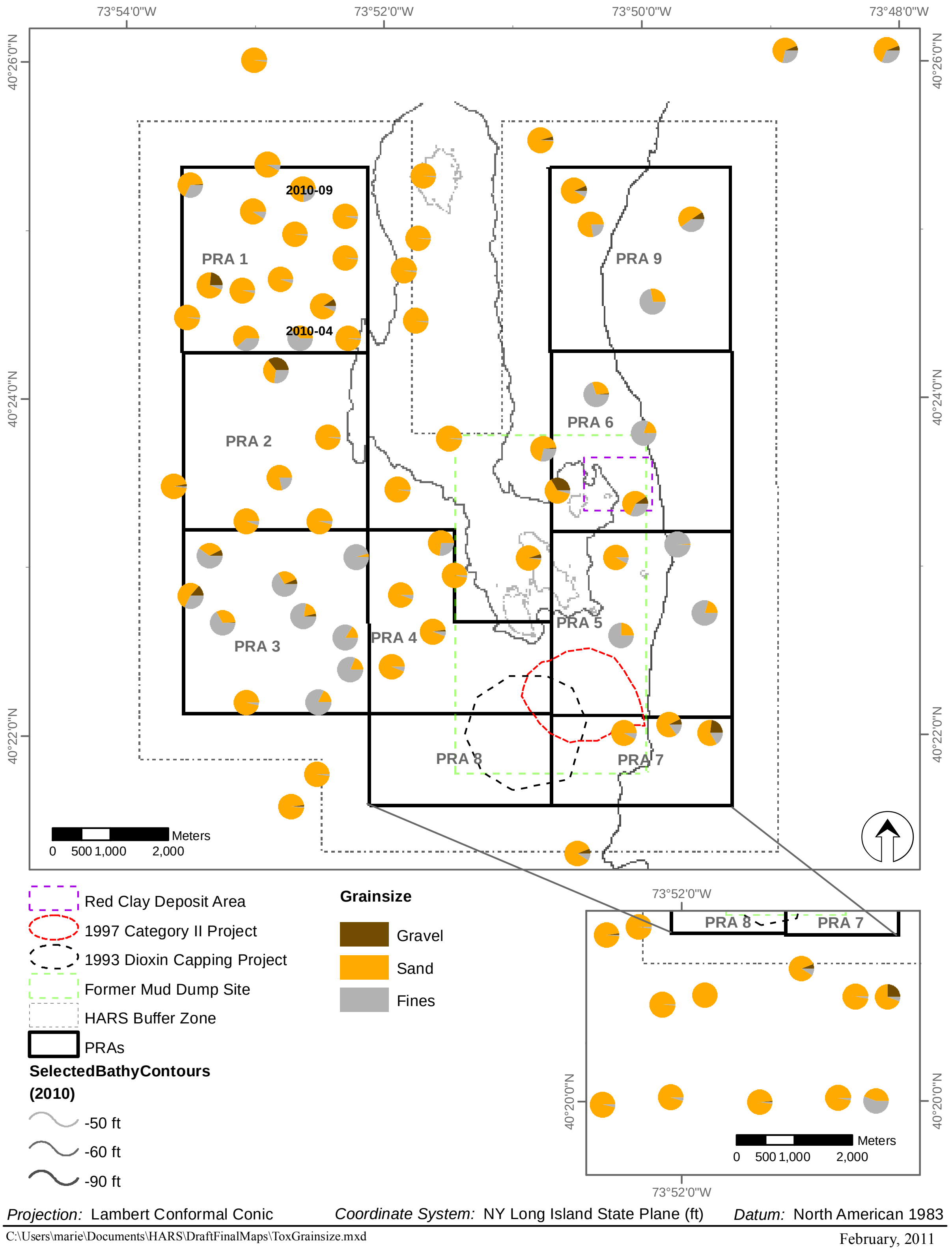


Figure 3-43. Grain size distribution of surface sediments (determined by laboratory analysis) at the general HARS monitoring stations

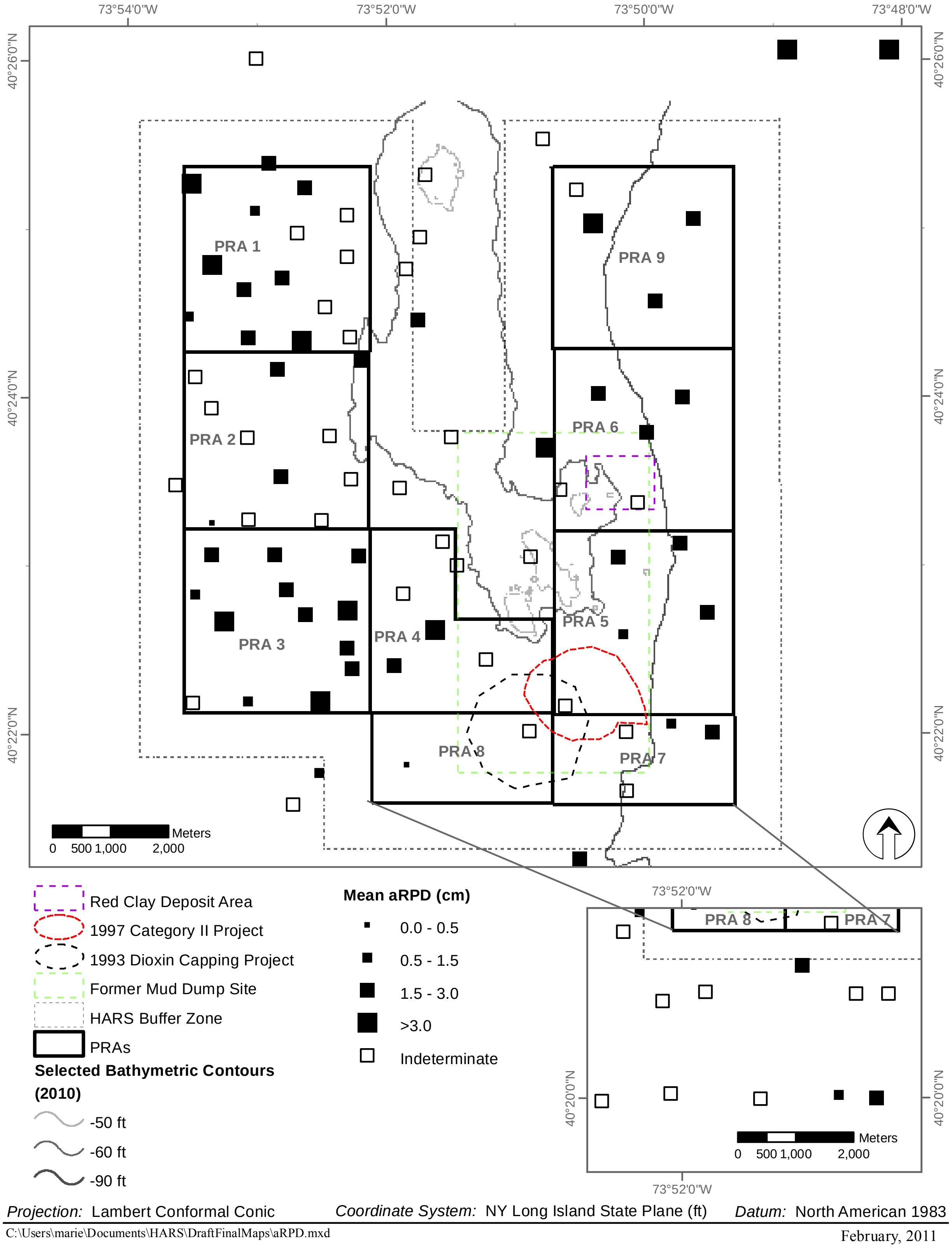


Figure 3-44. Average aRPD depths (cm) at the general HARS monitoring stations

Figure 3-45. Profile image from Station NOREMED-2 in PRA 9 showing muddy relict dredged material with a moderately well-developed aRPD depth of 2.5 cm

Figure 3-46. Infaunal successional stages at the general HARS monitoring stations

Figure 3-47. Profile image from Station 2001-2 showing soft, muddy dredged material with a Stage 2 on 3 community. Stage 2 is represented by the numerous small white bivalves (probably nut clams, *Ennucula tenuis*) that are visible just below the sediment surface. Evidence of Stage 3 includes two small subsurface feeding voids (arrows on left) and two larger, worm-like organisms (arrows on right).

Figure 3-48. A vertical burrow and several subsurface feeding voids provide evidence of a Stage 3 community in this profile image of red clay at Station NOREMED-5. A few small worm tubes are visible at the sediment surface, resulting in a Stage 1 on 3 successional designation for this image.

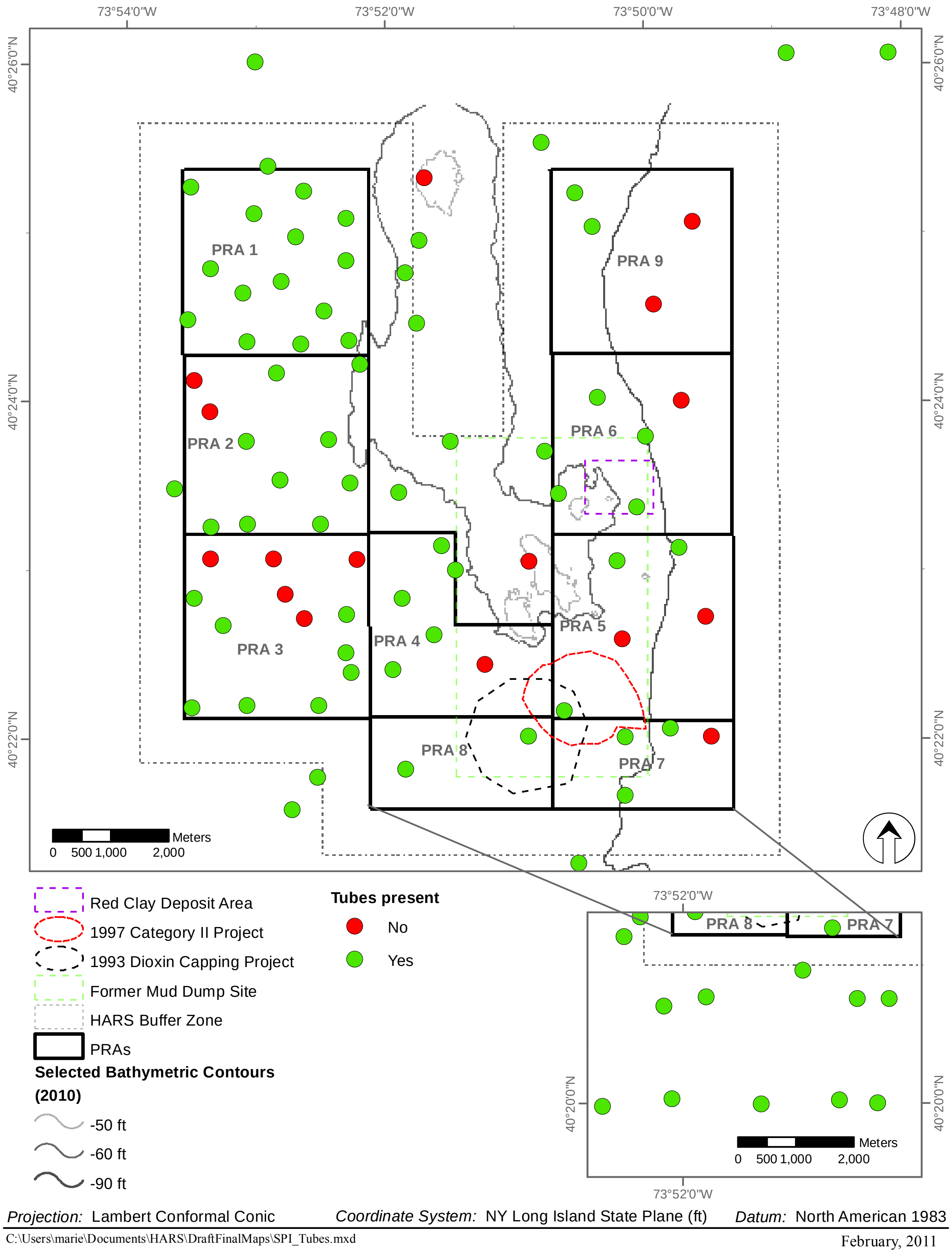
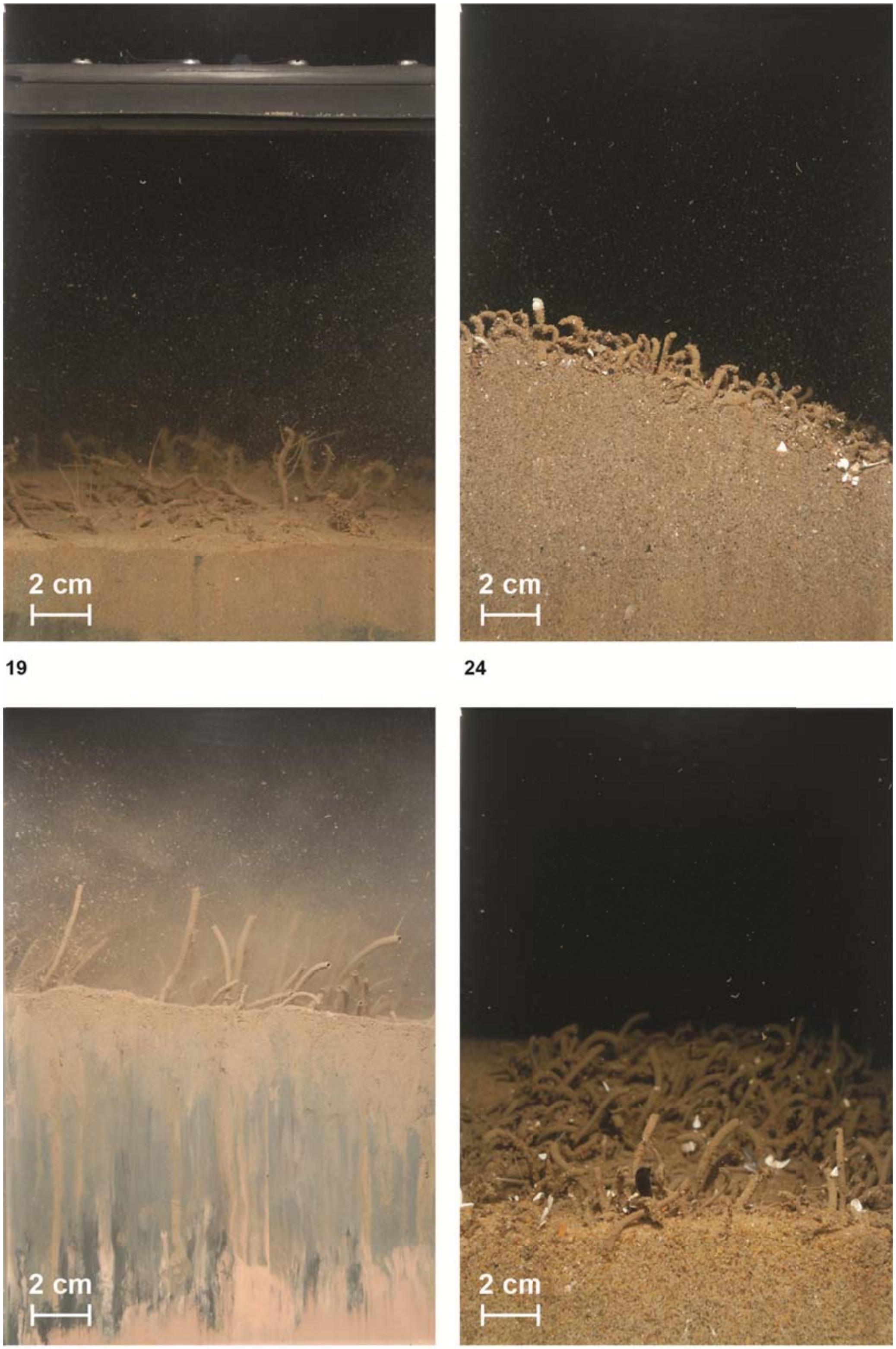


Figure 3-49. General HARS monitoring stations where profile images showed worm tubes at the sediment surface



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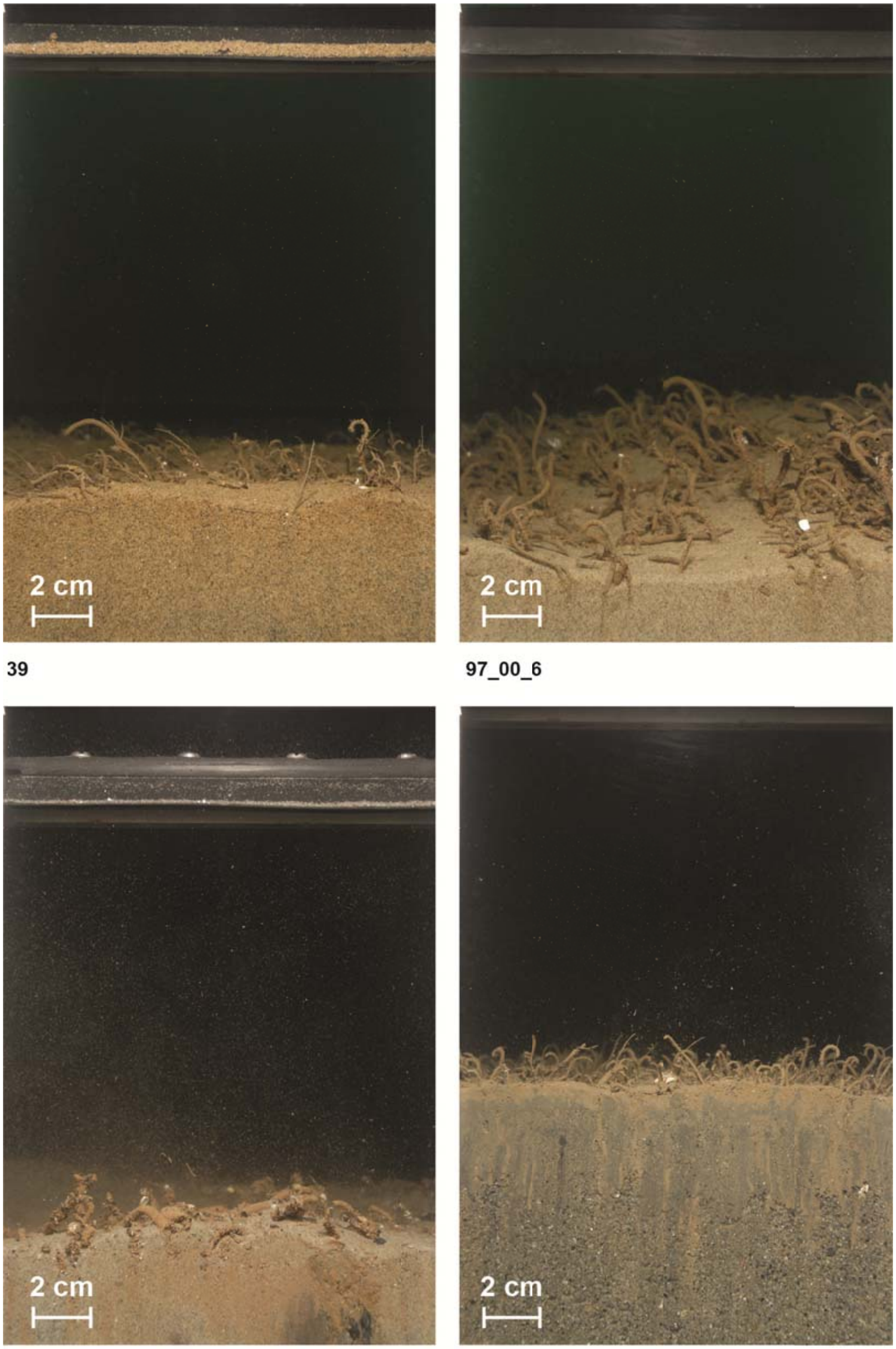
24

27

B. T-36 B

Figure 3-50. Profile images showing examples of various types of worm tubes at the sediment surface at general HARS monitoring stations



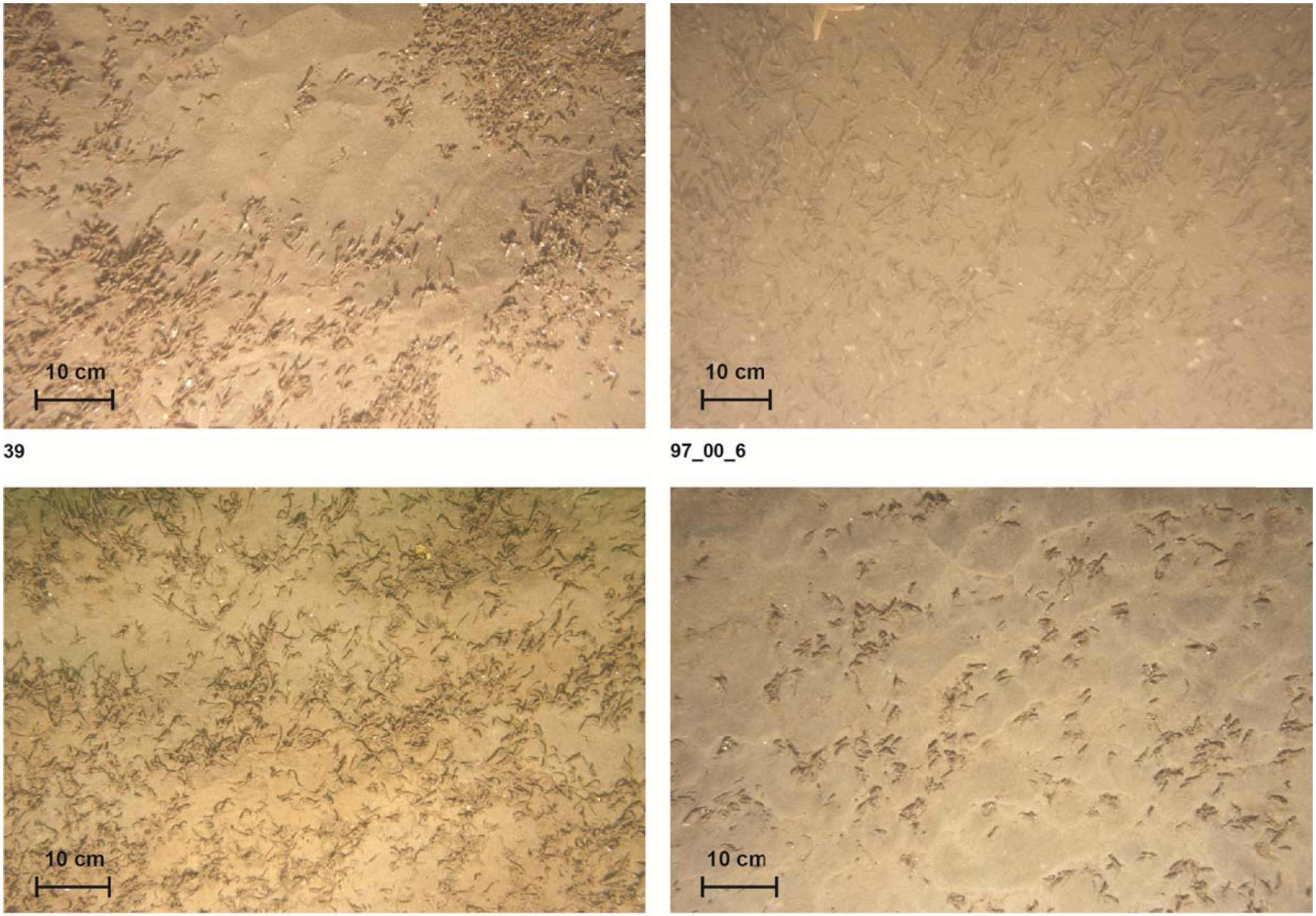
39

97_00_6

2010-19

NOREMED-4

Figure 3-51. Profile images showing additional examples of various types of worm tubes at the sediment surface at general HARS monitoring stations



39

97_00_6

2010-19

NOREMED-4

Figure 3-52. Plan-view images showing different types of worm tubes at the sediment surface at various general HARS monitoring stations

Table 3-10.

Results of Sediment Toxicity Testing at the General HARS Monitoring Stations

Station	% Survival	Normalized % Survival
Round 1		
Control	95%	
24	93%	98%
34	85%	89%
31	88%	93%
01	77%*	81%
17	89%	94%
39	80%	84%
44	89%	94%
Round 2		
Control	94%	
43	96%	102%
42	94%	100%
37	85%	90%
38	84%	89%
36	94%	100%
30	97%	103%
Round 3		
Control	97%	
27	88%	91%
26	83%	86%
25	89%	92%
2001-08	90%	93%
Round 4		
Control	93%	
22	93%	100%
14	96%	103%
05	84%	90%
12	86%	92%
13	92%	99%
2010-12	89%	96%
L-1200	100%	107%
19	98%	105%

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Table 3-10., continued

Results of Sediment Toxicity Testing at the General HARS Monitoring Stations

Station	% Survival	Normalized % Survival
Round 5		
Control	95%	
2010-14	92%	97%
20	97%	102%
16	92%	97%
2002_4	93%	98%
2003_05	94%	99%
28	99%	104%
2004_2	95%	100%
Round 6		
Control	100%	
29	96%	96%
2004_6	99%	99%
P2800	99%	99%
2010-18	98%	98%
35	93%	93%
2002_10	90%	90%
NOREMED_5	95%	95%
97_00_9	96%	96%
18	94%	94%
Round 7		
Control	97%	
46	96%	99%
33	99%	102%
Round 8		
Control	98%	
NOREMED_2	98%	100%
10	99%	101%
49	96%	98%
06	95%	97%
03	98%	100%
2002_1	99%	101%

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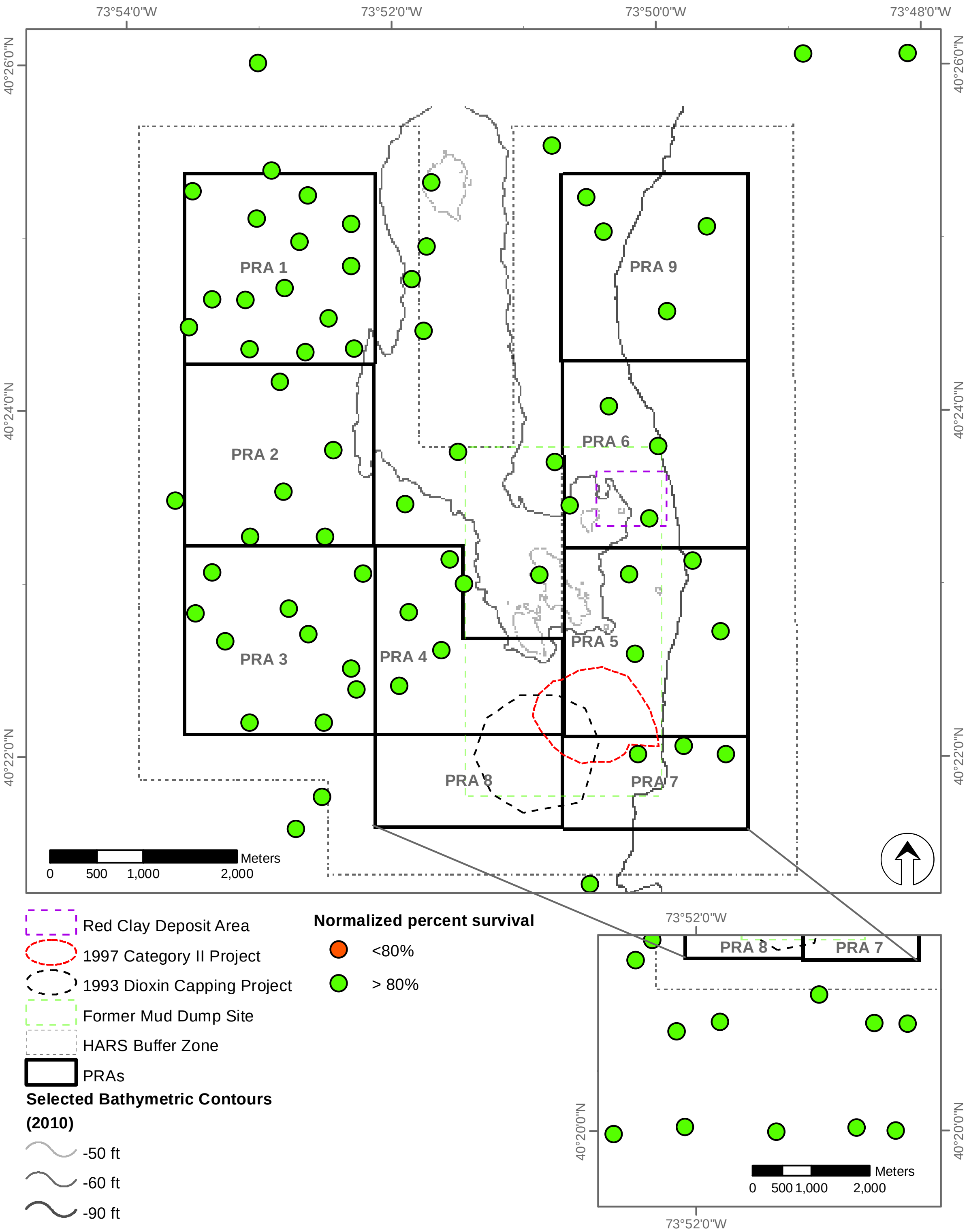
Table 3-10., continued

Results of Sediment Toxicity Testing at the General HARS Monitoring Stations

Station	% Survival	Normalized % Survival
Round 9		
Control	96%	
02	97%	101%
09	99%	103%
40	86% *	90%
2010-16	94%	98%
2010-19	95%	99%
Round 10		
Control	99%	
45	97%	98%
32	100%	101%
08	99%	100%
2010-15	98%	99%
2001_2	100%	101%
Round 11		
Control	97%	
2010-17	98%	101%

* Statistically significant compared to the control (α = 0.05)



Projection: Lambert Conformal Conic *Coordinate System:* NY Long Island State Plane (ft) *Datum:* North American 1983

C:\Users\marie\Documents\HARS\DraftFinalMaps\Survival.mxd

February, 2011

Figure 3-53. Results of sediment toxicity testing for the general HARS monitoring stations

Although statistical testing showed that the absolute percent survival rates of 77% at Station 01 and 86% at Station 40 were each significantly less than their respective control survival, the normalized percent survival rates at these two stations were greater than 80%, resulting in a “nontoxic” designation (Table 3-10).

As indicated in Table 2-1, many of the sediment toxicity stations visited in 2010 also had been sampled in the previous surveys of 1994, 2000, 2002, and 2005. The testing results for the 2002 and 2005 surveys were identical to those from 2010 in showing an absence of any significant sediment toxicity; all of the normalized percent survival values in these two past years were greater than 80% (Table 3-11). In the sediment toxicity survey of 2000, only 2 of the 33 stations sampled had significant toxicity. The original USEPA study of 1994 remains the only past survey that found significant, widespread toxicity, with normalized percent survival less than 80% at 25 of the 44 stations that were sampled (Table 3-11).

Table 3-11.

Normalized Percent Survival in Past Sediment
Toxicity Surveys (shading indicates significant toxicity)

Station	1994	2000	2002	2005	2010
PRA 1 Stations:					
4	99	NA	104	102	99
7	0	92	98	105	99
11	4	NA	101	104	104
E0800	NA	NA	100	99	94
G-1200	NA	102	95	NA	101
C-1200	NA	97	95	NA	101
E-1200	NA	97	NA	NA	NA
E-1600	NA	100	NA	NA	NA
E-300	NA	98	NA	NA	NA
ESE-600	NA	99	NA	NA	NA
F-1200	NA	96	NA	NA	NA
F-800	NA	100	NA	NA	NA
2NE-100	NA	97	NA	NA	NA
NE-700	NA	101	NA	NA	NA
NW-800	NA	92	NA	NA	NA
NWC-1	NA	81	NA	NA	NA
NWC-2	NA	82	NA	NA	NA
NWC-3	NA	99	NA	NA	NA
WNW-700	NA	63	NA	NA	NA
WNW-900	NA	59	NA	NA	NA
Non-PRA 1 Stations:					
1	104	NA	97	102	81
2	86	NA	97	101	101
3	47	NA	98	101	100
5	89	94	100	101	90
6	54	NA	95	97	97
8	98	97	97	97	100
9	85	NA	96	97	103
10	89	NA	103	101	101
12	72	97	99	101	92
13	24	102	96	108	99

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Table 3-11., continued

Normalized Percent Survival in Past Sediment
Toxicity Surveys (shading indicates significant toxicity)

Station	1994	2000	2002	2005	2010
Non-PRA 1 Stations (continued):					
14	6	NA	94	104	103
16	62	103	96	98	97
17	3	NA	89	108	94
18	1	89	100	103	94
19	0	NA	100	101	105
20	24	NA	93	100	102
22	3	NA	96	108	100
24	78	NA	101	99	98
25	77	NA	98	98	92
26	1	NA	99	98	86
27	11	94	100	97	91
28	1	NA	90	94	104
29	0	NA	99	99	96
30	60	NA	99	95	103
31	35	NA	103	98	93
32	41	94	101	100	101
33	43	NA	104	100	102
34	92	NA	104	100	89
35	78	NA	101	98	93
36	50	NA	95	102	100
37	94	NA	102	101	90
38	89	NA	92	100	89
39	93	NA	95	100	84
40	94	NA	107	102	90
42	97	100	100	95	100
43	95	95	99	99	102
44	87	99	96	100	94
45	99	96	97	101	98
46	99	93	85	100	99
49	82	96	99	101	98
L1200	NA	NA	99	NA	107
P2800	NA	NA	85	NA	99
EARLE-1	NA	99	NA	NA	NA

4.0 DISCUSSION

4.1 Characterization of Baseline Conditions in PRA 1

One objective of the 2010 HARS survey was to provide a baseline postremediation characterization of sediment physical and biological conditions, as well as sediment toxicity, within PRA 1. Both the profile and plan-view images revealed that fine to very fine sand was the dominant sediment type at the majority of stations. At some stations the sand did not appear to contain much fine-grained sediment (based on visual assessment of the SPI and plan-view images) and was therefore described as "clean," while at other stations the sand was described as muddy due to the presence of varying amounts of silt/clay. The laboratory grain size analysis confirmed that the dominant sediment type at most of the PRA 1 stations was fine sand containing varying amounts of silt and clay.

Although fine sand was dominant at many of the PRA 1 stations, there was some diversity in sediment types. Station 2010-04 was characterized by silt/clay and Station 2010-06 had considerable amounts of coarse sand and gravel. Although the profile images suggested that only fine sand was present at Station 2010-03, the plan-view image revealed the presence of a cobble-sized rock at the sediment surface. Distinct sand-over-mud layering was observed at Stations 2010-01 and G-1200.

Except for Stations 04 and 2010-09 located in the shipwreck buffer zone, where remediation material has not been placed, all of the surface sediment within PRA 1 consisted of remediation material. Past surveys showed that this material has changed over time as remediation activities have continued in PRA 1. In the SPI survey of 2005, for example, the remediation material observed at the stations in PRA 1 consisted of soft, fine-grained sediment. In 2006, about half of these stations were characterized by sand instead of soft mud. In the years following the 2006 survey, sand from Ambrose Channel was used for much of the remediation in PRA 1, as evidenced by the dominance of this sediment type at most of the 2010 SPI stations.

The remediation of PRA 1, therefore, has involved placing a final "capping" layer of fine sand over earlier layers of both sandy and muddy remediation material. This final sand layer represents a substrate that is very similar to the sand bottom that occurs naturally throughout much of the NY Bight area. From a habitat restoration perspective, the remediation activities appear to have resulted in physical conditions at many of the PRA 1 stations that are comparable to those existing in surrounding natural areas.

There was no sediment toxicity in samples from the PRA 1 stations, as determined by the standard 10-day amphipod test. This was one indication that the remediation material in PRA 1 was correctly designated as "HARS-suitable," because one of the requirements of this designation is that the material "not cause significant undesirable effects." Given the absence of toxicity, it is not surprising that the profile and plan-view images revealed that benthic infauna were inhabiting the surface sediments at stations throughout PRA 1.

At about half of the PRA 1 stations, there was evidence that subsurface-dwelling, Stage 3 taxa were present, often in conjunction with surface-dwelling Stage 1 or shallow-dwelling Stage 2 organisms. This represented a relatively advanced successional status and indicated that the remediation material was being successfully recolonized. As a result of bioturbation by the resident benthic infauna, redox depths were fairly well developed at many of the PRA 1 stations, indicating a moderate to high degree of sediment reworking.

There were at least two other lines of evidence supporting the conclusion that the remediation material in PRA 1 had become successfully colonized and that biological conditions within this PRA were comparable to those on the ambient seafloor. First, large worm tubes were present at the sediment surface at all of the sampling stations in PRA 1 (Figure 3-23), and these same types of tubes also occurred at many of the other stations sampled in the August 2010 survey, including both stations within the HARS and those on the ambient seafloor outside the HARS (Figure 3-49). Second, analysis of benthic community composition showed that eight of the dominant taxa at the PRA 1 stations were also among the dominants at the reference stations. Furthermore, PRA 1 and reference stations representing similar habitat types (e.g., clean fine sand, muddy sand, sand-over-mud) had somewhat similar community structure. Finally, the average number of benthic taxa, as well as average diversity, evenness, and species richness, were roughly comparable between the PRA 1 stations and the reference stations. All of these factors lent support to the conclusion that biological conditions within PRA 1 were broadly similar to those in nearby reference areas.

One notable finding of the 2010 survey was the occurrence of relatively large worm tubes at the sediment surface at a high proportion of stations, both within and outside the HARS. Such tubes have been observed in past HARS monitoring surveys, but they did not have the same widespread distribution across the entire survey area. In the 2005 survey, for example, dense tube mats of the surface-dwelling polychaete *Asabellides oculata* were observed at just a few stations having red clay remediation material (SAIC 2005). In the 2006 survey, the tubes were more widespread, occurring at many of the stations with remediation material in PRAs 1 through 4 (SAIC 2006). It is likely that many of the tubes in the 2010 survey also were constructed by *Asabellides oculata*, as this polychaete was among the top numerical dominants collected in the grab samples. In general, this tube-builder is known to form occasional tube mats in sandy sediments on the mid-Atlantic inner continental shelf (Diaz et al. 2003, 2004), including the nearshore zone off New Jersey (USACE 2001). The results of the 2005, 2006, and 2010 surveys suggest that populations of this organism may have increased in the general area of the HARS in recent years, although it is also possible that there was unusually high recruitment success in 2010 that may not necessarily be characteristic of other years.

The large surface worm tubes observed in the 2010 survey were characterized by significant variation in shape, size, and composition (Figures 3-50 to 3-52). For example, in some images the tubes were long, straight, and had a smooth outer surface that appeared to be composed of mud and mucous; while in other images the tubes were curved or had a rough outer surface constructed of organic debris and shell fragments. Tube building polychaetes are often opportunistic when selecting materials to construct tubes (Carey 1983, 1987). *Asabellides oculata* was found in relatively high numbers in the grab samples and therefore is a likely candidate as the tube constructor. It is possible that other species may have been present, but were simply missed in the grab samples. For example, *Diopatra cuprea* is a polychaete species not sampled in the grabs but which is known to construct shell-covered surface tubes like those observed at some stations. Regardless of taxonomic identity, it is clear that the ubiquitous worm tubes were influencing sediment transport patterns (Figure 3-52) and have the potential to provide a rich food source for bottom-dwelling fish and shellfish (Carey 1983, 1987; Friedrichs et al. 2000; Friedrichs and Graf 2009). It is notable that a number of commercial party fishing boats were operating in the vicinity of the HARS during the August field activities.

4.2 General HARS Monitoring

A second objective of the August 2010 survey was to assess any temporal changes in sediment quality and sediment toxicity that may have occurred in areas or at stations that have been sampled in the past, both within PRA 1 and throughout the HARS. The 2010 survey found that the stations located outside the HARS boundary were characterized primarily by fine to medium sand consistent with native sediment. The previous surveys of 2002, 2005, and 2006 likewise found rippled fine sand at these same stations, indicating no appreciable change in physical habitat conditions in the areas immediately surrounding the HARS.

The 2010 survey also found that stations within the HARS were characterized by either relict dredged material (in unremediated areas) or various types of remediation material. Similar results have been found in previous surveys, although the area covered by remediation material has been gradually expanding over time. For example, in the 2005 and 2006 surveys, remediation material was observed only in PRAs 1 through 4; while the 2010 survey found that the area covered by remediation material included not only PRAs 1 through 4, but also PRA 8 and part of PRA 5. Remediation activities obviously have been ongoing and have expanded to encompass new areas since the 2006 survey.

Similar to previous survey results, the 2010 results showed that the remediation material consisted of a variety of different sediment types, including red clay, organic-rich mud, clean fine sand, and rocks/gravel. The stations located in PRAs 5, 6, 7, and 9 on the eastern side of the HARS, where remediation material has not yet been placed, continued to be characterized by relict dredged material in 2010. Fine sand representing cap material from the 1993 and 1997 capping projects also continued to be observed at Stations 97-00-4 and 97-00-6. Overall, the 2010 results showed that the stations within the HARS boundary were characterized by a variety of different sediment types representing either remediation material or relict dredged material. The nature and extent of this material was largely consistent with that shown in the surveys of 2005 and 2006, indicating little change in physical habitat conditions over the past 5 years, except for the expansion of the area covered by remediation material and the higher densities of surface worm tubes.

In terms of biological conditions, evidence of advanced Stage 3 succession was observed primarily at the general HARS monitoring stations which had fine-grained sediment, in the form of either red clay or muddy dredged material. In contrast to the organic-poor native sand found in surrounding areas, organic-rich silt/clay sediment placed at the HARS is conducive to colonization by both surface-dwelling and deeper dwelling infauna, with succession ultimately resulting in the establishment of mature Stage 3 communities. At many of the 2010 stations, surface-dwelling Stage 1 polychaetes or shallow-dwelling Stage 2 bivalves occurred in conjunction with Stage 3 organisms, indicating some secondary succession that was likely a response to variations in the timing of disposal activities across the site. The 2010 results were quite similar to those of the 2002, 2005, and 2006 surveys, which likewise showed a mosaic of different successional stages across the site, with Stage 3 infauna occurring predominantly at silt/clay stations.

As indicated previously, there were large worm tubes observed at the sediment surface at many of the general HARS monitoring stations. Such tubes also were observed in the surveys of 2005 and 2006, but at fewer stations. Without greater knowledge of the identity and ecology of the tube-building organism(s), it is difficult to ascertain whether the widespread tube abundance observed in 2010 was part of a multiyear trend of increasing population density or the result of a one-time seasonal recruitment event. It is notable that the tubes occurred both at the stations with native sandy sediment outside the HARS and at stations with either remediation material or relict dredged material within the HARS. This provided evidence that, in terms of supporting populations of the tube-dwelling organism(s), benthic habitat conditions within the HARS were comparable to those on native sediment outside the HARS.

The results of sediment toxicity testing at the general HARS monitoring stations were the same as those at the PRA 1 stations: there was a complete absence of toxicity at all of the stations tested. As shown in Table 3-11, these results echoed those of the previous two sediment toxicity surveys of 2002 and 2005, which likewise showed that surface sediments were uniformly nontoxic at all of the sampled stations. As indicated previously, these results validated the process being used to screen sediments prior to designating them as either suitable or unsuitable for use as remediation material. Given the absence of any significant toxicity in the last three surveys, it is recommended that consideration be given to reducing either the frequency of such monitoring and/or the total number of stations tested in the future. In particular, it may not be necessary to sample at all of the stations located on native sand bottom outside the HARS boundary, as sediment conditions are unlikely to change significantly at these locations.

The 2000, 2002, 2005, and 2010 toxicity testing results stand in contrast to the results of the original toxicity survey of 1994. Specifically, all 26 of the stations located in and around the former MDS that were found to be toxic in the 1994 survey have been found to be nontoxic in the four subsequent surveys. Placement of cleaner remediation material over formerly toxic sediment is one possible explanation for the change in toxicity at a relatively small number of stations, principally those located in PRAs 1 through 4 where the bulk of remediation activity has taken place to date. However, as noted in a previous report (SAIC 2005), it is also possible that much of the toxicity observed in 1994 was due to a testing artifact: despite its potentially lethal effects on the test amphipod, ammonia was not purged from the 1994 sediment samples (Battelle 1996). Static testing, as opposed to flow-through, was used in the 1994 samples with high initial porewater ammonia (S. Knowles memorandum of 5 February 2002). The likelihood therefore exists that significant ammonia toxicity and/or ammonia-enhanced toxicity may have occurred in the 1994 tests, and that many or all of the results represented false positives. In contrast, all of the amphipod tests conducted in 2000, 2002, 2005, and 2010 involved purging of ammonia whenever the initial level in any sample was found to exceed the maximum allowable limit of 20 mg/L.

Overall, the results of the 2010 general HARS monitoring survey indicated that sediment quality was good, in the sense that it was supportive of a diverse community of benthic organisms. The profile images showed that surface-dwelling Stage 1 and/or shallow-dwelling Stage 2 organisms were present at a high proportion of stations within the HARS, usually in association with deeper-dwelling Stage 3 organisms. Measured aRPD depths indicated a moderate to high degree of bioturbation activities of resident infauna. Both the profile and plan-view images also showed that large tubes were present at the sediment surface at many stations within and outside the HARS. All of these factors, along with the absence of any significant sediment toxicity, are considered indicative of healthy benthic habitat conditions within the HARS and in surrounding areas at the time of the August 2010 survey.

5.0 CONCLUSIONS

Most of the stations in PRA 1 were characterized by fine sand, although silt/clay, coarse sand, gravel, and rocks were observed at a few stations. Except for two stations in the shipwreck buffer zone, the surface sediment at all the PRA 1 stations consisted of remediation material placed there since the HARS was designated in 1997.

The surface sand observed at many of the PRA 1 stations was very similar to the sand that occurs naturally throughout much of the NY Bight area. Remediation activities appeared to have resulted in physical habitat conditions at many of the PRA 1 stations that are comparable to those existing in surrounding natural areas.

There was an absence of any sediment toxicity at the PRA 1 stations, as determined by the standard 10-day amphipod test.

Profile and plan-view imaging revealed that benthic infauna were inhabiting the surface sediments at stations throughout PRA 1. Both surface-dwelling Stage 1 and shallow-dwelling Stage 2 organisms were present, usually along with advanced Stage 3 taxa at depth. Relatively large worm tubes were present at the sediment surface at all of the sampling stations in PRA 1.

Eight of the dominant benthic taxa at the PRA 1 stations were found to also be among the dominants at the reference stations. PRA 1 and reference stations representing similar habitat types were found to have somewhat similar benthic community structure. These findings, along with the profile and plan-view imaging results, indicated that the remediation material in PRA 1 had been successfully colonized by a diverse community of benthic organisms.

The general HARS monitoring showed that stations located outside the HARS boundary continued to be characterized primarily by fine to medium sand representing native sediment, consistent with the results of previous surveys.

Stations within the HARS were characterized by either relict dredged material or various types of remediation material, including red clay, organic-rich mud, clean fine sand, and rocks/gravel. The area of the HARS covered by remediation material has increased over time as disposal activities have expanded into new PRAs.

The 2010 results were similar to those of the 2002, 2005, and 2006 surveys in showing a mosaic of different successional stages across the site, with Stage 3 organisms occurring predominantly at silt/clay stations. Large worm tubes were observed at the sediment surface at many of the general HARS monitoring stations, both within and outside the HARS boundary.

The results of sediment toxicity testing at the general HARS monitoring stations showed an absence of toxicity at all of the stations tested. These results are similar to those of the previous three sediment toxicity surveys of 2000, 2002 and 2005.

Given the absence of any significant toxicity in the last three surveys, it is recommended that consideration be given to reducing either the frequency of such monitoring and/or the total number of stations tested for toxicity in the future.

Advanced Stage 3 succession, relatively deep aRPD depths, the widespread presence of large surface tubes, and the absence of sediment toxicity were all considered evidence that healthy benthic habitat conditions existed within the HARS and surrounding areas at the time of the August 2010 survey.

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APPENDIX A

Grain Size Scale for Sediments

Phi (Φ) size	**Size range (mm)**	**Size class (Wentworth class)**
< -1	> 2	Gravel
0 to –1	1 to 2	Very coarse sand
1 to 0	0.5 to 1	Coarse sand
2 to 1	0.25 to 0.5	Medium sand
3 to 2	0.125 to 0.25	Fine sand
4 to 3	0.0625 to 0.125	Very fine sand
> 4	< 0.0625	Silt/clay

APPENDIX B

SPI Raw Data

Station	REP	DATE	TIME	Stop Collar Setting (in)	# of Lead Weights per carriage	Water Depth (ft.)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	Grain Size RANGE	Penetration Area (sq.cm)	Penetration Mean (cm)	Penetration Minimum (cm)	Penetration Maximum (cm)	Boundary Roughness (cm)	Boundary Roughness Type	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State	METHANE
1	A	8/25/2010	17:02	16	5	60	14.5	3 to 2	1	>4	>4 to 1	94	6.5	5.1	7	1.9	Physical	ind		0		n
1	B	8/25/2010	17:03	16	5	60	14.5	3 to 2	1	>4	>4 to 1	88.1	6.1	5.6	6.7	1.1	Physical	ind		0		n
1	C	8/25/2010	17:04	16	5	60	14.5	3 to 2	1	>4	>4 to 1	94.9	6.5	5.4	7.3	1.9	Physical	ind		0		n
2	A	8/27/2010	8:19	16	5	100	14.5	4 to 3/>4	1	>4	>4 to 1	284.4	19.6	19.2	19.8	0.6	Biogenic	46.5	3.21	0		n
2	B	8/27/2010	8:20	16	5	100	14.5	4 to 3/>4	0	>4	>4 to 0	125.9	8.7	5.6	10.3	4.7	Biogenic	49.8	3.43	0		n
2	C	8/27/2010	8:21	16	5	100	14.5	4 to 3/>4	0	>4	>4 to 0	273.7	18.9	18.2	19.6	1.4	Biogenic	55.2	3.81	0		n
3	B	8/27/2010	8:06	16	5	105	14.5	>4	1	>4	>4 to 1	221.2	15.3	13.3	15.9	2.6	Biogenic	44.6	3.08	0		n
3	C	8/27/2010	8:07	16	5	105	14.5	4 to 3/>4	1	>4	>4 to 1	239.6	16.5	15.9	17.1	1.2	Biogenic	46.5	3.21	0		n
3	D	8/27/2010	8:08	16	5	105	14.5	4 to 3/>4	1	>4	>4 to 1	206	14.2	13	14.7	1.7	Biogenic	64.2	4.43	0		n
4	A	8/27/2010	16:36	14	3	70	14.5	4 to 3	1	>4	>4 to 1	99.1	6.8	5.8	8.1	2.3	Physical	38.6	2.66	0		n
4	C	8/27/2010	16:38	14	3	70	14.5	3 to 2	-1	>4	>4 to -1	31.4	2.2	1.5	2.8	1.3	Physical	ind		0		n
4	D	8/27/2010	16:39	14	3	70	14.5	3 to 2	-1	>4	>4 to -1	42.2	2.9	0.6	4.5	3.9	Physical	ind		0		n
5	A	8/27/2010	8:40	16	5	50	14.5	3 to 2	0	3	3 to 0	103.8	7.2	6.9	7.4	0.5	Physical	ind		0		n
5	B	8/27/2010	8:41	16	5	50	14.5	3 to 2	0	3	3 to 0	105.4	7.3	6.1	8.5	2.4	Physical	ind		0		n
5	D	8/27/2010	8:42	16	5	50	14.5	3 to 2	0	3	3 to 0	106.9	7.4	5.1	9	3.9	Physical	ind		0		n
6	A	8/27/2010	7:40	16	5	75	14.5	2 to 1	-1	3	3 to -1	78.2	5.4	5.1	5.9	0.8	Physical	ind		0		n
6	C	8/27/2010	7:41	16	5	75	14.5	2 to 1	-1	>4	>4 to -1	145.6	10.0	8	12.1	4.1	Physical	ind		0		n
6	D	8/27/2010	7:42	16	5	75	14.5	2 to 1	-1	>4	>4 to -1	98.5	6.8	6.1	7.2	1.1	Physical	ind		0		n
7	A	8/27/2010	16:17	14	3	70	14.5	4 to 3	1	>4	>4 to 1	31.1	2.1	1.7	2.5	0.8	Physical	19.5	1.34	0		n
7	B	8/27/2010	16:18	14	3	70	14.5	4 to 3	1	>4	>4 to 1	28.1	1.9	1.3	2.7	1.4	Biogenic	21.5	1.48	0		n
7	C	8/27/2010	16:19	14	3	70	14.5	4 to 3	1	>4	>4 to 1	42.7	2.9	2.5	3.2	0.7	Physical	25.6	1.77	0		n
8	B	8/27/2010	8:49	16	5	55	14.5	3 to 2	0	4	3 to 0	92.8	6.4	4.6	7.4	2.8	Physical	ind		0		n
8	C	8/27/2010	8:50	16	5	55	14.5	3 to 2	0	4	3 to 0	79.1	5.5	5	5.9	0.9	Physical	ind		0		n

APPENDIX B (CONTINUED)

SPI Raw Data

Station	REP	DATE	TIME	Stop Collar Setting (in)	# of Lead Weights per carriage	Water Depth (ft.)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	Grain Size RANGE	Penetration Area (sq.cm)	Penetration Mean (cm)	Penetration Minimum (cm)	Penetration Maximum (cm)	Boundary Roughness (cm)	Boundary Roughness Type	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State	METHANE
8	D	8/27/2010	8:51	16	5	55	14.5	3 to 2	0	4	3 to 0	38.3	2.6	1.8	3.3	1.5	Physical	ind		0		n
9	A	8/28/2010	18:18	15	3	85	14.5	4 to 3	-1	>4	>4 to -1	160.3	11.1	10.4	11.7	1.3	Biogenic	43.3	2.99	0		n
9	B	8/28/2010	18:19	15	3	85	14.5	4 to 3	-1	>4	>4 to -1	166.4	11.5	10.8	12	1.2	Biogenic	43.7	3.01	0		n
9	C	8/28/2010	18:20	15	3	85	14.5	4 to 3	-1	>4	>4 to -1	152	10.5	10	10.9	0.9	Biogenic	49.5	3.41	0		n
10	A	8/28/2010	18:07	15	2	97	14.5	>4	0	>4	>4 to 0	174.6	12.0	11.8	12.4	0.6	Biogenic	27.1	1.87	0		n
10	B	8/28/2010	18:08	15	2	97	14.5	>4	0	>4	>4 to 0	166.7	11.5	11.3	11.6	0.3	Biogenic	34.1	2.35	0		n
10	C	8/28/2010	18:09	15	2	97	14.5	>4	-1	>4	>4 to -1	131	9.0	8.3	9.7	1.4	Biogenic	20	1.38	0		n
11	A	8/27/2010	15:42	14	2	70	14.5	3 to 2	-1	>4	>4 to -1	43.2	3.0	2.3	3.6	1.3	Biogenic	ind		0		n
11	B	8/27/2010	15:42	14	2	70	14.5	3 to 2	0	>4	>4 to 0	46.5	3.2	2.4	3.7	1.3	Physical	32.7	2.26	0		n
11	C	8/27/2010	15:43	14	2	70	14.5	3 to 2	0	>4	>4 to 0	48.3	3.3	2.8	3.9	1.1	Physical	23.6	1.62	0		n
12	A	8/27/2010	8:57	16	5	59	14.5	3 to 2	0	>4	>4 to 0	54.5	3.8	3.3	4.1	0.8	Physical	ind		0		n
12	B	8/27/2010	8:58	16	5	59	14.5	3 to 2	0	>4	>4 to 0	100.5	6.9	6.3	7.6	1.3	Physical	ind		0		n
12	C	8/27/2010	8:59	16	5	59	14.5	3 to 2	0	>4	>4 to 0	83.5	5.8	5	6.3	1.3	Physical	ind		0		n
13	A	8/27/2010	9:04	16	5	56	14.5	3 to 2	0	>4	>4 to 0	68.8	4.7	4.2	5.3	1.1	Physical	39.87	2.75	0		n
13	B	8/27/2010	9:05	16	5	56	14.5	3 to 2	0	>4	>4 to 0	145.3	10.0	8	11.8	3.8	Physical	56.19	3.88	0		n
13	C	8/27/2010	9:06	16	5	56	14.5	3 to 2	0	>4	>4 to 0	81.2	5.6	5.1	6.5	1.4	Physical	25.9	1.79	0		n
14	A	8/28/2010	17:30	15	4	80	14.5	>4	-1	>4	>4 to -1	136.2	9.4	8.3	10.7	2.4	Physical	35.7	2.46	0		n
14	C	8/28/2010	17:31	15	4	80	14.5	>4	1	>4	>4 to 1	198.6	13.7	12.7	14.8	2.1	Biogenic	18.8	1.30	0		n
14	D	8/28/2010	17:32	15	4	80	14.5	>4	-1	>4	>4 to -1	162.6	11.2	10.7	11.6	0.9	Biogenic	13.8	0.95	0		n
15	A	8/28/2010	17:49	15	4	98	14.5	ind	ind	ind	ind	0	0.0	0	0	0.0	Physical	ind		ind		n
15	B	8/28/2010	19:49	15	4	98	14.5	4 to 3	-5	>4	>4 to -5	88.6	6.1	5.4	7.2	1.8	Physical	39.3	2.71	0		n
15	C	8/28/2010	17:51	15	4	98	14.5	ind	ind	ind	ind	0	0.0	0	0	0.0	Physical	ind		ind		n
16	A	8/27/2010	9:18	16	5	55	14.5	3 to 2	1	>4	>4 to 1	63	4.3	2.9	6.4	3.5	Physical	ind		0		n

APPENDIX B (CONTINUED)

SPI Raw Data

Station	REP	DATE	TIME	Stop Collar Setting (in)	# of Lead Weights per carriage	Water Depth (ft.)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	Grain Size RANGE	Penetration Area (sq.cm)	Penetration Mean (cm)	Penetration Minimum (cm)	Penetration Maximum (cm)	Boundary Roughness (cm)	Boundary Roughness Type	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State	METHANE
16	B	8/27/2010	9:19	16	5	55	14.5	3 to 2	0	>4	>4 to 0	24	1.7	0	3.4	3.4	Physical	ind		0		n
16	D	8/27/2010	9:21	16	5	55	14.5	3 to 2	1	>4	>4 to 1	89.9	6.2	5	7.1	2.1	Physical	ind		0		n
17	A	8/27/2010	10:21	16	5	64	14.5	3 to 2/>4	-1	>4	>4 to -1	218.1	15.0	12.7	16	3.3	Physical	47.1	3.25	0		n
17	C	8/27/2010	10:22	16	5	64	14.5	3 to 2/>4	0	>4	>4 to 0	188.9	13.0	12.5	13.4	0.9	Physical	37.8	2.61	0		n
17	D	8/27/2010	10:23	16	5	64	14.5	3 to 2/>4	0	>4	>4 to 0	179.7	12.4	10.9	13	2.1	Physical	48.5	3.34	0		n
18	B	8/28/2010	17:40	15	4	87	14.5	>4	0	>4	>4 to 0	188.7	13.0	12.5	13.6	1.1	Biogenic	23.7	1.63	5	r	n
18	C	8/28/2010	17:41	15	4	87	14.5	>4	0	>4	>4 to 0	181.7	12.5	12	12.8	0.8	Biogenic	28.1	1.94	2	r	n
18	D	8/28/2010	17:42	15	4	87	14.5	>4	1	>4	>4 to 1	195.4	13.5	13.1	13.8	0.7	Biogenic	31.9	2.20	2	r	n
19	B	8/28/2010	8:41	15	4	77	14.5	>4	0	>4	>4 to 0	118	8.1	7.8	8.4	0.6	Biogenic	59.6	4.11	0		n
19	C	8/28/2010	8:42	15	4	77	14.5	4 to 3	0	>4	>4 to 0	45.7	3.2	3	3.3	0.3	Biogenic	37.6	2.59	0		n
19	D	8/28/2010	8:43	15	4	77	14.5	4 to 3	0	>4	>4 to 0	62.9	4.3	3.9	5.1	1.2	Biogenic	19.3	1.33	14	r	n
20	A	8/27/2010	9:29	16	5	65	14.5	3 to 2	0	>4	>4 to 0	98	6.8	5.3	7.4	2.1	Physical	ind	ind	0		n
20	B	8/27/2010	9:29	16	5	65	14.5	3 to 2	0	>4	>4 to 0	96.1	6.6	4.4	7.7	3.3	Physical	ind	ind	0		n
20	C	8/27/2010	9:30	16	5	65	14.5	3 to 2	0	>4	>4 to 0	89.3	6.2	5.5	6.9	1.4	Physical	ind	ind	0		n
22	B	8/28/2010	17:21	15	4	56	14.5	3 to 2/>4	-1	>4	>4 to -1	203.9	14.1	13.8	15	1.2	Physical	ind	ind	0		n
22	C	8/28/2010	17:22	15	4	56	14.5	3 to 2/>4	-1	>4	>4 to -1	204.7	14.1	13.6	14.5	0.9	Physical	ind	ind	1	r	n
22	D	8/28/2010	17:23	15	4	56	14.5	3 to 2/>4	-2	>4	>4 to -2	220.9	15.2	15	15.8	0.8	Physical	ind	ind	0		n
24	A	8/27/2010	9:41	16	5	64	14.5	3 to 2	-1	>4	>4 to -1	123	8.5	5.7	10.2	4.5	Physical	ind	ind	0		n
24	C	8/27/2010	9:42	16	5	64	14.5	3 to 2	0	>4	>4 to 0	90.6	6.2	5.2	7.8	2.6	Physical	ind	ind	0		n
24	D	8/27/2010	9:43	16	5	64	14.5	3 to 2	-1	>4	>4 to -1	143.9	9.9	9.5	10.3	0.8	Physical	ind	ind	0		n
25	A	8/27/2010	9:51	16	5	52	14.5	0 to -1	-2	3	3 to -2	2.7	0.2	0	0.6	0.6	Physical	ind	ind	0		n
25	B	8/27/2010	9:52	16	5	52	14.5	-1 to -2	-5	4	4 to -5	10.8	0.7	0	1.5	1.5	Physical	ind	ind	0		n
25	C	8/27/2010	9:53	16	5	52	14.5	3 to 2	-1	4	4 to -1	114.3	7.9	6.6	9	2.4	Physical	ind	ind	0		n

APPENDIX B (CONTINUED)

SPI Raw Data

Station	REP	DATE	TIME	Stop Collar Setting (in)	# of Lead Weights per carriage	Water Depth (ft.)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	Grain Size RANGE	Penetration Area (sq.cm)	Penetration Mean (cm)	Penetration Minimum (cm)	Penetration Maximum (cm)	Boundary Roughness (cm)	Boundary Roughness Type	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State	METHANE
26	A	8/28/2010	16:51	14	2	62	14.5	4 to 3	-1	>4	>4 to -1	87.5	6.0	5.5	6.3	0.8	Physical	ind	ind	0		n
26	B	8/28/2010	16:52	14	2	62	14.5	3 to 2	-1	>4	>4 to -1	66	4.6	3.5	5.6	2.1	Physical	31.6	2.18	20	r	n
26	C	8/28/2010	16:53	14	2	62	14.5	3 to 2	0	>4	>4 to 0	105.2	7.3	6	8.3	2.3	Physical	ind	ind	5	r	n
27	A	8/28/2010	17:03	14	2	87	14.5	>4	1	>4	>4 to 1	263.3	18.2	17.7	18.3	0.6	Biogenic	26	1.79	0		n
27	B	8/28/2010	17:04	14	2	87	14.5	>4	1	>4	>4 to 1	165.8	11.4	10.6	12	1.4	Biogenic	32.2	2.22	0		n
27	C	8/28/2010	17:05	14	2	87	14.5	>4	1	>4	>4 to 1	226.7	15.6	15.3	16.3	1.0	Biogenic	55.9	3.86	2	r	n
28	A	8/28/2010	9:52	15	3	80	14.5	>4	1	>4	>4 to 1	205.8	14.2	13.7	14.4	0.7	Biogenic	86.4	5.96	0		n
28	C	8/28/2010	9:54	15	3	80	14.5	>4	1	>4	>4 to 1	195.2	13.5	12.8	13.7	0.9	Biogenic	78.8	5.43	0		n
28	E	8/28/2010	9:56	15	3	80	14.5	>4	1	>4	>4 to 1	180.5	12.4	11.6	12.9	1.3	Biogenic	55.2	3.81	2	r	n
29	A	8/28/2010	10:50	15	3	81	14.5	>4	1	>4	>4 to 1	260.1	17.9	17.2	18.2	1.0	Biogenic	42.1	2.90	0		n
29	B	8/28/2010	10:50	15	3	81	14.5	>4	1	>4	>4 to 1	260.5	18.0	17.6	18.3	0.7	Biogenic	43.7	3.01	0		n
29	C	8/28/2010	10:51	15	3	81	14.5	>4	1	>4	>4 to 1	256.8	17.7	17.2	17.9	0.7	Biogenic	32.5	2.24	0		n
30	B	8/28/2010	16:43	15	4	78	14.5	>4	1	>4	>4 to 1	>310.3	>21.3	>21.2	>21.4	ind	ind	ind	ind	ind		n
30	C	8/28/2010	16:43	15	4	78	14.5	>4	1	>4	>4 to 1	>310.3	>21.3	>21.2	>21.4	ind	ind	ind	ind	ind		n
30	D	8/28/2010	16:44	15	4	78	14.5	>4	1	>4	>4 to 1	279.3	19.3	19	19.6	0.6	Physical	17.3	1.19	0		n
31	B	8/28/2010	13:58	15	4	84	14.5	4 to 3	1	>4	>4 to 1	49.2	3.4	2.8	3.8	1.0	Physical	ind	ind	0		n
31	G	8/28/2010	15:51	15	4	84	14.5	4 to 3	1	>4	>4 to 1	53.7	3.7	3.8	4	0.2	Physical	ind	ind	0		n
31	H	8/28/2010	15:52	15	4	84	14.5	4 to 3	1	>4	>4 to 1	55.2	3.8	3.3	4.2	0.9	Physical	ind	ind	0		n
32	A	8/28/2010	16:14	15	4	91	14.5	4 to 3	1	>4	>4 to 1	105.7	7.3	6.8	7.6	0.8	Physical	9.6	0.66	0		n
32	B	8/28/2010	16:15	15	4	91	14.5	ind	ind	ind	ind	0	0.0	0	0	0.0	ind	ind	ind	ind		ind
32	C	8/28/2010	16:16	15	4	91	14.5	4 to 3	-4	>4	>4 to -4	93.5	6.4	5.3	7	1.7	Physical	34.9	2.41	6	r	n
33	B	8/28/2010	16:23	15	4	96	14.5	4 to 3	-5	>4	>4 to -5	69.5	4.8	4.5	5.2	0.7	Physical	29.8	2.06	0		n
33	C	8/28/2010	16:23	15	4	96	14.5	-4 to -5	-5	>4	>4 to -5	0	0.0	0	0	0.0	ind	ind	ind	ind		ind

APPENDIX B (CONTINUED)

SPI Raw Data

Station	REP	DATE	TIME	Stop Collar Setting (in)	# of Lead Weights per carriage	Water Depth (ft.)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	Grain Size RANGE	Penetration Area (sq.cm)	Penetration Mean (cm)	Penetration Minimum (cm)	Penetration Maximum (cm)	Boundary Roughness (cm)	Boundary Roughness Type	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State	METHANE
33	D	8/28/2010	16:24	15	4	96	14.5	ind	ind	ind	ind	0	0.0	0	0	0.0	ind	ind	ind	ind		ind
34	A	8/27/2010	10:39	16	5	76	14.5	3 to 2	-1	>4	>4 to -1	76.4	5.3	4.9	5.7	0.8	Physical	21	1.45	0		n
34	B	8/27/2010	10:41	16	5	76	14.5	2 to 1	-1	>4	>4 to -1	67.9	4.7	3.7	5.2	1.5	Physical	ind	ind	0		n
34	D	8/27/2010	10:43	16	5	76	14.5	2 to 1	-1	>4	>4 to -1	60.7	4.2	3.8	4.9	1.1	Physical	ind	ind	0		n
35	A	8/27/2010	10:50	16	5	71	14.5	2 to 1	-1	>4	>4 to -1	72.3	5.0	4.4	5.7	1.3	Physical	ind	ind	0		n
35	B	8/27/2010	10:51	16	5	71	14.5	2 to 1	-1	>4	>4 to -1	137.6	9.5	8.7	9.4	0.7	Physical	ind	ind	0		n
35	D	8/27/2010	10:53	16	5	71	14.5	2 to 1	-2	>4	>4 to -2	105	7.2	6.3	7.6	1.3	Physical	ind	ind	0		n
36	A	8/27/2010	11:30	16	5	87	14.5	4 to 3	0	>4	>4 to 0	77.6	5.4	5	5.7	0.7	Physical	ind	ind	0		n
36	C	8/27/2010	11:32	16	5	87	14.5	4 to 3	0	>4	>4 to 0	100.3	6.9	6.7	7.2	0.5	Biogenic	39.4	2.72	0		n
36	D	8/27/2010	11:33	16	5	87	14.5	4 to 3	1	>4	>4 to 1	115.4	8.0	7.5	8.4	0.9	Physical	36.6	2.52	0		n
37	A	8/27/2010	11:01	16	5	72	14.5	3 to 2	-1	>4	>4 to -1	70.1	4.8	2.6	7.5	4.9	Physical	ind	ind	0		n
37	B	8/27/2010	11:02	16	5	72	14.5	3 to 2	1	>4	>4 to 1	110.4	7.6	6.7	8.4	1.7	Physical	ind	ind	0		n
37	D	8/27/2010	11:04	16	5	72	14.5	3 to 2	-1	>4	>4 to -1	53.5	3.7	3.5	4	0.5	Physical	ind	ind	0		n
38	A	8/27/2010	11:15	16	5	76	14.5	3 to 2	-1	>4	>4 to -1	44.5	3.1	1.3	4.2	2.9	Physical	ind	ind	0		n
38	C	8/27/2010	11:17	16	5	76	14.5	3 to 2	-1	>4	>4 to -1	132.8	9.2	7.7	9.7	2.0	Physical	ind	ind	0		n
38	D	8/27/2010	11:18	16	5	76	14.5	3 to 2	-1	>4	>4 to -1	70.8	4.9	4	5.8	1.8	Physical	ind	ind	0		n
39	B	8/27/2010	11:43	16	5	93	14.5	3 to 2	-1	>4	>4 to -1	55.2	3.8	3.2	4.5	1.3	Physical	ind	ind	0		n
39	C	8/27/2010	11:44	16	5	93	14.5	3 to 2	-1	>4	>4 to -1	68	4.7	4.3	5.1	0.8	Physical	ind	ind	0		n
39	D	8/27/2010	11:45	16	5	93	14.5	3 to 2	1	>4	>4 to 1	67.6	4.7	4.2	5.1	0.9	Biogenic	ind	ind	0		n
40	A	8/27/2010	11:52	16	5	104	14.5	1 to 0	-3	>4	>4 to -3	88.8	6.1	4.1	7.4	3.3	Physical	ind	ind	0		n
40	C	8/27/2010	11:54	16	5	104	14.5	2 to 1	0	>4	>4 to 0	82.3	5.7	4.9	6.3	1.4	Physical	ind	ind	0		n
40	D	8/27/2010	11:55	16	5	104	14.5	1 to 0	-3	>4	>4 to -3	72.9	5.0	3.5	6.6	3.1	Physical	ind	ind	0		n
42	B	8/27/2010	13:37	16	5	72	14.5	4 to 3	1	>4	>4 to 1	72.4	5.0	4.5	5.4	0.9	Physical	ind	ind	0		n

APPENDIX B (CONTINUED)

SPI Raw Data

Station	REP	DATE	TIME	Stop Collar Setting (in)	# of Lead Weights per carriage	Water Depth (ft.)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	Grain Size RANGE	Penetration Area (sq.cm)	Penetration Mean (cm)	Penetration Minimum (cm)	Penetration Maximum (cm)	Boundary Roughness (cm)	Boundary Roughness Type	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State	METHANE
42	C	8/27/2010	13:38	16	5	72	14.5	4 to 3	1	>4	>4 to 1	88.1	6.1	5.3	6.8	1.5	Physical	ind	ind	0		n
42	D	8/27/2010	13:40	16	5	72	14.5	4 to 3	1	>4	>4 to 1	70.9	4.9	4	5.3	1.3	Physical	ind	ind	0		n
43	A	8/27/2010	13:23	16	5	81	14.5	4 to 3	1	>4	>4 to 1	62.6	4.3	3.8	4.7	0.9	Physical	ind	ind	0		n
43	B	8/27/2010	13:24	16	5	81	14.5	4 to 3	1	>4	>4 to 1	45.7	3.2	2.8	3.4	0.6	Physical	ind	ind	0		n
43	C	8/27/2010	13:26	16	5	81	14.5	4 to 3	1	>4	>4 to 1	66.5	4.6	4.3	5	0.7	Physical	ind	ind	0		n
44	A	8/27/2010	13:09	16	5	83	14.5	3 to 2	-2	>4	>4 to -2	84.6	5.8	5	6.3	1.3	Physical	ind	ind	0		n
44	B	8/27/2010	13:09	16	5	83	14.5	2 to 1	-1	>4	>4 to -1	66.3	4.6	4	5.7	1.7	Physical	ind	ind	0		n
44	C	8/27/2010	13:10	16	5	83	14.5	2 to 1	-1	>4	>4 to -1	73.7	5.1	4.4	5.7	1.3	Physical	ind	ind	0		n
45	B	8/27/2010	12:55	16	5	94	14.5	3 to 2	0	>4	>4 to 0	63.8	4.4	4.1	4.8	0.7	Physical	21.8	1.5	0		n
45	C	8/27/2010	12:56	16	5	94	14.5	3 to 2	0	>4	>4 to 0	82.4	5.7	5.1	6.1	1.0	Physical	ind	ind	0		n
45	D	8/27/2010	12:57	16	5	94	14.5	3 to 2	0	>4	>4 to 0	59.5	4.1	3.5	4.5	1.0	Physical	ind	ind	0		n
46	B	8/27/2010	12:06	16	5	105	14.5	>4-3	1	>4	>4 to 1	195.2	13.5	13.1	13.9	0.8	Biogenic	46.7	3.2	0		n
46	C	8/27/2010	12:07	16	5	105	14.5	>4-3	1	>4	>4 to 1	217.2	15.0	14.5	15.4	0.9	Biogenic	26.9	1.9	2	r	n
46	D	8/27/2010	12:08	16	5	105	14.5	>4-3	1	>4	>4 to 1	210.2	14.5	14.3	14.8	0.5	Biogenic	31.9	2.2	3	r	n
49	A	8/28/2010	18:27	15	3	80	14.5	3 to 2	-2	>4	>4 to -2	18	1.2	0	3.1	3.1	Physical	ind	ind	0		n
49	D	8/28/2010	18:30	15	3	80	14.5	ind	ind	ind	ind	0	0.0	0	0	0.0	Physical	ind	ind	ind		ind
97_00_4	A	8/28/2010	13:41	14	2	72	14.5	3 to 2	0	>4	>4 to 0	42.8	3.0	2.5	3.8	1.3	Physical	ind	ind	0		n
97_00_4	B	8/28/2010	13:42	14	2	72	14.5	3 to 2	-1	>4	>4 to -1	43.4	3.0	2.5	3.5	1.0	Physical	ind	ind	0		n
97_00_4	D	8/28/2010	13:44	14	2	72	14.5	3 to 2	0	>4	>4 to 0	69.4	4.8	3.9	5.2	1.3	Physical	ind	ind	0		n
97_00_6	A	8/28/2010	13:49	15	4	70	14.5	3 to 2	0	>4	>4 to 0	70.1	4.8	4.4	5.3	0.9	Physical	ind	ind	0		n
97_00_6	B	8/28/2010	13:50	15	4	70	14.5	3 to 2	1	>4	>4 to 1	49.3	3.4	2.1	4.8	2.7	Physical	ind	ind	0		n
97_00_6	C	8/28/2010	13:51	15	4	70	14.5	3 to 2	0	>4	>4 to 0	33.8	2.3	1.8	3.1	1.3	Physical	ind	ind	0		n
97_00_9	B	8/28/2010	17:13	14	2	68	14.5	>4	-3	>4	>4 to -3	36.5	2.5	1	3.5	2.5	Physical	ind	ind	0		n

APPENDIX B (CONTINUED)

SPI Raw Data

Station	REP	DATE	TIME	Stop Collar Setting (in)	# of Lead Weights per carriage	Water Depth (ft.)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	Grain Size RANGE	Penetration Area (sq.cm)	Penetration Mean (cm)	Penetration Minimum (cm)	Penetration Maximum (cm)	Boundary Roughness (cm)	Boundary Roughness Type	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State	METHANE
97_00_9	C	8/28/2010	17:14	14	2	68	14.5	>4	-3	>4	>4 to -3	55.7	3.8	3.3	4.5	1.2	Physical	ind	ind	20	o	n
97_00_9	D	8/28/2010	17:15	14	2	68	14.5	>4	2	>4	>4 to 2	45.1	3.1	2.2	3.8	1.6	Physical	ind	ind	0		n
2001_2	A	8/28/2010	10:40	15	3	82	14.5	>4	1	>4	>4 to 1	287.1	19.8	19.5	19.9	0.4	Biogenic	24	1.7	0		n
2001_2	B	8/28/2010	10:41	15	3	82	14.5	>4	0	>4	>4 to 0	261.9	18.1	16.5	19.3	2.8	Biogenic	59.1	4.1	0		n
2001_2	C	8/28/2010	10:42	15	3	82	14.5	>4	0	>4	>4 to 0	289.5	20.0	19.8	20	0.2	Biogenic	47.1	3.2	0		n
2001_3	A	8/28/2010	11:03	14	2	80	14.5	>4	0	>4	>4 to 0	226.4	15.6	15.3	15.8	0.5	Biogenic	49.4	3.4	0		n
2001_3	B	8/28/2010	11:04	14	2	80	14.5	>4	1	>4	>4 to 1	219.5	15.1	14.6	15.6	1.0	Biogenic	43.3	3.0	0		n
2001_3	C	8/28/2010	11:05	14	2	80	14.5	>4	1	>4	>4 to 1	215.8	14.9	14.6	15.2	0.6	Biogenic	44.6	3.1	0		n
2001_5	A	8/28/2010	8:49	15	4	77	14.5	3 to 2	0	>4	>4 to 0	120.8	8.3	7.9	9	1.1	Physical	ind	ind	0		n
2001_5	B	8/28/2010	8:49	15	4	77	14.5	3 to 2	0	>4	>4 to 0	44.8	3.1	2	4.3	2.3	Physical	ind	ind	0		n
2001_5	D	8/28/2010	8:51	15	4	77	14.5	3 to 2	0	>4	>4 to 0	59.7	4.1	3.7	4.6	0.9	Physical	ind	ind	0		n
2001_6	B	8/28/2010	11:34	14	2	72	14.5	>4	1	>4	>4 to 1	108.5	7.5	6.8	8.3	1.5	Physical	27.3	1.9	0		n
2001_6	C	8/28/2010	11:35	14	2	72	14.5	>4	-4	>4	>4 to -4	71.5	4.9	3.6	5.9	2.3	Physical	14.1	1.0	0		n
2001_6	D	8/28/2010	11:35	14	2	72	14.5	>4	2	>4	>4 to 2	143.1	9.9	8.8	10.4	1.6	Biogenic	29	2.0	3	o	n
2001_8	B	8/28/2010	7:49	15	4	73	14.5	>4	-4	>4	>4 to -4	155.2	10.7	10.4	11	0.6	Physical	52.6	3.6	0		n
2001_8	C	8/28/2010	7:51	15	4	73	14.5	-2 to -4	-6	>4	>4 to -6	111.1	7.7	6.5	8.4	1.9	Physical	29.3	2.0	0		n
2001_8	D	8/28/2010	7:52	15	4	73	14.5	>4	-2	>4	>4 to -2	180.3	12.4	12.6	14.3	1.7	Physical	ind	ind	0		n
2002_1	A	8/28/2010	12:44	14	2	62	14.5	3 to 2	0	>4	>4 to 0	68.4	4.7	2.6	6.5	3.9	Physical	ind	ind	0		n
2002_1	B	8/28/2010	12:45	14	2	62	14.5	3 to 2	0	>4	>4 to 0	52.5	3.6	0.8	7	6.2	Physical	ind	ind	0		n
2002_1	D	8/28/2010	12:47	14	2	62	14.5	3 to 2	0	>4	>4 to 0	54.7	3.8	3.1	4.1	1.0	Physical	ind	ind	0		n
2002_4	A	8/28/2010	12:52	14	2	73	14.5	3 to 2/>4	-1	>4	>4 to -1	208.4	14.4	13.1	15.3	2.2	Physical	ind	ind	0		n
2002_4	C	8/28/2010	12:54	14	2	73	14.5	3 to 2	0	>4	>4 to 0	189.1	13.0	12.5	13.7	1.2	Physical	ind	ind	0		n
2002_4	D	8/28/2010	12:55	14	2	73	14.5	3 to 2/>4	-1	>4	>4 to -1	157.3	10.8	10.4	11.2	0.8	Physical	ind	ind	0		n

APPENDIX B (CONTINUED)

SPI Raw Data

Station	**REP**	**DATE**	**TIME**	**Stop Collar Setting (in)**	**# of Lead Weights per carriage**	**Water Depth (ft.)**	**Calibration Constant**	**Grain Size Major Mode (phi)**	**Grain Size Maximum (phi)**	**Grain Size Minimum (phi)**	**Grain Size RANGE**	**Penetration Area (sq.cm)**	**Penetration Mean (cm)**	**Penetration Minimum (cm)**	**Penetration Maximum (cm)**	**Boundary Roughness (cm)**	**Boundary Roughness Type**	**RPD Area (sq.cm)**	**Mean RPD (cm)**	**Mud Clast Number**	**Mud Clast State**	**METHANE**
2002_9	A	8/28/2010	8:19	15	4	65	14.5	3 to 2	-1	>4	>4 to -1	65.7	4.5	4	5.1	1.1	Physical	ind	ind	0		n
2002_9	B	8/28/2010	8:21	15	4	65	14.5	4 to 3	0	>4	>4 to 0	39.7	2.7	2.1	3.6	1.5	Physical	ind	ind	0		n
2002_9	C	8/28/2010	8:22	15	4	65	14.5	3 to 2	0	>4	>4 to 0	67.4	4.6	3.5	5.2	1.7	Physical	ind	ind	0		n
2002_10	B	8/28/2010	8:12	15	4	67	14.5	3 to 2	0	>4	>4 to 0	68.4	4.7	3.3	6.1	2.8	Physical	ind	ind	0		n
2002_10	C	8/28/2010	8:13	15	4	67	14.5	3 to 2	0	>4	>4 to 0	83.4	5.8	5.4	6	0.6	Physical	ind	ind	0		n
2002_10	D	8/28/2010	8:14	15	4	67	14.5	3 to 2	0	>4	4 to 0	61	4.2	3.7	4.5	0.8	Physical	ind	ind	0		n
2003-10	A	8/27/2010	16:49	14	3	67	14.5	>4	-4	>4	>4 to -4	103.1	7.1	6.7	7.8	1.1	Physical	ind	ind	3	o	n
2003-10	B	8/27/2010	16:49	14	3	67	14.5	>4	-4	>4	>4 to -4	41.9	2.9	1.7	3.5	1.8	Physical	ind	ind	2	o	n
2003-10	C	8/27/2010	16:50	14	3	67	14.5	>4	-4	>4	>4 to -4	96.4	6.6	4.8	7.8	3.0	Physical	ind	ind	0		n
2003_5	B	8/28/2010	9:44	15	4	70	14.5	>4	1	>4	>4 to 1	169	11.7	10.9	12.2	1.3	Biogenic	19.9	1.4	0		n
2003_5	C	8/28/2010	9:45	15	4	70	14.5	>4	0	>4	>4 to 0	228.6	15.8	15.1	16.4	1.3	Biogenic	14.9	1.0	5	o	n
2003_5	D	8/28/2010	9:46	15	4	70	14.5	>4	1	>4	>4 to 1	146.3	10.1	9.6	10.9	1.3	Physical	11	0.8	0		n
2004_2	A	8/28/2010	11:12	14	2	74	14.5	>4	1	>4	>4 to 1	153.6	10.6	9.7	11.2	1.5	Biogenic	38.4	2.6	0		n
2004_2	B	8/28/2010	11:13	14	2	74	14.5	>4	0	>4	>4 to 0	86.7	6.0	4.6	8.4	3.8	Physical	ind	ind	5	b	n
2004_2	D	8/28/2010	11:14	14	2	74	14.5	>4	2	>4	>4 to 2	99.9	6.9	3.1	8.7	5.6	Physical	ind	ind	1	o	n
2004_6	A	8/28/2010	13:02	14	2	74	14.5	2 to 1/>4	-1	>4	>4 to -1	106.8	7.4	6.9	8	1.1	Physical	43.4	3.0	0		n
2004_6	C	8/28/2010	13:04	14	2	74	14.5	2 to 1/>4	-2	>4	>4 to -2	127.7	8.8	7.9	9.2	1.3	Physical	ind	ind	0		n
2004_6	D	8/28/2010	13:05	14	2	74	14.5	2 to 1/>4	-2	>4	>4 to -2	124.4	8.6	8	9	1.0	Physical	57.1	3.9	0		n
2004_9	A	8/28/2010	13:10	14	2	68	14.5	-6	ind	ind	ind	0	0.0	0	0	0.0	Physical	ind	ind	ind		n
2004_9	B	8/28/2010	13:11	14	2	68	14.5	-6	-8	>4	>4 to -8	0	0.0	0	0	0.0	Physical	ind	ind	ind		n
2004_9	D	8/28/2010	13:12	14	2	68	14.5	-7	-8	>4	>4 to -8	0	0.0	0	0	0.0	Physical	ind	ind	ind		n
2005_4	A	8/28/2010	8:02	15	4	59	14.5	4 to 3	1	>4	>4 to 1	68.9	4.8	4.3	5.3	1.0	Physical	36.1	2.5	0		n
2005_4	B	8/28/2010	8:03	15	4	59	14.5	4 to 3	1	>4	>4 to 1	88.7	6.1	4.9	7.2	2.3	Physical	34.2	2.4	0		n

APPENDIX B (CONTINUED)

SPI Raw Data

Station	REP	DATE	TIME	Stop Collar Setting (in)	# of Lead Weights per carriage	Water Depth (ft.)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	Grain Size RANGE	Penetration Area (sq.cm)	Penetration Mean (cm)	Penetration Minimum (cm)	Penetration Maximum (cm)	Boundary Roughness (cm)	Boundary Roughness Type	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State	METHANE
2005_4	D	8/28/2010	8:04	15	4	59	14.5	4 to 3	1	>4	>4 to 1	67.8	4.7	3.6	5.7	2.1	Physical	30.1	2.1	0		n
2010-01	B	8/25/2010	16:45	16	5	72	14.5	4 to 3/>4	-1	>4	>4 to -1	290.7	20.0	19	20.8	1.8	Biogenic	69.7	4.8	0		n
2010-01	C	8/25/2010	16:46	16	5	72	14.5	4 to 3/>4	-1	>4	>4 to -1	>315.6	>21.7	>21.7	>21.7	ind	ind	ind	ind	ind		n
2010-01	D	8/25/2010	16:48	16	5	72	14.5	4 to 3/>4	-1	>4	>4 to -1	287.6	19.8	19.5	20.1	0.6	Biogenic	35.9	2.5	0		n
2010-02	A	8/27/2010	15:32	14	2	70	14.5	3 to 2	0	>4	>4 to 0	75.6	5.2	4.9	5.6	0.7	Biogenic	26.3	1.8	0		n
2010-02	C	8/27/2010	15:34	14	2	70	14.5	4 - 3/3 - 2	0	>4	>4 to 0	172.1	11.9	11.2	12.3	1.1	Physical	33.3	2.3	0		n
2010-02	D	8/27/2010	15:35	14	2	70	14.5	3 to 2	0	>4	>4 to 0	162.6	11.2	11.1	11.7	0.6	Biogenic	ind	ind	0		n
2010-03	A	8/27/2010	15:22	14	2	72	14.5	3 to 2	-8	4	4 to -8	13.4	0.9	0	2.4	2.4	Physical	ind	ind	0		n
2010-03	C	8/27/2010	15:24	14	2	72	14.5	3 to 2	-4	>4	>4 to -4	39.9	2.8	1.4	4.6	3.2	Physical	8.3	0.6	0		n
2010-03	D	8/27/2010	15:25	14	2	72	14.5	3 to 2	-1	>4	>4 to -1	35.8	2.5	1.9	2.8	0.9	Physical	ind	ind	0		n
2010-04	E	8/27/2010	15:04	14	2	70	14.5	>4	0	>4	>4 to 0	228.9	15.8	15.2	16.1	0.9	Biogenic	48.9	3.4	0		n
2010-04	F	8/27/2010	15:05	14	2	70	14.5	>4	0	>4	>4 to 0	227.4	15.7	15.2	15.8	0.6	Biogenic	40.5	2.8	0		n
2010-04	G	8/27/2010	15:06	14	2	70	14.5	>4	0	>4	>4 to 0	231.3	16.0	15.6	16.6	1.0	Biogenic	50.8	3.5	0		n
2010-05	A	8/27/2010	14:23	16	5	60	14.5	3 to 2	0	>4	>4 to 0	76.7	5.3	4.5	5.8	1.3	Biogenic	ind	ind	0		n
2010-05	B	8/27/2010	14:24	16	5	60	14.5	3 to 2	1	>4	>4 to 1	80.1	5.5	4.9	5.9	1.0	Physical	ind	ind	0		n
2010-05	C	8/27/2010	14:25	16	5	60	14.5	3 to 2	1	>4	>4 to 1	62.5	4.3	3.4	5.2	1.8	Physical	ind	ind	0		n
2010-06	A	8/27/2010	14:31	16	5	67	14.5	3 to 2	-4	>4	>4 to -4	65.7	4.5	3.9	4.8	0.9	Physical	ind	ind	0		n
2010-06	C	8/27/2010	14:33	16	5	67	14.5	-1 to -2	-4	>4	>4 to -4	53.7	3.7	2.8	4.2	1.4	Physical	ind	ind	0		n
2010-06	D	8/27/2010	14:34	16	5	67	14.5	-1 to -2	-4	>4	>4 to -4	62.1	4.3	3.3	5.1	1.8	Physical	ind	ind	0		n
2010-07	A	8/27/2010	15:51	14	3	60	14.5	3 to 2	1	>4	>4 to 1	51.3	3.5	2.5	4.2	1.7	Physical	ind	ind	0		n
2010-07	B	8/27/2010	15:52	14	3	60	14.5	3 to 2	1	>4	>4 to 1	67.1	4.6	4.2	5.2	1.0	Physical	ind	ind	0		n
2010-07	D	8/27/2010	15:53	14	3	60	14.5	3 to 2	1	>4	>4 to 1	49.3	3.4	2.8	4.5	1.7	Physical	ind	ind	0		n
2010-08	A	8/27/2010	15:59	14	3	63	14.5	3 to 2	1	>4	>4 to 1	45.6	3.1	2.9	3.3	0.4	Physical	ind	ind	0		n

SPI Raw Data

Station	REP	DATE	TIME	Stop Collar Setting (in)	# of Lead Weights per carriage	Water Depth (ft.)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	Grain Size RANGE	Penetration Area (sq.cm)	Penetration Mean (cm)	Penetration Minimum (cm)	Penetration Maximum (cm)	Boundary Roughness (cm)	Boundary Roughness Type	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State	METHANE
2010-08	B	8/27/2010	16:00	14	3	63	14.5	3 to 2	1	>4	>4 to 1	47.9	3.3	2.7	3.8	1.1	Physical	ind	ind	0		n
2010-08	C	8/27/2010	16:01	14	3	63	14.5	3 to 2	1	>4	>4 to 1	47.3	3.3	2.7	3.9	1.2	Physical	ind	ind	0		n
2010-09	B	8/27/2010	16:27	14	3	69	14.5	>4 to 3	-1	>4	>4 to -1	72.1	5.0	4.8	5.2	0.4	Biogenic	30.9	2.1	0		n
2010-09	C	8/27/2010	16:28	14	3	69	14.5	>4 to 3	-1	>4	>4 to -1	97.9	6.8	6.2	7.2	1.0	Physical	47.5	3.3	0		n
2010-09	D	8/27/2010	16:29	14	3	69	14.5	>4 to 3	-1	>4	>4 to -1	64.5	4.4	4	4.7	0.7	Physical	40.8	2.8	0		n
2010-10	A	8/27/2010	16:09	14	3	66	14.5	3 to 2	1	>4	>4 to 1	56.6	3.9	3.4	4.3	0.9	Physical	ind	ind	0		n
2010-10	C	8/27/2010	16:11	14	3	66	14.5	3 to 2	1	>4	>4 to 1	20.1	1.4	0.1	3	2.9	Physical	ind	ind	0		n
2010-10	D	8/27/2010	16:12	14	3	66	14.5	3 to 2	1	>4	>4 to 1	53.9	3.7	3.1	4.3	1.2	Physical	ind	ind	0		n
2010-11	A	8/27/2010	16:57	14	3	65	14.5	-6 to -8	-8	-6	-6 to -8	0	0.0	0	0	0.0	ind	ind	ind	ind		ind
2010-11	B	8/27/2010	16:58	14	3	65	14.5	-6 to -8	-8	-6	-6 to -8	0	0.0	0	0	0.0	ind	ind	ind	ind		ind
2010-11	C	8/27/2010	16:59	14	3	65	14.5	-6 to -8	-8	-6	-6 to -8	0	0.0	0	0	0.0	ind	ind	ind	ind		ind
2010-12	B	8/27/2010	14:04	16	5	71	14.5	3 to 2	0	>4	>4 to 0	81.9	5.6	4.2	6.7	2.5	Physical	ind	ind	0		n
2010-12	C	8/27/2010	14:05	16	5	71	14.5	3 to 2	-1	4	4 to -1	94.9	6.5	4.1	7.9	3.8	Physical	ind	ind	0		n
2010-12	D	8/27/2010	14:06	16	5	71	14.5	3 to 2	-1	>4	>4 to -1	80.9	5.6	3.9	6.5	2.6	Physical	ind	ind	0		n
2010-13	A	8/28/2010	9:06	15	4	73	14.5	>4	2	>4	>4 to 2	58.6	4.0	3.8	4.3	0.5	Physical	3.7	0.3	0		n
2010-13	B	8/28/2010	9:07	15	4	73	14.5	-6 to -8	-8	-6	-6 to -8	0	0.0	0	0	0.0	Physical	ind	ind	ind		ind
2010-13	D	8/28/2010	9:09	15	4	73	14.5	-6 to -8	-8	-6	-6 to -8	0	0.0	0	0	0.0	Physical	ind	ind	ind		ind
2010-14	B	8/28/2010	8:31	15	4	72	14.5	3 to 2	0	>4	>4 to 0	78.6	5.4	3.9	6.2	2.3	Physical	ind	ind	0		n
2010-14	C	8/28/2010	8:32	15	4	72	14.5	3 to 2	0	>4	>4 to 0	56.6	3.9	2.9	5.3	2.4	Physical	ind	ind	0		n
2010-14	D	8/28/2010	8:33	15	4	72	14.5	3 to 2	0	>4	>4 to 0	65.5	4.5	4.1	4.8	0.7	Physical	ind	ind	0		n
2010-15	B	8/28/2010	9:15	15	4	75	14.5	>4	1	>4	>4 to 1	177.1	12.2	11.4	12.9	1.5	Physical	22.4	1.5	1	b	n
2010-15	C	8/28/2010	9:16	15	4	75	14.5	>4	1	>4	>4 to 1	281.5	19.4	18.6	20	1.4	Physical	41.6	2.9	4	o	n
2010-15	D	8/28/2010	9:17	15	4	75	14.5	>4	1	>4	>4 to 1	245.5	16.9	16.6	17.3	0.7	Biogenic	22	1.5	3	b	n

APPENDIX B (CONTINUED)

SPI Raw Data

Station	REP	DATE	TIME	Stop Collar Setting (in)	# of Lead Weights per carriage	Water Depth (ft.)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	Grain Size RANGE	Penetration Area (sq.cm)	Penetration Mean (cm)	Penetration Minimum (cm)	Penetration Maximum (cm)	Boundary Roughness (cm)	Boundary Roughness Type	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State	METHANE
2010-16	A	8/28/2010	12:35	14	2	72	14.5	>4	2	>4	>4 to 2	173.7	12.0	9.7	15.5	5.8	Physical	23.9	1.6	4	o	n
2010-16	B	8/28/2010	12:36	14	2	72	14.5	>4	0	>4	>4 to 0	232.9	16.1	14.1	18.2	4.1	Physical	21.9	1.5	10	b	n
2010-16	C	8/28/2010	12:37	14	2	72	14.5	>4	0	>4	>4 to 0	206	14.2	13.2	14.9	1.7	Physical	25.9	1.8	15	b	n
2010-17	A	8/28/2010	11:24	14	2	80	14.5	ind	ind	ind	ind	0	0.0	0	0	0.0	Physical	ind	ind	ind	ind	ind
2010-17	B	8/28/2010	11:25	14	2	80	14.5	-6	-8	>4	>4 to -8	0	0.0	0	0	0.0	Physical	ind	ind	ind	ind	ind
2010-17	C	8/28/2010	11:26	14	2	80	14.5	>4	2	>4	>4 to 2	37.7	2.6	1.1	3.7	2.6	Physical	25.1	1.7	2	r	n
2010-18	A	8/28/2010	10:26	15	3	81	14.5	>4	2	>4	>4 to 2	60.5	4.2	2.4	5.2	2.8	Physical	ind	ind	15	b	n
2010-18	B	8/28/2010	10:27	15	3	81	14.5	>4	1	>4	>4 to 1	175.8	12.1	11.4	12.8	1.4	Physical	49.3	3.4	0		n
2010-18	D	8/28/2010	10:29	15	3	81	14.5	>4	2	>4	>4 to 2	ind	7.0	ind	ind	ind	ind	ind	ind	ind		n
2010-19	A	8/28/2010	10:14	15	3	77	14.5	4 to 3	0	>4	>4 to 0	38	2.6	1.6	3.1	1.5	Physical	ind	ind	0		n
2010-19	B	8/28/2010	10:15	15	3	77	14.5	4 to 3	0	>4	>4 to 0	40.4	2.8	1.9	3.2	1.3	Physical	15.1	1.0	0		n
2010-19	C	8/28/2010	10:16	15	3	77	14.5	4 to 3	-1	>4	>4 to -1	48.6	3.4	2.8	3.9	1.1	Physical	ind	ind	0		n
E0800	A	8/25/2010	16:06	16	5	73	14.5	4 to 3	-4	>4	>4 to -4	76.8	5.3	4.8	5.8	1.0	Physical	45.1	3.1	0		n
E0800	B	8/25/2010	16:07	16	5	73	14.5	-2 to -3	-4	>4	>4 to -4	61.5	4.2	3.3	4.8	1.5	Physical	ind	ind	0		n
E0800	C	8/25/2010	16:09	16	5	73	14.5	4 to 3	-4	>4	>4 to -4	48	3.3	1.6	4.4	2.8	Physical	ind	ind	0		n
G-1200	B	8/27/2010	15:14	14	2	74	14.5	3 to 2/>4	0	>4	>4 to 0	226.3	15.6	15.2	15.8	0.6	Biogenic	49.3	3.4	0		n
G-1200	C	8/27/2010	15:15	14	2	74	14.5	4 to 3/>4	-1	>4	>4 to -1	172.8	11.9	11.3	13	1.7	Physical	36.6	2.5	0		n
G-1200	D	8/27/2010	15:16	14	2	74	14.5	4 to 3/>4	-1	>4	>4 to -1	224.1	15.5	15.2	16.1	0.9	Biogenic	42.9	3.0	0		n
L1200	B	8/28/2010	9:00	15	4	77	14.5	3 to 2	0	>4	>4 to 0	50.3	3.5	3.1	3.7	0.6	Physical	ind	ind	0		n
L1200	C	8/28/2010	9:00	15	4	77	14.5	3 to 2	0	>4	>4 to 0	56	3.9	3.3	5	1.7	Physical	ind	ind	0		n
L1200	D	8/28/2010	9:01	15	4	77	14.5	3 to 2	0	>4	>4 to 0	72.9	5.0	4.5	5.4	0.9	Physical	ind	ind	0		n
NOREMED_1	B	8/28/2010	10:04	15	3	72	14.5	2 to 1	-1	>4	>4 to -1	61.4	4.2	4.1	4.8	0.7	Physical	ind	ind	0		n
NOREMED_1	C	8/28/2010	10:05	15	3	72	14.5	2 to 1	-1	>4	>4 to -1	53.2	3.7	3.1	3.9	0.8	Physical	ind	ind	0		n

APPENDIX B (CONTINUED)

SPI Raw Data

Station	REP	DATE	TIME	Stop Collar Setting (in)	# of Lead Weights per carriage	Water Depth (ft.)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	Grain Size RANGE	Penetration Area (sq.cm)	Penetration Mean (cm)	Penetration Minimum (cm)	Penetration Maximum (cm)	Boundary Roughness (cm)	Boundary Roughness Type	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State	METHANE
NOREMED_1	D	8/28/2010	10:06	15	3	72	14.5	2 to 1	-1	>4	>4 to -1	78.3	5.4	5	5.8	0.8	Physical	ind	ind	0		n
NOREMED_2	A	8/28/2010	17:58	15	2	97	14.5	>4	2	>4	>4 to 2	160.1	11.0	10.7	11.2	0.5	Biogenic	38.4	2.6	0		n
NOREMED_2	B	8/28/2010	17:58	15	2	97	14.5	>4	2	>4	>4 to 2	134.5	9.3	9	9.7	0.7	Biogenic	36.6	2.5	0		n
NOREMED_2	C	8/28/2010	17:59	15	2	97	14.5	>4	2	>4	>4 to 2	185	12.8	12.5	13.1	0.6	Biogenic	29.1	2.0	0		n
NOREMED_3	B	8/28/2010	16:06	15	4	86	14.5	3 to 2	-3	>4	>4 to -3	24	1.7	0.4	2.2	1.8	Physical	ind	ind	0		n
NOREMED_3	C	8/28/2010	16:07	15	4	86	14.5	3 to 2	-6	>4	>4 to -6	18.2	1.3	0.6	1.8	1.2	Physical	ind	ind	0		n
NOREMED_3	D	8/28/2010	16:08	15	4	86	14.5	3 to 2	-4	>4	>4 to -4	8.8	0.6	0.4	1.4	1.0	Physical	ind	ind	0		n
NOREMED_4	B	8/28/2010	13:29	14	2	80	14.5	4-3/2 to 1	-1	>4	>4 to -1	130.4	9.0	8.3	9.5	1.2	Biogenic	6.4	0.4	0		n
NOREMED_4	C	8/28/2010	13:30	14	2	80	14.5	>4/2 to 1	-1	>4	>4 to -1	125.3	8.6	8.1	8.9	0.8	Biogenic	7.2	0.5	0		n
NOREMED_4	D	8/28/2010	13:30	14	2	80	14.5	>4/2 to 1	-1	>4	>4 to -1	104	7.2	6.1	7.6	1.5	Biogenic	5.6	0.4	0		n
NOREMED_5	B	8/28/2010	16:33	15	4	98	14.5	>4	0	>4	>4 to 0	297.3	20.5	20.3	20.7	0.4	Biogenic	49.2	3.4	0		n
NOREMED_5	C	8/28/2010	16:34	15	4	98	14.5	>4	0	>4	>4 to 0	259.2	17.9	15.5	19.7	4.2	Biogenic	21.7	1.5	1	r	n
NOREMED_5	D	8/28/2010	16:35	15	4	98	14.5	>4	0	>4	>4 to 0	289.9	20.0	19.5	20.1	0.6	Biogenic	33.6	2.3	0		n
P2800	A	8/28/2010	13:19	14	2	79	14.5	>4/3 to 2	0	>4	>4 to 0	138.6	9.6	7.7	10.7	3.0	Physical	38.3	2.6	0		n
P2800	B	8/28/2010	13:20	14	2	79	14.5	>4/3 to 2	0	>4	>4 to 0	163.6	11.3	10.9	11.6	0.7	Biogenic	12.3	0.8	0		n
P2800	C	8/28/2010	13:20	14	2	79	14.5	>4/3 to 2	0	>4	>4 to 0	192.7	13.3	12.7	14	1.3	Physical	22.1	1.5	0		y

APPENDIX B (CONTINUED)

SPI Raw Data

Station	REP	TOTAL DM AREA	TOTAL DM MEAN		TOTAL DM MIN		TOTAL DM MAX		Low DO?	Surface Sand Layer Area (sq. cm)	Mean Surface Sand Layer Thickness (cm)	COMMENT	Feeding Void #	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage
1	A								n			Ambient clean fine sand>pen; a few scattered Diopatra tubes@surf; no rpd contrast	0				ind
1	B								n			Ambient clean fine rippled sand>pen; moderately dense Diopatra tubes@surf; no rpd contrast; assymetrical ripple	0				ind
1	C								n			Ambient clean fine rippled sand>pen; low density of Diopatra tubes@surf; no rpd contrast; assymetrical ripples	0				ind
2	A	284.4	>	19.6	>	19.2	>	19.8	n			Relict DM>pen=S/M=silty very fine sand over sulfidic silt-clay DM; subsurface voids/burrows+worms; surf tubes; moderate rpd contrast	4	7.5	16.7	12.1	1 on 3
2	B	125.9	>	8.7	>	5.6	>	10.3	n			Relict sandy DM>pen=silty very fine sand over moderately reduced silt-clay; hydroids, Diopatra tube, Maldanid body@surf; subsurface voids/burrows	4	1.5	5.8	3.7	1 on 3
2	C	273.7	>	18.9	>	18.2	>	19.6	n			Relict DM>pen=S/M=silty very fine sand over sulfidic silt-clay DM; small voids+1-2 small worms; varied surf tubes; Podocerid whips on tubes; amp tubes in farfield; weak to moderate rpd contrast	3	7	12.6	9.8	1 on 3
3	B	221.2	>	15.3	>	13.3	>	15.9	n			Relict DM>pen; silty very fine sand in upper layers over mostly reduced silt-clay@depth; numerous Podocerid whips+several thick surf tubes; extensive voids/burrows; unique org w/ burrow@lower left	5	6.2	14.9	10.6	1 on 3
3	C	239.6	>	16.5	>	15.9	>	17.1	n			Relict DM>pen; silty very fine sand over moderately reduced streaky grey silt-clay@depth; dense Podocerid whips; burrow+void w/ org; weak to moderate rpd	2	4.4	7.9	6.2	1 on 3
3	D	206	>	14.2	>	13	>	14.7	n			Relict DM>pen; silt-clay w/ some very fine sand over reduced silt-clay@depth; moderate to strong rpd contrast; dense Podocerid stalks; 1 burrow/void / reddish org; white/grey org@depth	1	5.9	7.3	6.6	1 on 3
4	A	99.1	>	6.8	>	5.8	>	8.1	n			Sandy DM>pen; silty firm very fine sand>pen; reduced@depth w/ moderate rpd contrast; dense Diopatra tubes	0				2
4	C	31.4	>	2.2	>	1.5	>	2.8	n			Sandy DM>pen; silty fine to medium firm sand=underpen; numerous large thick surf tubes, some Diopatra	0				2 -> 3

SPI Raw Data

Station	REP	TOTAL DM AREA	TOTAL DM MEAN		TOTAL DM MIN		TOTAL DM MAX		Low DO?	Surface Sand Layer Area (sq. cm)	Mean Surface Sand Layer Thickness (cm)	COMMENT	Feeding Void #	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage
4	D	42.2	>	2.9	>	0.6	>	4.5	n			Sandy DM>pen; silty fine to medium firm sand=underpen; numerous large thick surf tubes=dense Diopatra	0				2 -> 3
5	A								n			Ambient clean fine sand>pen; homogenous light color=no rpd contrast; rippled bottom	0				ind
5	B								n			Ambient clean fine sand>pen; homogenous light color=no rpd contrast; rippled bottom	0				ind
5	D								n			Ambient clean fine sand>pen; homogenous light color=no rpd contrast; rippled bottom	0				ind
6	A								n			Ambient medium to coarse sand>pen; "darker" color due to reddish/brown grains; a few small polychaete tubes at SWI; no rpd contrast; trough in farfield=rippled	0				ind
6	C								n			Ambient medium to coarse sand>pen; significant coarse fraction; darker color; several recumbent Diopatra tubes; 1 tube has Podocerid amp stalk attached	0				ind
6	D								n			Ambient medium to coarse sand>pen; 1 or 2 small polychaete tubes @ SWI: farfield trough/ripple; darker color	0				ind
7	A	31.1	>	2.1	>	1.7	>	2.5	n			Very firm silty very fine sand>pen; DM=remediation material(?); muddy floc+a few larger tubes@surf; v. weak rpd contrast=subtle darker hues@depth	0				ind
7	B	28.1	>	1.9	>	1.3	>	2.7	n			Very firm silty very fine sand>pen; DM=remediation material; muddy floc@surf; numerous large+small surf tubes (1 or 2 Diopatra in farfield); reduced patches@depth	0				2 on 3
7	C	42.7	>	2.9	>	2.5	>	3.2	n			Very firm silty very fine sand>pen; DM=remediation material; muddy floc@surf; numerous large+small surf tubes; faint reduced patches@depth	0				2 on 3
8	B								n			Ambient clean fine rippled sand>pen; homogenous light color=no rpd contrast	0				ind
8	C								n			Ambient clean fine rippled sand>pen; homogenous light color=no rpd contrast	0				ind

APPENDIX B (CONTINUED)

SPI Raw Data

Station	REP	TOTAL DM AREA	TOTAL DM MEAN		TOTAL DM MIN		TOTAL DM MAX		Low DO?	Surface Sand Layer Area (sq. cm)	Mean Surface Sand Layer Thickness (cm)	COMMENT	Feeding Void #	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage
8	D								n			Ambient clean fine rippled sand>pen; homogenous light color=no rpd contrast; a few scattered Diopatra tubes in farfield	0				ind
9	A	160.3	>	11.1	>	10.4	>	11.7	n			Relict sandy DM>pen; muddy very fine to fine sand w/ reduced patches@depth; moderate but variable rpd contrast; thick surf tubes+Podocerid amp stalks; subsurface voids+burrows	3	2.7	11.3	7.0	1 on 3
9	B	166.4	>	11.5	>	10.8	>	12	n			Relict sandy DM>pen; muddy-silty very fine sand (or sandy mud) w/ moderately reduced patches@depth=weak to moderate rpd contrast; dense thick surf tubes w/ Podocerid stalks attached; vertical oxy burrow/void complex	4	3.4	11.3	7.4	1 on 3
9	C	152	>	10.5	>	10	>	10.9	n			Relict sandy DM>pen; muddy-silty very fine sand/sandy mud; large surf tubes w/ Podocerids attached; voids+1 small reddish org; moderate rpd contrast	1	2.3	2.9	2.6	1 on 3
10	A	174.6	>	12.0	>	11.8	>	12.4	n			Relict muddy DM>pen; silt-clay w/ some fine sand in surface layer;dense Podocerid stalks+surf tubes; 3-4 small subsurface worm-like orgs but no voids	0				1 on 3
10	B	166.7	>	11.5	>	11.3	>	11.6	n			Relict muddy DM>pen; silt-clay w/ some v. fine sand; reduced/sulfidic@depth=moderate rpd contrast; varied surf tubes+several Podocerid stalks; possible Nucula in upper 1-2 cm; worm+void@depth	1	10	10.5	10.3	1 on 3
10	C	131	>	9.0	>	8.3	>	9.7	n			Relict muddy DM>pen; silt-clay w/ fine sand fraction; surf tubes+a few Podocerid stalks; feeding void/burrow complex; several small worm-like orgs@depth	2	4.6	8.3	6.5	1 on 3
11	A	43.2	>	3.0	>	2.3	>	3.6	n			Firm slightly silty fine sand DM>pen; DM=remediation material in PRA1; numerous Diopatra tubes=many w/ sand grains but not shells; homogenous color=no rpd contrast	0				2
11	B	46.5	>	3.2	>	2.4	>	3.7	n			Firm silty-muddy fine sand DM>pen; DM=remediation material in PRA1; numerous Diopatra tubes@swi with Podocerid whips	0				2
11	C	48.3	>	3.3	>	2.8	>	3.9	n			Firm silty-muddy fine sand DM>pen; DM=remediation material in PRA1; numerous Diopatra tubes@swi.	0				2 -> 3

APPENDIX B (CONTINUED)

SPI Raw Data

Station	REP	TOTAL DM AREA	TOTAL DM MEAN		TOTAL DM MIN		TOTAL DM MAX		Low DO?	Surface Sand Layer Area (sq. cm)	Mean Surface Sand Layer Thickness (cm)	COMMENT	Feeding Void #	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage
12	A								n			Ambient clean fine rippled sand>pen; homogenous color+texture; no rpd contrast; scattered Diopatra tubes@swi in farfield	0				ind
12	B								n			Ambient clean fine rippled sand>pen; homogenous color+texture; no rpd contrast	0				ind
12	C								n			Ambient clean fine rippled sand>pen; homogenous color+texture; no rpd contrast; 1 Diopatra tube visible in farfield	0				ind
13	A								n			Ambient clean fine rippled sand>pen; homogenous color+texture, but slightly darker@depth; low rpd contrast; scattered Diopatra tubes@surf	0				ind
13	B								n			Ambient clean, well-sorted fine rippled sand>pen; homogenous color+texture, but patch of black mud@depth; scattered Diopatra tubes@surf	0				ind
13	C								n			S/M=Ambient clean fine rippled sand over dark/reduced ambient sand mixed with muddy historic DM; scattered Diopatra tubes@surf	0				ind
14	A	136.2	>	9.4	>	8.3	>	10.7	n			S/M=surface layer of oxy muddy v. fine sand over homogenous black muddy historic DM; dense Diopatra tubes; several larger-bodied worm-like orgs@depth	0				2 -> 3
14	C	198.6	>	13.7	>	12.7	>	14.8	n			Relict muddy DM>pen; thin slightly sandy oxy surf layer over dark/reduced historic DM; dense thick surf tubes do not look like Diopatra; oxy subsurface voids	3	5.8	8.8	7.3	1 on 3
14	D	162.6	>	11.2	>	10.7	>	11.6	n			Relict muddy DM>pen; thin sandy oxy surf layer over dark/reduced historic DM; dense Diopatra tubes@surf; subsurface voids+large red worm visible at bottom left.	2	4.8	9.8	7.3	1 on 3
15	A								n			No pen=rocks covered w/ extensive hydroids	ind				ind
15	B	88.6	>	6.1	>	5.4	>	7.2	n			Relict mixed DM>pen; poorly sorted mix of mud, sand, gravel+brick frags; scattered surf tubes+subsurface voids/burrows	3	2.3	5.5	3.9	1 on 3
15	C								n			No pen=rocks covered w/ extensive hydroids	ind				ind

APPENDIX B (CONTINUED)

SPI Raw Data

Station	REP	TOTAL DM AREA	TOTAL DM MEAN		TOTAL DM MIN		TOTAL DM MAX		Low DO?	Surface Sand Layer Area (sq. cm)	Mean Surface Sand Layer Thickness (cm)	COMMENT	Feeding Void #	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage
16	A								n			Ambient clean fine rippled sand>pen; homogenous color=no rpd contrast; elongated rusted metal object in farfield; scattered Diopatra tubes	0				ind
16	B								n			Ambient clean fine rippled sand>pen; homogenous color=no rpd contrast; scattered Diopatra tubes in farfield	0				ind
16	D								n			Ambient clean fine rippled sand>pen; homogenous color=no rpd contrast; likely Diopatra tubes in farfield	0				ind
17	A	218.1	>	15.0	>	12.7	>	16	n	80.1	5.5	S/M=ambient clean fine rippled sand over black/reduced muddy relict DM; vertical burrow is drag-down relict of bivalve shell; 2 deep voids@bottom of frame; dense large thick surf tubes	2	12.1	15.6	13.9	1 on 3
17	C	188.9	>	13.0	>	12.5	>	13.4	n	78.1	5.4	S/M=ambient clean fine sand over black muddy relict DM; subtle smearing=difficult rpd measurement; dense htick surf tubes and 1 subsurface worm evident @sand/mud interface	0				1 on 3
17	D	179.7	>	12.4	>	10.9	>	13	n	56.4	3.9	S/M=ambient clean fine sand over black muddy relict DM; subtle smearing=difficult rpd measurement; thick surf tubes (Diopatra)+1 long thin subsurface stg 3 org	0				1 on 3
18	B	188.7	>	13.0	>	12.5	>	13.6	n			Relict muddy DM>pen; uniform grey silt-clay w/ moderate to strong rpd contrast; large surf tubes festooned w/ Podocerid stalks; large subsurface burrow; small white bivalves (Nucula?) in upper 1-2 cm	0				1 on 3
18	C	181.7	>	12.5	>	12	>	12.8	n			Relict muddy DM>pen; large surf tubes w/ attached Podocerid stalks; small white bivalves in upper 1-2 cm=Nucula; 1 thin subsurface org	0				1 on 3
18	D	195.4	>	13.5	>	13.1	>	13.8	n			Relict muddy DM>pen; surf tubes; Podocerid stalks+Nucula in upper 2 cm; reddish Stg 3 worm in lwr right corner	0				1 on 3
19	B	118	>	8.1	>	7.8	>	8.4	n			Muddy-sandy DM>pen; subtle layering=upper 5 cm is light-colored silt-clay over thin grey sand horizon over reduced silt-clay; dense surf tubes; shallow void/burrows; Stg 3 womr in lwr right corner	1	0.7	0.9	0.8	1 on 3

Station	REP	TOTAL DM AREA		TOTAL DM MEAN		TOTAL DM MIN		TOTAL DM MAX	Low DO?	Surface Sand Layer Area (sq. cm)	Mean Surface Sand Layer Thickness (cm)	COMMENT	Feeding Void #	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage
19	C	45.7	>	3.2	>	3	>	3.3	n			Muddy-sandy DM>pen; firm very fine sand w/ significant reddish-brown silt-clay ("red clay fines"?); reduced horizon@depth; dense large surf tubes (not Diopatra) w/ many Podocerid stalks attached	0				1 on 3
19	D	62.9	>	4.3	>	3.9	>	5.1	n			Muddy-sandy DM>pen; firm very fine sand w/ reddish-brown silt-clay ("red clay fines"); dense large thick tubes w/ Podocerid stalks; reduced mud clasts=camera artifacts from sled base; tube dragdown	0				1 on 3
20	A								n			Ambient clean fine rippled sand>pen; scattered Diopatra tubes@surf; small assymetrical ripples; dragdown of tubes+attached small shell frags; no rpd contrast	0				ind
20	B								n			Ambient clean fine rippled sand>pen; scattered upright+recumbent Diopatra tubes@surf; 1 org@depth; no rpd contrast	0				ind
20	C								n			Ambient clean fine rippled sand>pen; a few Diopatra tubes w/ shells+1 smooth thick tube	0				ind
22	B	203.9	>	14.1	>	13.8	>	15	n	122.7	8.5	S/M=Ambient clean fine rippled sand over black relict muddy DM; Diopatra tube@surf+large worm@sand/mud interface on left	0				1 on 3
22	C	204.7	>	14.1	>	13.6	>	14.5	n	132.5	9.1	S/M=ambient clean fine rippled sand over black relict muddy DM; a few Diopatra tubes@surf	0				ind
22	D	220.9	>	15.2	>	15	>	15.8	n	127.4	8.8	S/M=ambient clean fine rippled sand over black relict muddy DM; single Diopatra tube in farfield; small voids+worm@depth	3	10.3	11.4	10.9	1 on 3
24	A								n			Ambient clean fine to medium rippled sand>pen; dense large surf tubes ; small shell frags; no rpd contrast	0				ind
24	C								n			Ambient clean fine rippled sand>pen;dense Diopatra tubes@surf; a few white shell frags; no rpd contrast	0				ind
24	D								n			Ambient clean fine rippled sand>pen; dense Diopatra tubes@surf; small white shell frags; no rpd contrast	0				ind
25	A								n			Underpen=firm coarse to very coarse sand w/ some gravel+rounded red brick frags; possible relict DM in former Mud Dump Site?	0				ind
25	B								n			Underpen=medium sand w/ high gravel content (mostly pebbles); numerous rounded brick frags=relict sandy DM in Mud Dump Site?	0				ind

APPENDIX B (CONTINUED)

SPI Raw Data

Station	REP	TOTAL DM AREA		TOTAL DM MEAN		TOTAL DM MIN		TOTAL DM MAX	Low DO?	Surface Sand Layer Area (sq. cm)	Mean Surface Sand Layer Thickness (cm)	COMMENT	Feeding Void #	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage
25	C								n			Ambient clean fine rippled sand>pen; high variability at this station; no visible surf tubes+no rpd contrast	0				ind
26	A								n			Ambient clean fine rippled sand>pen; Diopatra tube@surf@right; no rpd contrast	0				ind
26	B	66	>	4.6	>	3.5	>	5.6	n			Mixed DM>pen=mix of fine sand+red clay; sand over mud layering; dense Diopatra tubes; reduced mud clasts; high variability station	0				2 -> 3
26	C	105.2	>	7.3	>	6	>	8.3	n			Mixed DM>pen=mix of fine sand+red clay; possible smearing artifact from last rep=no rpd measurement; v. small subsurface voids; dense Diopatra tubes	7	1.6	5.2	3.4	2 -> 3
27	A	263.3	>	18.2	>	17.7	>	18.3	n			Soft layered red clay DM>pen; layering of reddish/grey soft mud over red clay w/ black and red streaks; subsurface voids+burrows; dense large smooth long surf tubes (Asabellides?); a few Nucula in upper 2 cm	4	7.9	18	13.0	1 on 3
27	B	165.8	>	11.4	>	10.6	>	12	n			Soft layered red clay DM>pen; layering of reddish-grey soft mud over streaky red clay; small voids on left; dense smooth thick long surf tubes (Asabellides), moderate rpd contrast	3	3.4	5	4.2	1 on 3
27	C	226.7	>	15.6	>	15.3	>	16.3	n			Soft layered red clay DM>pen; reddish-brown mud over homogenous red clay@depth; dense thick long smooth surf tubes (Asabellides?); subsurface void/burrow complex	2	7.7	10.6	9.2	1 on 3
28	A	205.8	>	14.2	>	13.7	>	14.4	n			Soft red clay DM>pen; uniform texture; upper 8 cm is red grading to black/sufidic@depth; bio reworking of upper 3 cm, Nucula present in upper 2-3 cm; 2 subsurface voids/burrows	2	1.9	6.1	4.0	2 on 3
28	C	195.2	>	13.5	>	12.8	>	13.7	n			Soft red clay DM>pen; uniform texture; upper 7-8 cm is red over black/sulfidic mud@depth; Large surf tubes (Asabellides); amphipod stalk; Nucula; subsurface worms+1 void@far left edge	1	9.2	9.3	9.3	2 on 3
28	E	180.5	>	12.4	>	11.6	>	12.9	n			Soft red clay DM>pen; uniform texture; reddish brown color over black/sulfidic clay@depth; dense Nucula; Diopatra tubes w/ Podocerid stalks; 1-2 subsurface worms present, edge of burrow transected in mid-left subsurface	0				2 on 3

APPENDIX B (CONTINUED)

SPI Raw Data

Station	REP	TOTAL DM AREA		TOTAL DM MEAN		TOTAL DM MIN		TOTAL DM MAX	Low DO?	Surface Sand Layer Area (sq. cm)	Mean Surface Sand Layer Thickness (cm)	COMMENT	Feeding Void #	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage
29	A	260.1	>	17.9	>	17.2	>	18.2	n			Soft muddy reddish DM>pen; reddish color=likely red clay DM; slightly sandy in upper 3-4 cm; large surf tubes (Asabellides?); Podocerid stalks; Nucula; several subsurface voids+1-2 orgs; reduced@depth	5	7.6	12.2	9.9	2 on 3
29	B	260.5	>	18.0	>	17.6	>	18.3	n			Soft muddy reddish DM>pen; reddish color=partial red clay DM; reduced@depth; multiple layers;large surf tubes (Asabellides); Podocerid stalk; Nucula; several subsurface voids+orgs	3	6.1	11.5	8.8	2 on 3
29	C	256.8	>	17.7	>	17.2	>	17.9	n			Soft muddy reddish DM>pen; partial red clay DM; multiple layers; reduced@depth; dense large surf tubes (Asabellides); dense Nucula; Podocerid stalks;subsurface void+ a few small orgs	1	10.2	10.5	10.4	2 on 3
30	B	>310.3	>	21.3	>	21.2	>	21.4	n			Overpen; soft muddy relict grey/brown DM>pen; tube dragdown; several small voids+orgs@depth=Stg 3	2	ind	ind	ind	3
30	C	>310.3	>	21.3	>	21.2	>	21.4	n			Overpen; soft muddy relict grey/brown DM>pen; at least one void+1 larger-bodied worm@depth	1	ind	ind	ind	3
30	D	279.3	>	19.3	>	19	>	19.6	n			Soft muddy relict grey-brown DM>pen; DM layering; vertical oxy burrows/tubes@depth=Stg 3; large thick surf tubes; a few Nucula	0				1 on 3
31	B								n			Muddy firm very fine sand>pen; floccy mud+dense large tubes@surf:; Podocerid stalks among tubes; sand=cap sand from dioxin capping project	0				ind
31	G								n			Muddy firm fine sand>pen; floccy mud+large tubes@surf (Diopatra); a few Podocerid stalks; no rpd contrast	0				ind
31	H								n			Muddy firm fine sand>pen; dense large tubes@surf+numerous Podocerid stalks; no rpd contrast; sand=cap material over dioxin mound?	0				ind
32	A								n			Muddy reduced fine to very fine sand>pen; thin rpd w/ moderate contrast; ambient sand?; several large tubes@surf; a few Podocerid stalks	0				2 -> 3
32	B								ind			No pen=hardbottom=rock covered w/ hydroids in farfield	ind				ind

APPENDIX B (CONTINUED)

SPI Raw Data

Station	REP	TOTAL DM AREA	TOTAL DM MEAN		TOTAL DM MIN		TOTAL DM MAX		Low DO?	Surface Sand Layer Area (sq. cm)	Mean Surface Sand Layer Thickness (cm)	COMMENT	Feeding Void #	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage
32	C	93.5	>	6.4	>	5.3	>	7	n			Poorly sorted mixed relict DM>pen; mix of gravel, sand, and mud; weak rpd contrast; a few surf tubes+Podocerid stalks	0				2
33	B	69.5	>	4.8	>	4.5	>	5.2	n			Poorly sorted mixed relict DM>pen; mix of gravel, sand, and mud; reduced patches@depth; hydroids on rocks; patchy rpd	0				2
33	C								ind			No pen=hardbottom=mixed gravel (mostly pebbles) over sand in farfield; historic DM?	ind				ind
33	D								ind			No pen=hardbottom=pebbles in farfield=historic DM?	ind				ind
34	A								n			Ambient medium to coarse sand>pen; reddish muddy surface deposit (probably "red clay fines"); dense surf tubes	0				2 -> 3
34	B								n			Ambient medium sand>pen; reddish muddy surface deposit=red clay fines; subsurface burrows; large surf tubes; sand is dark=no clear rpd contrast	0				2 -> 3
34	D								n			Ambient medium sand>pen; reddish mud@surf=red clay fines; large reddish surf tubes=made of red clay fines; a few Podocerid stalks among tubes; no rpd contrast	0				2
35	A								n			Ambient medium sand>pen; dense surf tubes=some smooth, some w/ shells+sand grains, some recumbent, some upright (Diopatra); sea star in farfield; no rpd contrast	0				ind
35	B								n			Ambient medium sand>pen; 1 or 2 partial tubes w/ attached sand grains@surf=Stg 1; small patch of reddish/slightly reduced mudd@depth; many dark sand grains, extensive subsurface burrowing by polychaetes	0				ind
35	D								n			Ambient medium sand>pen; minor coarse sand fraction w/ some granules; dark sand grains; a few recumbent large polychaete tubes on sediment surface, smaller errant polychaetes burrowing through subsurface sand	0				ind
36	A								n			Ambient muddy very fine sand>pen; high mud content=subsurface org but no rpd contrast; dense large surf tubes w/ Podocerid whips; Nucula in upper 2 cm	0				2 on 3

APPENDIX B (CONTINUED)

SPI Raw Data

Station	REP	TOTAL DM AREA	TOTAL DM MEAN	TOTAL DM MIN	TOTAL DM MAX	Low DO?	Surface Sand Layer Area (sq. cm)	Mean Surface Sand Layer Thickness (cm)	COMMENT	Feeding Void #	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage
36	C					n			Ambient muddy fine to very fine sand>pen; reduced-sulfidic patches@depth=weak to moderate rpd contrast; Diopatra tubes, shell frags, abundant Nucula in upper 1 cm; 1 v. small reddish subsurface org	0				2 -> 3
36	D					n			Ambient muddy fine to very fine sand>pen; weak rpd contrast w/ black-sulfidic sed@depth (historic DM??); dense Diopatra tubes w/ Podocerid stalks); dense Nucula	0				2 -> 3
37	A					n			Ambient clean fine to medium rippled sand>pen; dense large surf tubes w/ cemented sand grains+a few shells (Diopatra)	0				ind
37	B					n			Ambient clean fine to medium rippled sand>pen; dense large surf tubes, some smooth some w/ cemented sand grains; no rpd contrast	0				ind
37	D					n			Ambient clean fine to medium rippled sand>pen; v. dense large surf tubes (most likely Asabellides mat); no rpd contrast	0				ind
38	A					n			Ambient clean fine rippled sand>pen; many large surf tubes; shell frags; low pen=firm sand	0				ind
38	C					n			Ambient clean fine rippled sand>pen; 2-3 large surf tubes; no rpd contrast	0				ind
38	D					n			Ambient clean fine rippled sand>pen; scattered large surf tubes, some w/ cemented shells (Diopatra); no rpd contrast	0				ind
39	B					n			Ambient clean fine rippled sand>pen; numerous large smooth upright surf tubes w/ curved tops; Podocerid stalks	0				ind
39	C					n			Ambient clean fine rippled sand>pen; numerous large smooth upright surf tubes w/ curved tops; numerous Podocerid stalks.	0				ind
39	D					n			Ambient clean fine slightly rippled sand>pen; numerous large upright surf tubes; some with curved tops; some Diopatra; Podocerid stalks on many tubes	0				ind
40	A					n			Ambient coarse sand>pen; somewhat poorly sorted=minor fractions of medium sand and granules/pebbles; thin surface dep layer of muddy organic floc w/ dense Podocerid stalks+some tubes	0				ind

SPI Raw Data

Station	REP	TOTAL DM AREA	TOTAL DM MEAN	TOTAL DM MIN	TOTAL DM MAX	Low DO?	Surface Sand Layer Area (sq. cm)	Mean Surface Sand Layer Thickness (cm)	COMMENT	Feeding Void #	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage
40	C					n			Ambient medium to coarse sand>pen; more well-sorted than previous rep; thin surf dep layer of muddy detritus w/ numerous Podocerid stalks+some large worm tubes	0				ind
40	D					n			Ambient poorly-sorted coarse sand>pen; medium sand, granules+pebbles present; thin surface dep lyr of muddy detritus w/ numerous Podocerid stalks+large worm tubes	0				ind
42	B					n			Ambient fine to very fine sand>pen; muddy detritus and dense large surf tubes@surf; Diopatra tubes w/ cemented sand grains	0				ind
42	C					n			Ambient fine to very fine sand>pen; slightly rippled?; muddy surface w/ dense upright large tubes	0				ind
42	D					n			Ambient fine to very fine sand>pen; slightly rippled; muddy surface w/ dense upright large tubes, some smooth and some w/ cemented sand grains (Diopatra)	0				ind
43	A					n			Ambient fine to very fine sand>pen; numerous assorted large surf tubes (smooth and decorated); Podocerid stalks; large-bodied worm@depth	0				ind
43	B					n			Ambient firm fine to very fine sand>pen; numerous assorted large surf tubes (smooth+decorated); Podocerid stalks on tubes;	0				ind
43	C					n			Ambient firm slightly muddy fine to very fine sand>pen; assorted large surf tubes; Podocerid stalks on tubes	0				ind
44	A					n			Ambient fine to medium sand>pen; minor coarse sand fraction; scattered large surf tubes (Diopatra); Podocerid stalks on tubes; no rpd contrast	0				ind
44	B					n			Ambient fine to medium sand>pen; scattered large surf tubes; a few Podocerid stalks	0				ind
44	C					n			Ambient fine to medium sand>pen; scattered large surf tubes; no rpd contrast	0				ind
45	B					n			Ambient fine sand>pen; some muddy detritus @ surf and dragged down in upper 2-3 cm; dense large tubes +a few Podocerid stalks	0				ind

APPENDIX B (CONTINUED)

SPI Raw Data

Station	REP	TOTAL DM AREA	TOTAL DM MEAN	TOTAL DM MIN	TOTAL DM MAX	Low DO?	Surface Sand Layer Area (sq. cm)	Mean Surface Sand Layer Thickness (cm)	COMMENT	Feeding Void #	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage
45	C					n			Ambient clean fine sand>pen; slightly rippled; numerous large surf tubes+some Podocerid stalks	0				ind
45	D					n			Ambient clean fine slightly rippled sand>pen; numerous large surf tubes (multiple species); small white shell frags; a few Podocerid stalks in farfield	0				ind
46	B	195.2	> 13.5	> 13.1	> 13.9	n			Very fine sandy silty DM>pen; deep rpd but black/reduced/sulfidic@depth; large surf worm tubes, Cerianthid in background, Podocerid stalks, vertical oxy burrow/tubes; 1 subsurface worm-like org; high density of Nucula in oxidized surface layer	0				2 on 3
46	C	217.2	> 15.0	> 14.5	> 15.4	n			Very fine sandy silty relict DM>pen; moderate rpd contrast; black/reduced@depth; subsurface voids+worms; Podocerid stalks, large tubes, burrowing anemone, Nucula	2	2.4	6.8	4.6	2 on 3
46	D	210.2	> 14.5	> 14.3	> 14.8	n			Very fine sandy silty relict DM>pen; moderate rpd contrast; black/reduced@depth; large surf tubes+Podocerid stalks; subsurface voids, oxy vertical tubes, whitish org; Nucula	2	5.2	7.3	6.3	2 on 3
49	A					n			Ambient, rippled firm fine sand>pen; numerous shell frags+small rocks (gravel)@surf; seastar in farfield; a few large surf tubes (recumbent Diopatra?)	0				ind
49	D					ind			No pen=hard bottom=rocks; hydroid tips on far right edge of image -- PV confirms rocks with epiphytes	ind				ind
97_00_4	A	42.8	> 3.0	> 2.5	> 3.8	n			Clean fine cap sand>pen; sand is cap material at 93 dioxin capping project (Ambrose channel sand); dense large surf tubes (Diopatra); small reduced patch@depth	0				ind
97_00_4	B	43.4	> 3.0	> 2.5	> 3.5	n			Clean fine cap sand>pen; sand=dioxin capping project cap; slightly muddy@surf+in upper 2-3 cm; dense large surf tubes (Diopatra and others)	0				ind
97_00_4	D	69.4	> 4.8	> 3.9	> 5.2	n			Clean fine cap sand>pen; slightly muddy in upper 3-4 cm; sand=cap material; dense large assorted surf tubes=Diopatra and others	0				ind

APPENDIX B (CONTINUED)

SPI Raw Data

Station	REP	TOTAL DM AREA		TOTAL DM MEAN		TOTAL DM MIN		TOTAL DM MAX	Low DO?	Surface Sand Layer Area (sq. cm)	Mean Surface Sand Layer Thickness (cm)	COMMENT	Feeding Void #	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage
97_00_6	A	70.1	>	4.8	>	4.4	>	5.3	n			Clean fine cap sand>pen; sand=cap material from 97 dioxin capping project; dense large assorted surf tubes=Diopatra+others; Podocerid stalks on tubes; some minor dragdown of muddy tube material	0				ind
97_00_6	B	49.3	>	3.4	>	2.1	>	4.8	n			Clean fine cap sand>pen; sand=cap material from 97 dioxin capping project; dense large assorted surf tubes (many w/ curved tops); worms visible inside a few tubes; a few Podocerid stalks on tubes	0				ind
97_00_6	C	33.8	>	2.3	>	1.8	>	3.1	n			Clean fine cap sand>pen; sand=cap material from 97 dioxin capping project; very dense large surf tubes w/ curved tops+Podocerid stalks attached	0				ind
97_00_9	B	36.5	>	2.5	>	1	>	3.5	n			Low pen=firm red clay DM>pen; sed surf has small rocks (granules/pebbles); subsurface void/burrow+1-2 small worms below void; large surf tube@left; reduce patches but no continuous rpd across frame	2	2.1	2.4	2.3	2 -> 3
97_00_9	C	55.7	>	3.8	>	3.3	>	4.5	n			Firm consolidated red clay DM>pen; numerous red clay clasts@surf; a few surf tubes+shallow burrows; no clear rpd contrast	0				1 -> 2
97_00_9	D	45.1	>	3.1	>	2.2	>	3.8	n			Firm consolidated red clay DM>pen; reduced patches but rpd not continuous (rpd>pen); dense surf tubes and/or Podocerid stalks; shallow voids/burrow	2	0.6	2.3	1.5	1 on 3
2001_2	A	287.1	>	19.8	>	19.5	>	19.9	n			Soft muddy DM>pen; DM=remediation material; reduced@depth w/ weak to moderate rpd contrast; possibly fresh material=subtle multiple layers; a few large surf tubes+v. dense Nucula in upper 2-3 cm; 1-2 thin subsurface worms	0				2 on 3
2001_2	B	261.9	>	18.1	>	16.5	>	19.3	n			Soft muddy DM>pen; DM=remediation material (recent); black/reduced@depth w/ moderate rpd contrast; dense surf worm tubes+Podocerid stalks; dense Nucula; subsurface worms+several partial voids; vertical oxy tubes/burrows	4	8.4	15.5	12.0	2 on 3

APPENDIX B (CONTINUED)

SPI Raw Data

Station	REP	TOTAL DM AREA	TOTAL DM MEAN		TOTAL DM MIN		TOTAL DM MAX		Low DO?	Surface Sand Layer Area (sq. cm)	Mean Surface Sand Layer Thickness (cm)	COMMENT	Feeding Void #	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage
2001_2	C	289.5	>	20.0	>	19.8	>	20	n			Soft muddy DM>pen; recent remediation material; black/reduced@depth; possible multiple layers; assorted surf tubes+Podocerid stalks; dense Nucular in upper 2-3 cm; subsurface voids+several larger-bodied worms	2	4.3	8.9	6.6	2 on 3
2001_3	A	226.4	>	15.6	>	15.3	>	15.8	n			Soft muddy DM>pen; recent(?) remediation material; black/reduced@depth; multiple DM layers; dense lrg surf tubes (Asabellides?) w/ Podocerid stalks; 1 white anemone@surf and 1 in sed; subsurface orgspartial/indistinct voids; Nucula in upper 1-2 cm	3	2.8	4.7	3.8	2 on 3
2001_3	B	219.5	>	15.1	>	14.6	>	15.6	n			Soft muddy DM>pen; recent remediation material; sulfidic banding@depth; multiple layers; void@bottom edge of image; dense large surf tubes w/ Podocerid stalks; anemone@surf@right; Nucula in upper 1-2 cm; whitish subsurface org	1	14.7	14.9	14.8	2 on 3
2001_3	C	215.8	>	14.9	>	14.6	>	15.2	n			Soft muddy DM>pen; recent(?) remediation material; black/sulfidic patches@depth; dense large surf tubes (Asabellides?); Podocerid stalks; numerous Nucula in upper 1-2 cm; subsurface=1 void+1 larger-bodied worm	1	8.1	8.2	8.2	2 on 3
2001_5	A	120.8	>	8.3	>	7.9	>	9	n			Muddy fine sand (DM)>pen; sand=remediation material in PRA 2; dense muddy large surf tubes w/ Podocerid stalks; slight dragdown of muddy fines	0				ind
2001_5	B	44.8	>	3.1	>	2	>	4.3	n			Muddy fine sand (DM)>pen; sand=remediation material in PRA 2; large muddy surf tubes, some recumbent/clumped; rippled sand surface; a few Podocerid stalks; slight mud dragdown	0				ind
2001_5	D	59.7	>	4.1	>	3.7	>	4.6	n			Muddy fine sand (DM)>pen; sand=remediation material in PRA 2; numerous large upright and recumbent surf tubes; a few Podocerid stalks	0				ind
2001_6	B	108.5	>	7.5	>	6.8	>	8.3	n			Red clay DM>pen; clay is moderately firm/consolidated; slightly sandy in upper 2-3 cm; small tubes+muddy floc@surf; several subsurface voids and 1-2 v. small orgs	4	1.5	2.5	2.0	1 on 3

APPENDIX B (CONTINUED)

SPI Raw Data

Station	REP	TOTAL DM AREA	TOTAL DM MEAN	TOTAL DM MIN	TOTAL DM MAX	Low DO?	Surface Sand Layer Area (sq. cm)	Mean Surface Sand Layer Thickness (cm)	COMMENT	Feeding Void #	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage
2001_6	C	71.5	> 4.9	> 3.6	> 5.9	n			Red clay DM>pen; clay is moderately firm/consolidated; scattered pebbles@surf; difficult rpd measurement; small surf tubes+1 segmented v. small subsurface org@left; looks like recent disposal	0				1 on 3
2001_6	D	143.1	> 9.9	> 8.8	> 10.4	n			Red clay DM>pen; upper 1 cm is reworked over consolidated clay@depth; a few black streaks of reduced sed; several subsurface voids/burrows	5	1.8	5.1	3.5	1 on 3
2001_8	B	155.2	> 10.7	> 10.4	> 11	n			Mixed DM>pen; remediation material in PRA2; sand-silty mud over consolidated black+white clay@depth; pebbles+worm tubes+Podocerid stalks@surf; hydroids on rocks; void/burrow in lwr right corner of image	1	8.7	10.2	9.5	1 on 3
2001_8	C	111.1	> 7.7	> 6.5	> 8.4	n			Mixed poorly sorted DM>pen; chaotic fabric=mix of rocks, sand, and reddish clay; hydroids on rocks; a few surf tubes; shallow void@center of image.	1	2.2	2.4	2.3	1 on 3
2001_8	D	180.3	> 12.4	> 12.6	> 14.3	n			Mixed DM>pen; mostly streaky consolidated red clay w/ sandy surface layers; chaotic fabric; small work tubes@surf; voids@depth.	4	5.1	9.2	7.2	1 on 3
2002_1	A	68.4	> 4.7	> 2.6	> 6.5	n			Clean fine rippled sand>pen; sand is relatively new DM (area has received remediation material); large surf tubes=Diopatra	0				ind
2002_1	B	52.5	> 3.6	> 0.8	> 7	n			Clean fine rippled sand>pen; sand is relatively new remediation material in PRA 4; numerous scattered large Diopatra tubes	0				ind
2002_1	D	54.7	> 3.8	> 3.1	> 4.1	n			Clean fine rippled sand>pen; sand is relatively new remediation material in PRA 4; scattered upright large Dioapatra tubes	0				ind
2002_4	A	208.4	> 14.4	> 13.1	> 15.3	n	179.7	12.4	S/M=upper 12 cm is clean fine sand over black/reduced muddy DM@depth; sand= remediation material; 1 small void in mud; dense large surf tubes=Diopatra	1	13.2	13.3	13.3	1 on 3
2002_4	C	189.1	> 13.0	> 12.5	> 13.7	n			Clean fine sand>pen; sand is relatively new remediation material in PRA 4; dense large surf tubes (Diopatra)	0				ind
2002_4	D	157.3	> 10.8	> 10.4	> 11.2	n	136.2	9.4	S/M=upper 9 to 10 cm is clean fine sand over black/reduced muddy DM@depth; sand=remediation material; dense Diopatra tubes w/ Podocerid stalks; 1 long thin worm-like org in mud@depth	0				1 on 3

APPENDIX B (CONTINUED)

SPI Raw Data

Station	REP	TOTAL DM AREA	TOTAL DM MEAN		TOTAL DM MIN		TOTAL DM MAX		Low DO?	Surface Sand Layer Area (sq. cm)	Mean Surface Sand Layer Thickness (cm)	COMMENT	Feeding Void #	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage
2002_9	A	65.7	>	4.5	>	4	>	5.1	n			Clean fine sand>pen; sand is relatively new remediation material in PRA 2; scattered large surf tubes (Diopatra); possible Podocerid stalk in farfield; tube/shell dragdown	0				ind
2002_9	B	39.7	>	2.7	>	2.1	>	3.6	n			Clean fine firm sand>pen; slightly rippled; sand is relatively new remediation material in PRA 2; scattered large surf tubes (Diopatra)	0				ind
2002_9	C	67.4	>	4.6	>	3.5	>	5.2	n			Clean fine firm sand>pen; sand is relatively new remediation material in PRA 2; scattered large surf tubes (Diopatra?)	0				ind
2002_10	B	68.4	>	4.7	>	3.3	>	6.1	n			Clean fine sand>pen; sand is relatively new remediation material in PRA 2; scattered large surf tubes (Diopatra?)	0				ind
2002_10	C	83.4	>	5.8	>	5.4	>	6	n			Clean fine sand>pen; sand is relatively new remediation material in PRA 2; scattered large surf tubes (Diopatra?); tube dragdown	0				ind
2002_10	D	61	>	4.2	>	3.7	>	4.5	n			Clean fine sand>pen; sand is relatively new remediation material in PRA 2; numerous scattered large surf tubes (Diopatra?); dragdown of worm split out of tube	0				ind
2003-10	A	103.1	>	7.1	>	6.7	>	7.8	n			Red clay DM>pen; clay=remediation material in PRA 2; homogenous consolidated clay w/ large hydroid-covered clay clumps+pebbles@surf; small work tubes+1 small subsurface worm-like org; faint reduced patches but no real rpd contrast	0				2 -> 3
2003-10	B	41.9	>	2.9	>	1.7	>	3.5	n			Red clay DM>pen; clay=remed. material in PRA 2; underpen=consolidated/stiff clay w/ large clumps mixed with small rocks (pebbles)@surf; hydroids on rocks; small surf tubes	0				ind
2003-10	C	96.4	>	6.6	>	4.8	>	7.8	n			Red clay DM>pen; clay=remed material in PRA 2; faint reduced patches but no real rpd contrast; hydroid-covered rocks (some cobbles+many pebbles)@surf; shallow burrows= Stg 2	0				2 -> 3
2003_5	B	169	>	11.7	>	10.9	>	12.2	n			Red clay DM>pen; clay=remed. material in PRA 3; slightly sandy; continuous dark/reduced horizon@depth=weak rpd contrast; a few large surf tubes; several subsurface voids+several long thin red worm-like orgs=Stg 3;	4	2.9	9.6	6.3	1 on 3

APPENDIX B (CONTINUED)

SPI Raw Data

Station	REP	TOTAL DM AREA	TOTAL DM MEAN		TOTAL DM MIN		TOTAL DM MAX		Low DO?	Surface Sand Layer Area (sq. cm)	Mean Surface Sand Layer Thickness (cm)	COMMENT	Feeding Void #	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage
2003_5	C	228.6	>	15.8	>	15.1	>	16.4	n			Red clay DM>pen; remediation material in PRA 3; slightly sandy in upper 2-3 cm; shallow sulfidic horizon=rpd; a few large surf tubes; several partial voids+1 large deep void/burrow complex	4	4.3	15.7	10.0	1 on 3
2003_5	D	146.3	>	10.1	>	9.6	>	10.9	n			Red clay DM>pen; remed. material in PRA 3; slightly sandy in upper 1 cm; a few large surf tubes; 1 large grey subsurface org (possibly Cerianthid)=Stg 3; a few small worms @depth; shallow sulfidic horizon	0				1 on 3
2004_2	A	153.6	>	10.6	>	9.7	>	11.2	n			Red clay DM>pen; remed material in PRA 3; upper 1 cm has pelletized texture=biogenic; several subsurface voids/burrows; a few surf tubes+small worms @depth	3	2.3	8.8	5.6	1 on 3
2004_2	B	86.7	>	6.0	>	4.6	>	8.4	n			Red clay DM>pen; remed material in PRA 3; pull-away on right (due to clay stiffness); reduced patches but no clear rpd (esp. w/ pullaway); 1-2 surf tubes	0				ind
2004_2	D	99.9	>	6.9	>	3.1	>	8.7	n			Red clay DM>pen; remed material in PRA 3; large angular clay clump transected@left; reduced patches@depth but no clear rpd; void/burrow complex@far right	2	1.6	4.1	2.9	1 on 3
2004_6	A	106.8	>	7.4	>	6.9	>	8	n	76.2	5.3	S/M=upper 4-5 cm is muddy medium sand DM over black/reduced muddy DM@depth; sand has red brick particles' dense large surf tubes+Podocerid stalks; 1 subsurface segmented larger-bodied org@left	0				1 on 3
2004_6	C	127.7	>	8.8	>	7.9	>	9.2	n			Muddy medium to coarse sand>pen; patch of black mud@depth=likely S/M; dense large surf tubes (Diopatra) w/ Podocerid stalks; red particles in sand=weathered brick; anemone in farfield	0				ind
2004_6	D	124.4	>	8.6	>	8	>	9	n			S/M=upper 8 cm is medium to coarse sand over black-grey muddy DM@depth; red particles in sand=brick; sand is reduced@depth=weak rpd contrast; dense large surf tubes (Diopatra) w/ Podocerid stalks	0				ind

Station	REP	TOTAL DM AREA	TOTAL DM MEAN		TOTAL DM MIN		TOTAL DM MAX		Low DO?	Surface Sand Layer Area (sq. cm)	Mean Surface Sand Layer Thickness (cm)	COMMENT	Feeding Void #	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage
2004_9	A								n			No pen=rock covered w/ dense hydroids; rock=likely DM; rock is at least cobble-sized	ind				ind
2004_9	B								n			No pen=mostly cobble-sized rocks coverd with thick growth of hydroids+ various epifauna; 1 sea star visible; rocks=likely DM	ind				ind
2004_9	D								n			No pen=cobble-sized rocks covered with growth of hydroids; rocks=likely DM	ind				ind
2005_4	A	68.9	>	4.8	>	4.3	>	5.3	n			Very fine to fine sand>pen; sand is most likely remediation material in PRA 2; scattered large surf tubes (Diopatra) w/ attached Podocerid stalks; faintly reduced patches@depth=v. weak rpd contrast	0				ind
2005_4	B	88.7	>	6.1	>	4.9	>	7.2	n			Very fine to fine sand>pen; sand is most likely remediation material in PRA2; scattered large surf tubes (Diopatra) w/ Podocerid stalks; faintly reduced@depth=v. weak rpd contrast	0				ind
2005_4	D	67.8	>	4.7	>	3.6	>	5.7	n			Very fine to fine rippled sand>pen; most likely remediation material in PRA2; many large surf tubes (Diopatra); faintly reduced@depth=v. weak rpd contrast	0				ind
2010-01	B	290.7	>	20.0	>	19	>	20.8	n	119.7	8.3	S/M; distinct layering of muddy v. fine sand w/ small whit shell frags (remediation material) over reduced-sulfidic muddy remediation material; large surf tubes (Diopatra?); evidence of Mulinia in top 2 cm and subsurface activity in mud	0				3
2010-01	C	>315.6	>	21.7	>	21.7	>	21.7	n			Overpenetration; S/M similar to previous rep=muddy fine to v. fine sand w/ numerous small white shell frags (remediation material) over muddy reduced remediation material: distinct sulfidic horizon@depth	0				3
2010-01	D	287.6	>	19.8	>	19.5	>	20.1	n	128.8	8.9	S/M=distinct layering of muddy fine to v. fine sand w/ shell frags over reduced soft muddy DM; remediation material>pen; dense large surf tubes (Diopatra); sulfidic horizon below sand layer; 1 small partial void	1	10.9	11.1	11.0	1 on 3

APPENDIX B (CONTINUED)

SPI Raw Data

Station	REP	TOTAL DM AREA	TOTAL DM MEAN	TOTAL DM MIN	TOTAL DM MAX	Low DO?	Surface Sand Layer Area (sq. cm)	Mean Surface Sand Layer Thickness (cm)	COMMENT	Feeding Void #	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage
2010-02	A	75.6	> 5.2	> 4.9	> 5.6	n			Fine sand remediation material>pen; upper 2-3 cm is muddy from settlement of fines; dense large surf tubes (Diopatra) w/ attached Podocerid stalks;	0				ind
2010-02	C	172.1	> 11.9	> 11.2	> 12.3	n			Fine sand remediation material>pen; upper 3-4 of very fine silty sand grading to fine and then to medium sand ; dense large surf tubes (Diopatra) w/ Podocerid stalks	0				ind
2010-02	D	162.6	> 11.2	> 11.1	> 11.7	n			Fine sand remediation material>pen; silty very fine sand at surface grading into mostly clean sand;dense large surf tubes w/ attached Podocerid stalks	0				ind
2010-03	A	13.4	> 0.9	> 0	> 2.4	n			Underpen=rocks over fine sand remediation material; cobble to boulder sized rocks w/ epifauna over fine sand	0				ind
2010-03	C	39.9	> 2.8	> 1.4	> 4.6	n			Consolidated, firm v. muddy fine sand (remediation material)>pen; pebbles/brick frags@surf; mud@depth is reduced w/ thin rpd, appears to be recently eroded; a few large surf tubes; void-like opening lwr right	0				ind
2010-03	D	35.8	> 2.5	> 1.9	> 2.8	n			Low pen=firm fine sand (remediation material)>pen; Patch of mud on left and 1muddy tube dragdown; a few surf surf tubes; no rpd contrast	0				ind
2010-04	E	228.9	> 15.8	> 15.2	> 16.1	n			Soft muddy layered DM>pen; remediation material; 9-10 cm upper layer of brown mud over reddish clay@depth; sulfidic horizon@bottom of upper lyr: dense large surf tubes w/ Podocerid stalks; Nucula in upper 2-3 cm; 2 subsurface voids	2	13.4	13.9	13.7	2 on 3
2010-04	F	227.4	> 15.7	> 15.2	> 15.8	n			Soft muddy layered DM>pen; remediation material; distinct layering=9 cm upper lyr of brown mud over red clay; sulfidic horizon=bottom of upper lyr; dense surf tubes, Nucula, subsurface void+worm-like org	1	10.1	10.2	10.2	2 on 3

APPENDIX B (CONTINUED)

SPI Raw Data

Station	REP	TOTAL DM AREA	TOTAL DM MEAN		TOTAL DM MIN		TOTAL DM MAX		Low DO?	Surface Sand Layer Area (sq. cm)	Mean Surface Sand Layer Thickness (cm)	COMMENT	Feeding Void #	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage
2010-04	G	231.3	>	16.0	>	15.6	>	16.6	n			Soft muddy layered DM>pen; remediation material; distinct layering=10 cm upper lyr of brown mud over red clay; dense surf tubes w/ Podocerid stalks, Nucula, several voids in lwr layer; lrg org@far right in upper lyr; worm-like org	4	10	14.9	12.5	2 on 3
2010-05	A	76.7	>	5.3	>	4.5	>	5.8	n			Clean fine sand>pen; sand=remediation material in PRA1; slight dragdown of mud from tubes; dense large surf tubes w/ attached Podocerid stalks	0				ind
2010-05	B	80.1	>	5.5	>	4.9	>	5.9	n			Well-sorted fine sand>pen; remediation material in PRA1; dragdown of mud from tubes; dense large surf tubes (Diopatra) w./ attached Podocerid stalks	0				ind
2010-05	C	62.5	>	4.3	>	3.4	>	5.2	n			Clean fine sand>pen; remediation material in PRA1; large surf tubes (Diopatra); 1 tube has short Podocerid stalk; 2 subsurface orgs are most likely the worms associated with surface tubes	0				ind
2010-06	A	65.7	>	4.5	>	3.9	>	4.8	n			Firm, poorly-sorted sand-gravel mix>pen; mostly fine sand w/ fractions of coarse sand+small gravel+shell frags; remedation material in PRA1; 1 or 2 large surf tubes in farfield (Diopatra)??	0				ind
2010-06	C	53.7	>	3.7	>	2.8	>	4.2	n			Firm, poorly-sorted sand-gravel mix>pen; fine sand w/ significant coarse sand, pebbles, and shell frags; remediation material in PRA1	0				ind
2010-06	D	62.1	>	4.3	>	3.3	>	5.1	n			Firm poorly-sorted sand-gravel mix>pen; mostly coarse to v. coarse sand w/ minor fine sand; some granules+pebbles; recumbent Diopatra tube@left; Podocerid stalk	0				ind
2010-07	A	51.3	>	3.5	>	2.5	>	4.2	n			Firm clean fine sand>pen; sand is remediation material in PRA1; dense large surf tubes (Diopatra)	0				ind
2010-07	B	67.1	>	4.6	>	4.2	>	5.2	n			Firm clean fine sand>pen; sand is remediation material in PRA1; dense large surf tubes (Diopatra); slight dragdown of muddy tubes+shells	0				ind
2010-07	D	49.3	>	3.4	>	2.8	>	4.5	n			Firm clean fine sand>pen; sand is remediation material in PRA1; numerous large surf tubes (Diopatra)l tube dragdown; small patch of black/reduced sed@depth	0				ind

SPI Raw Data

Station	REP	TOTAL DM AREA	TOTAL DM MEAN	TOTAL DM MIN	TOTAL DM MAX	Low DO?	Surface Sand Layer Area (sq. cm)	Mean Surface Sand Layer Thickness (cm)	COMMENT	Feeding Void #	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage
2010-08	A	45.6	> 3.1	> 2.9	> 3.3	n			Firm clean fine sand>pen; sand is remediation material in PRA1; numerous large surf tubes (Diopatra)	0				ind
2010-08	B	47.9	> 3.3	> 2.7	> 3.8	n			Firm clean fine sand>pen; sand is remediation material in PRA1; numerous large surf tubes (Diopatra); 1-2 Podocerid stalks	0				ind
2010-08	C	47.3	> 3.3	> 2.7	> 3.9	n			Firm clean fine sand>pen; sand is remediation material in PRA1; scattered large surf tubes (Diopatra) w/ shell-armored tubes; Podocerid stalk	0				ind
2010-09	B	72.1	> 5.0	> 4.8	> 5.2	n			Firm muddy very fine sand>pen; sandy mud or muddy sand=remediation material in PRA1; reduced@depth w/ moderate rpd contrast; dense large surf tubes (Diopatra); 1 dark worm-like org@depth	0				1 on 3
2010-09	C	97.9	> 6.8	> 6.2	> 7.2	n			Firm muddy very fine sand>pen; remediation material in PRA1; reduced@depth w/ moderate rpd contrast; small white shell frags; 1 small/dark worm@bottom center of image	0				1 on 3
2010-09	D	64.5	> 4.4	> 4	> 4.7	n			Firm muddy very fine sand>pen; remediation material in PRA1; faintly reduced@depth w/ weak rpd contrast; several Diopatra tubes@surf; edge of subsurface burrows transected	3	1.1	2.9	2.0	1 on 3
2010-10	A	56.6	> 3.9	> 3.4	> 4.3	n			Firm mostly clean fine sand>pen; sand is remediation material in PRA1; small patch of reduced sed@depth; v. dense large surf tubes, upright+recumbent; Podocerid stalks; tube+org dragdown	0				ind
2010-10	C	20.1	> 1.4	> 0.1	> 3	n			Firm clean fine sand>pen; underpen; sand is remediation material in PRA1; dense recumbent Diopatra tubes@surf; tube+org dragdown	0				ind
2010-10	D	53.9	> 3.7	> 3.1	> 4.3	n			Firm clean fine sand>pen; remediation material in PRA1; v. dense Diopatra tubes; a few attached Podocerid stalks; minor dragdown of tubes+associated orgs	0				ind
2010-11	A	ind				ind			No pen=hard bottom; top of a cobble-sized rock is visible; covered with hydroids+white sponge or anemone; rock=remedation material	ind				ind
2010-11	B	ind				ind			No pen=hard bottom; top of a cobble-sized rock is visible; covered with hydroids; rock=remedation material	ind				ind

SPI Raw Data

Station	REP	TOTAL DM AREA		TOTAL DM MEAN		TOTAL DM MIN		TOTAL DM MAX	Low DO?	Surface Sand Layer Area (sq. cm)	Mean Surface Sand Layer Thickness (cm)	COMMENT	Feeding Void #	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage
2010-11	C	ind							ind			No pen=hard bottom; top of a cobble-sized rock is visible; covered with hydroids; rock=remedation material	ind				ind
2010-12	B								n			Clean fine sand>pen; patch of red clay@depth; no visible tubes; station is outside HARS boundary so sand is most likely ambient	0				ind
2010-12	C								n			Clean fine rippled sand>pen; high boundary roughness=ripple transect; no visible tubes; sand looks like ambient	0				ind
2010-12	D								n			Muddy fine sand>pen; ambient sand w/ high degree of reddish fines from nearby disposal in PRA; scattered Diopatra tubes armored with white shell frags -- appears to be apron of deposit	0				ind
2010-13	A	58.6	>	4.0	>	3.8	>	4.3	n			Consolidated, reduced silt-clay remedation material>pen; dark grey cohesive clay w/ thin veneer of oxy sed (rpd close to zero); surf tubes+shallow burrows+a few small shallow-dwelling worms	0				1 going to 2
2010-13	B								ind			No pen=hard bottom; cobble-sized rock in farfield w/ some epifaunal growth; rock=remediation material in PRA2	ind				ind
2010-13	D								ind			No pen=hard bottom; part of cobble-sized rock visible w/ epifaunal growth; rock=remediation material in PRA2	ind				ind
2010-14	B	78.6	>	5.4	>	3.9	>	6.2	n			Poorly sorted silty medium to finesand>pen; sand=remediation material; patches of red clay@depth (thin dragged down veneer); void in sand; large surf tubes (Diopatra)	0				ind
2010-14	C	56.6	>	3.9	>	2.9	>	5.3	n			Fine sand>pen; sand=remediation material; patches of red clay@depth (thin dragged down veneer; dense large Diopatra tubes w/ attached Podocerid stalks; subsurface animals visible	0				ind
2010-14	D	65.5	>	4.5	>	4.1	>	4.8	n			Fine sand>pen; sand=remediation material; patch or thin veneer of red clay@depth; dense large Diopatra tubes at SWI w/ attached Podocerid stalks in farfield	0				ind
2010-15	B	177.1	>	12.2	>	11.4	>	12.9	n			Red clay DM>pen; slighty sandy in upper 3 cm (possible layering) over streaky cohesive clay@depth; a few Nucula; numerous full and partial voids; subsurface worm@left	5	1.4	12.5	7.0	2 on 3

APPENDIX B (CONTINUED)

SPI Raw Data

Station	REP	TOTAL DM AREA	TOTAL DM MEAN	TOTAL DM MIN	TOTAL DM MAX	Low DO?	Surface Sand Layer Area (sq. cm)	Mean Surface Sand Layer Thickness (cm)	COMMENT	Feeding Void #	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage
2010-15	C	281.5	> 19.4	> 18.6	> 20	n			Red clay DM>pen; possible layering=13 cm dark clay lyr over cohesive red clay; a few Nucula+burrows in upper 2 cm; several small subsurface orgs=Stg 3	0				2 on 3
2010-15	D	245.5	> 16.9	> 16.6	> 17.3	n			Red clay DM>pen; possible layering; pelletized surface w/ numerous shallow burrows+2 small voids; Nucula@far left	2	2	2.8	2.4	2 on 3
2010-16	A	173.7	> 12.0	> 9.7	> 15.5	n			Cohesive grey/reddish clay remediation material>pen; high surface roughness+angularity=relatively fresh material; small surf tubes+shallow oxy voids on far left edge	2	1	1.9	1.5	1 -> 2
2010-16	B	232.9	> 16.1	> 14.1	> 18.2	n			Cohesive grey/reddish clay remediation material>pen; high surface roughness w/ large clay clumps=relatively fresh material; small surf tubes+2 voids@far right image edge	2	8.3	10	9.2	1 on 3
2010-16	C	206	> 14.2	> 13.2	> 14.9	n			Cohesive grey/reddish clay remedation material>pen; numerous clay clumps+clasts@surf=recent material; a few surf tubes+several vertical oxy burrows+1 larger-bodied worm about 5 cm @ depth	0				1 on 3
2010-17	A	ind				ind			No pen=rocks=looks like pebbles to small cobbles@sed surf in farfield; rocks=remediation material	ind				ind
2010-17	B	ind				ind			No pen=rocks=pebbles to cobble-sized rocks on top of red clay; shrimp and leaf litter among rocks; rocks=remediation material	ind				ind
2010-17	C	37.7	> 2.6	> 1.1	> 3.7	n			Low pen=firm red clay>pen; remediation material; shrimp@sed surf@right; a few small surf tubes+several small worms@depth	0				2 -> 3
2010-18	A	60.5	> 4.2	> 2.4	> 5.2	n			Low pen=firm red clay>pen; remedation material; high boundary roughness, relatively weathered deposit, small polychaetes @ depth	0				2 -> 3
2010-18	B	175.8	> 12.1	> 11.4	> 12.8	n			Red clay remediation material>pen; upper 2-3 cm is muddy very fine sand over cohesive red clay@depth; sulfidic patches+weak rpd contrast; a few large surf tubes+numerous Podocerid stalks; subsurface voids+lrg worm@right edge of image	3	4.7	11.6	8.2	1 on 3
2010-18	D	ind				n			Image not analyzable due to large patch of red clay adhering to faceplate. Partial profile suggests red clay w/ sandy surface+dense Diopatra tubes w/ attached Podocerid stalks, burrows @ depth	ind				1 on 3

SPI Raw Data

Station	REP	TOTAL DM AREA	TOTAL DM MEAN		TOTAL DM MIN		TOTAL DM MAX		Low DO?	Surface Sand Layer Area (sq. cm)	Mean Surface Sand Layer Thickness (cm)	COMMENT	Feeding Void #	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage
2010-19	A	38	>	2.6	>	1.6	>	3.1	n			Firm muddy fine to very fine sand>pen; sand=remediation material; dense large surf tubes (Diopatra); some tube dragdown	0				ind
2010-19	B	40.4	>	2.8	>	1.9	>	3.2	n			Firm muddy fine to very fine sand>pen; black/reduced@depth w/ moderate rpd contrast; dense large surf tubes (Diopatra); sand=remediation material	0				ind
2010-19	C	48.6	>	3.4	>	2.8	>	3.9	n			Firm muddy fine to very fine sand>pen; reduced patches@depth but no consistent rpd contrast; tube dragdown; dense large surf tubes (Diopatra)	0				ind
E0800	A	76.8	>	5.3	>	4.8	>	5.8	n			Poorly sorted mix of mud, sand, and gravel>pen; remediation material; mostly muddy v. fine sand w/ pebble-sized red brick fragments; surf tubes, hydroids on rocks, and 1 subsurface org=Stg 3	0				1 on 3
E0800	B	61.5	>	4.2	>	3.3	>	4.8	n			Poorly sorted mix of mud, sand and gravel>pen; remediation material; muddy sand/sandy mud mixed with many pebble-sized red brick fragments;	0				ind
E0800	C	48	>	3.3	>	1.6	>	4.4	n			Poorly sorted mix of mud, sand and gravel>pen; remediation material; muddy sand/sandy mud w/ significant granular brick frags; a few large surf tubes (Diopatra); subsurface burrow	0				ind
G-1200	B	226.3	>	15.6	>	15.2	>	15.8	n	106.2	7.3	S/M=7 to 8 cm surf layer of clean fine sand over black/reduced muddy DM; both lyrs=remedation material; dragdown of tubes+surf fines; dense large tubes (Diopatra)+Nucula	0				1 on 3
G-1200	C	172.8	>	11.9	>	11.3	>	13	n	103.1	7.1	S/M=6 to 9 cm surf layer of clean fine sand over dark/reduced muddy DM; both lyrs=remediation material; dense large surf tubes+Podocerid stalks; 2 large-bodied worms@depth	0				1 on 3
G-1200	D	224.1	>	15.5	>	15.2	>	16.1	n			S/M=6 to 8 cm surf layer of clean fine sand over dark/reduced muddy DM; both lyrs=remediation material; dense large surf tubes+Podocerid stalks; 2-3 v. small voids in upper sand layer	2	2.9	4	3.5	1 on 3
L1200	B	50.3	>	3.5	>	3.1	>	3.7	n			Clean fine sand>pen; sand=remediation material; dense large surf tubes (Diopatra); tubes have reddish tint=red clay fines; Podocerid stalks	0				ind

APPENDIX B (CONTINUED)

SPI Raw Data

Station	REP	TOTAL DM AREA	TOTAL DM MEAN	TOTAL DM MIN	TOTAL DM MAX	Low DO?	Surface Sand Layer Area (sq. cm)	Mean Surface Sand Layer Thickness (cm)	COMMENT	Feeding Void #	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage
L1200	C	56	> 3.9	> 3.3	> 5	n			Clean fine sand>pen; sand=remediation material; dense large surf tubes (Diopatra) w/ attached Podocerid stalks; tubes have reddish tint=red clay fines; sea star in farfield	0				ind
L1200	D	72.9	> 5.0	> 4.5	> 5.4	n			Clean fine sand>pen; sand=remediation material; dense large surf tubes (Diopatra?) w/ attached Podocerid stalks; tube dragdown; tubes have reddish tint=red clay fines	0				ind
NOREMED_1	B	61.4	> 4.2	> 4.1	> 4.8	n			Medium sand>pen; sand is reasonably well-sorted mix of medium to coarse sand; ambient sand in buffer zone?; dense large surf tubes (Diopatra)	0				ind
NOREMED_1	C	53.2	> 3.7	> 3.1	> 3.9	n			Medium sand>pen; mix of medium to coarse sand; ambient sand in buffer zone?; small patch of silt-clay@lwr right corner; dense large surf tubes (Diopatra)	0				ind
NOREMED_1	D	78.3	> 5.4	> 5	> 5.8	n			Medium sand>pen; slightly muddy from tube dragdown; medium to coarse sand=ambient sand in buffer zone?; numerous large surf tubes (Diopatra)	0				ind
NOREMED_2	A	160.1	> 11.0	> 10.7	> 11.2	n			Soft moderately reduced mud>pen; historic weathered DM in PRA 9; surf tubes, Podocerid stalks, Nucula, larger-bodied subsurface Cerianthid w/ vertical oxy burrow	0				2 on 3
NOREMED_2	B	134.5	> 9.3	> 9	> 9.7	n			Soft moderately reduced mud>pen; historic weathered DM in PRA 9; surf tubes, Podocerid stalks, Nucula; several small/thin subsurface orgs=Stg 3	0				2 on 3
NOREMED_2	C	185	> 12.8	> 12.5	> 13.1	n			Soft moderately reduced mud>pen; historic weathered DM in PRA 9; a few surf tubes+Podocerid stalks, a few Nucula; slight rpd smearing; reduced patches@depth	0				2 -> 3
NOREMED_3	B					n			Underpen=firm fine sand>pen; mostly fine ambient sand w/ some coarse and small gravel; shell frags, flocculant detritus+a few large tubes??@surf;	0				ind
NOREMED_3	C					n			Underpen=firm fine sand>pen; ambient sand; numerous shell frags+small rocks (granules+1 pebble)@surf; epifauna on rock	0				ind

APPENDIX B (CONTINUED)

SPI Raw Data

Station	REP	TOTAL DM AREA	TOTAL DM MEAN	TOTAL DM MIN	TOTAL DM MAX	Low DO?	Surface Sand Layer Area (sq. cm)	Mean Surface Sand Layer Thickness (cm)	COMMENT	Feeding Void #	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage
NOREMED_3	D					n			Underpen=firm fine sand>pen; shell frags+some coarse sand+small gravel present; ambient sand; large surf tube@left in nearfield=Diopatra	0				ind
NOREMED_4	B	130.4	> 9.0	> 8.3	> 9.5	n			Mixed mud+sand DM>pen; poorly sorted mix of medium to coarse sand+brown/reddish mud=remediation material; layering=upper 2 cm is muddy over sand; reduced band@surf with diffusional rpd; dense large curly tubes w/ attached Podocerid stalks	0				1 on 3
NOREMED_4	C	125.3	> 8.6	> 8.1	> 8.9	n			M/S=1 to 3 cm reddish brown silt-clay over grey medium to coarse sand; remediation material; dense large curly tubes w/ Podocerid stalks, worms burrowing @ depth	0				1 on 3
NOREMED_4	D	104	> 7.2	> 6.1	> 7.6	n			M/S=1-2 cm of brown silt over grey medium to coarse sand; silt is reduced w/ thin rpd; remediation materail; dense large curly tubes@surf with worms at depth	0				1 on 3
NOREMED_5	B	297.3	> 20.5	> 20.3	> 20.7	n			Soft red clay remediation material>pen; possible layering=7 cm brown silt over cohesive red clay; several surf tubes+1 partial whitish subsurface org=Stg 3; weak rpd contrast	0				1 on 3
NOREMED_5	C	259.2	> 17.9	> 15.5	> 19.7	n			Soft red clay remediation material>pen; 5 cm surf lyr brown sandy silt over cohesive red clay; large burrow w/ multiple voids-like chambers+opening@surf; a few surf tubes; weak rpd contrast	5	4.6	17.5	11.1	1 on 3
NOREMED_5	D	289.9	> 20.0	> 19.5	> 20.1	n			Soft red clay remedation material>pen; 5-6 cm surf lyr borown sandy silt over cohesive red clay; small burrows in upper 1 cm; large-bodied org@left+subsurface voids	2	6.2	8.2	7.2	1 on 3
P2800	A	138.6	> 9.6	> 7.7	> 10.7	n			Mixed mud+sand remediation material>pen; upper 5-6 cm is muddy sand (tube dragdown?) over cleaner fine to medium sand; dense large surf tubes w/ many Podocerid stalks; subsurface burrows	0				1 on 3
P2800	B	163.6	> 11.3	> 10.9	> 11.6	n			Grey fine to medium sand remedation material>pen; upper 2-3 cm is muddy (reddish/brown mud); dense large surf tubes w/ Podocerid stalks; some tube dragdown	0				ind

APPENDIX B (CONTINUED)

SPI Raw Data

Station	REP	TOTAL DM AREA	TOTAL DM MEAN		TOTAL DM MIN		TOTAL DM MAX		Low DO?	Surface Sand Layer Area (sq. cm)	Mean Surface Sand Layer Thickness (cm)	COMMENT	Feeding Void #	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage
P2800	C	192.7	>	13.3	>	12.7	>	14	n			M/S=upper 5-6 cm of brown silt-clay over grey medium sand; remediation material; sand has pulled away due to methane gas pocket; a few large surf tubes w/ Podocerid stalks	0				2 -> 3

APPENDIX C

Plan-View Raw Data

STATION	REP	Date	Time	Length of image (cm)	Height of image (cm)	Field of View imaged (m^2)	Sediment Type	Bedforms	Infauna	Burrows	Tubes	Tracks	Epifauna	Mudclasts	Debris	Comment
1	A	8/25/2010	17:02	88.5	58.8	0.52	Rippled fine sand	y	y	n	y	n	n	n	n	Rippled clean fine sand w/ numerous shell-covered recumbent Diopatra tubes; assymetrical ripples
2	C	8/27/2010	8:21	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	High turbidity - laser dots and sediment surface not visible
3	A	8/27/2010	8:05	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	High turbidity - laser dots and sediment surface not visible - only one white shell visible
4	C	8/27/2010	16:38	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	High turbidity - laser dots and sediment surface not visible
5	B	8/27/2010	8:41	81.6	54.2	0.44	Rippled fine sand	y	y	n	y	n	y	n	n	Rippled clean fine sand; single shell-covered recumbent Diopatra tube; small white shell frags+coarser sand particles among ripples
6	A	8/27/2010	7:40	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	High turbidity - laser dots and sediment surface not visible
7	A	8/27/2010	16:18	89.6	59.4	0.53	Muddy sand	n	y	n	y	n	n	n	n	Fine sand w/ numerous shell frags covered with muddy detritus; a few small tubes visible
8	B	8/27/2010	8:49	87.3	57.9	0.51	Rippled fine sand	y	y	n	y	n	y	n	n	Fine rippled sand w/ a few scattered clusters of shell-encrusted recumbent Diopatra tubes; snail or hermit crab in upper right corner
9	A	8/28/2010	18:18	ind	ind	ind	Muddy fine sand	n	y	n	y	n	ind	ind	n	Muddy fine sand (based on SPI) w/ numerous shell frags+worm tubes; image quality is poor; lasers dots not visible
10	A	8/28/2010	18:07	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	High turbidity - laser dots and sediment surface not visible
11	A	8/27/2010	15:42	90.1	59.8	0.54	Muddy fine sand	n	y	n	y	n	n	n	n	Muddy fine sand (based on SPI) w/ very dense mostly recumbent worm tubes+small shell frags;
12	A	8/27/2010	8:57	88.9	59	0.52	Rippled fine sand	y	y	n	y	n	n	n	n	Clean rippled fine sand; assymetrical ripples; a few scattered recumbent shell-encrusted Diopatra tubes; small white shell frags
13	A	8/27/2010	9:05	92.7	61.4	0.57	Rippled fine sand	y	y	n	y	n	n	n	n	Clean rippled fine sand; assymetrical ripples; numerous scattered recumbent shell-encrusted Diopatra tubes

APPENDIX C (CONTINUED)

Plan-View Raw Data

STATION	REP	Date	Time	Length of image (cm)	Height of image (cm)	Field of View imaged (m^2)	Sediment Type	Bedforms	Infauna	Burrows	Tubes	Tracks	Epifauna	Mudclasts	Debris	Comment
14	A	8/28/2010	17:30	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	High turbidity - laser dots and sediment surface not visible
15	A	8/28/2010	17:49	ind	ind	ind	Rocks on fine sand	ind	ind	ind	ind	ind	ind	ind	ind	High turbidity - laser dots not visible; one rock w/ hydroids visible in upper part of image; white shell frags@sed surf?
16	A	8/27/2010	9:19	88.6	58.8	0.52	Rippled fine sand	y	y	n	y	n	n	n	y	Clean rippled fine sand; numerous individual+clusters of shell-encrusted Diopatra tubes; rusted iron bar
17	B	8/27/2010	10:22	86.4	57.3	0.50	Silty fine sand	n	y	n	y	n	y	n	y	Muddy fine sand; dense muddy surf tubes (Diopatra or other?); several burrowing anemones; patch of pebbles; 1 small crab@upper left
18	A	8/28/2010	17:39	ind	ind		ind	ind	ind	ind	ind	ind	ind	ind	ind	High turbidity - laser dots and sediment surface not visible
19	A	8/28/2010	8:40	88.9	59	0.52	Silt-clay	n	y	n	y	n	n	n	n	Silt-clay w/ scattered clusters of muddy tubes; numerous white shell frags@sed surface; Cerianthid anemone@center of image
20	A	8/27/2010	9:29	79.4	52.7	0.42	Fine sand	y	y	n	y	n	n	n	n	Fine sand w/ small discontinuous assymetrical ripples; numerous shell-encrusted Diopatra tubes (individual and clusters)
22	A	8/28/2010	17:20	92.5	61.4	0.57	Rippled fine sand	y	y	n	y	n	n	n	n	Rippled fine sand; assymetrical ripples; numerous pebbles+shell and brick frags; 2 or 3 shell-encrusted Diopatra tubes
24	A	8/27/2010	9:41	81.4	54	0.44	Fine sand	y	y	n	y	y	n	n	n	Fine sand w/ small discontinuous assymetrical ripples; dense Diopatra tubes=individuals+clusters; faint tracks upper right
25	B	8/27/2010	9:52	82.3	54.6	0.45	Medium to coarse sand	y	y	n	y	n	n	n	n	Medium sand w/ patches of coarse sand and gravel (granules/pebbles); 1 shell-encrusted Diopatra tube; faint ripples
26	D	8/28/2010	16:54	91.8	61	0.56	Silty fine sand	y	y	n	y	y	n	y	n	Silty fine sand w/ faint assymetrical ripples; large clay clump@bottom of frame; faint tracks; numerous Diopatra tubes (individual+clusters)

APPENDIX C (CONTINUED)

Plan-View Raw Data

STATION	REP	Date	Time	Length of image (cm)	Height of image (cm)	Field of View imaged (m^2)	Sediment Type	Bedforms	Infauna	Burrows	Tubes	Tracks	Epifauna	Mudclasts	Debris	Comment
27	A	8/28/2010	17:03	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	High turbidity - laser dots and sediment surface not visible
28	C	8/28/2010	9:54	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	High turbidity - laser dots and sediment surface not visible
29	A	8/28/2010	10:50	94.4	62.7	0.59	Silt-clay	n	y	n	y	n	y	n	n	Silt-clay w/ very dense large, long smooth tubes (Assabellides?); seastar@upper edge of frame
30	C	8/28/2010	16:43	ind	ind	ind	Silt-clay	ind	ind	ind	ind	ind	ind	ind	ind	High turbidity - laser dots not visible - sed surface obscured - SPI suggest silt-clay - possible shell frags
31	G	8/28/2010	15:51	89.2	59.2	0.53	Muddy fine sand	n	y	n	y	n	n	n	n	Sed surf is muddy w/ moderately dense large tubes; SPI shows muddy surface over fine sand; camera frame footprint
32	A	8/28/2010	16:14	86	57.1	0.49	Muddy fine sand	n	y	n	y	n	n	n	n	Sed surf is muddy w/ numerous large thick tubes; 1 anemone; SPI shows muddy surface over fine sand
33	B	8/28/2010	16:22	91.2	60.6	0.55	Mixed gravel	n	n	n	y	n	y	n	y	Mixed gravel=mostly granules, pebbles and cobbles; muddy veneer; hydroids on some rocks; shell frags
34	A	8/27/2010	10:40	85.4	56.6	0.48	Muddy sand	n	y	n	y	n	n	n	n	Sed surf is muddy w/ very dense large tubes+tube clusters; SPI shows muddy veneer over fine to medium sand
35	A	8/27/2010	10:50	93.3	61.9	0.58	Medium sand	y	y	n	y	n	y	n	n	Medium sand w/ patch of gravel (granules/pebbles); large patch of surface mud w/ dense large tubes; shell frags; 2 sea stars
36	D	8/27/2010	11:33	91.2	60.5	0.55	Muddy fine sand	n	y	n	y	n	n	n	n	Sed surf is muddy w/ numerous large thick shell-encrusted Diopatra tubes; anemone upper left; many small white shells (Nucula?); SPI shows muddy fine sand
37	A	8/27/2010	11:01	82.3	54.6	0.45	Fine sand	y	y	n	y	n	n	n	n	Fine sand w/ dense large surf tubes+tube clusters; Diopatra or other?; shell frags
38	B	8/27/2010	11:16	88.6	59.7	0.53	Rippled fine sand	y	y	n	y	n	n	n	n	Rippled fine sand w/ shell frags+moderately dense large surf tubes+tube clusters (Diopatra?); assymetrical ripples
39	B	8/27/2010	11:43	86.6	57.4	0.50	Muddy fine sand	n	y	n	y	n	n	n	n	Sed surf appears silty-muddy but SPI shows fine sand; dense large surf tubes across entire image; some small white shells/shell frags

APPENDIX C (CONTINUED)

Plan-View Raw Data

STATION	REP	Date	Time	Length of image (cm)	Height of image (cm)	Field of View imaged (m^2)	Sediment Type	Bedforms	Infauna	Burrows	Tubes	Tracks	Epifauna	Mudclasts	Debris	Comment
40	A	8/27/2010	11:52	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	High turbidity - laser dots and sediment surface not visible
42	C	8/27/2010	13:38	87.4	58	0.51	Muddy fine sand	n	y	n	y	n	n	n	n	Sed surf appears muddy - SPI shows muddy veneer over fine sand; dense large surf tubes+tube clusters (Diopatra or other?)
43	B	8/27/2010	13:34	ind	ind	ind	Muddy fine sand	n	y	n	y	n	n	n	n	Fuzzy image - no lasers; sed surf appears muddy but SPI shows mud veneer over sand; large surf tubes visible in part of image
44	A	8/27/2010	13:09	89.1	59.2	0.53	Fine to medium sand	n	y	n	y	n	y	n	n	Fine to medium sand w/ shell frags and some gravel; dense large surf tubes+tube clusters (Diopatra?); hermit crab@left
45	A	8/27/2010	12:54	92.4	61.3	0.57	Muddy fine sand	n	y	n	y	n	n	n	n	Fuzzy image; SPI shows fine sand w/ muddy surface veneer; large surf tubes+shell frags visible in planview
46	A	8/27/2010	12:05	91.7	57.4	0.53	Silt-clay	n	y	y	y	n	n	n	n	Fuzzy image; SPI shows silt-clay (DM); some tubes+burrow openings visible in planview
49	C	8/28/2010	18:29	92.1	61.1	0.56	Rocks	n	n	n	n	n	y	n	n	Cobble- to boulder-size rocks covered with epifaunal growth (hydroids; colonial bryozoans); patch of sand/gravel; sea star
97_00_4	A	8/28/2010	13:41	96.5	64	0.62	Fine sand	n	y	n	y	n	n	n	n	Slightly muddy fine sand w/ dense large surf tubes (Diopatra?); numerous small shell frags
97_00_6	A	8/28/2010	13:49	96.6	64.1	0.62	Fine sand	n	y	n	y	n	n	n	n	Fine sand w/ very dense large surf tubes+tube clusters: tubes are long, curved, and smooth
97_00_9	A	8/28/2010	17:12	95.1	63	0.60	Red clay	n	y	y	y	n	y	y	n	Red clay w veneer of silt; probably weathered DM clay clumps; scattered pebbles+clay clasts, some with hydroids; numerous burrowing anemones+1 potential burrow opening
2001_2	B	8/28/2010	10:41	93.6	62.1	0.58	Silt-clay	n	y	n	y	n	y	n	y	Silt-clay (SPI shows muddy DM) w/ very dense large surf tubes/tube mats; mix of tubes+detritus; small pile of rocks w/ sea stars; small crab

APPENDIX C (CONTINUED)

Plan-View Raw Data

STATION	REP	Date	Time	Length of image (cm)	Height of image (cm)	Field of View imaged (m²)	Sediment Type	Bedforms	Infauna	Burrows	Tubes	Tracks	Epifauna	Mudclasts	Debris	Comment
2001_3	A	8/28/2010	11:04	87	57.8	0.50	Silt-clay	n	y	n	y	n	n	n	n	Silt-clay w/ very dense large, long, smooth tubes (Assabellides?); tube mat; Podocerid stalks visible on many tubes; a few burrowing anemone visible among tubes
2001_5	C	8/28/2010	8:50	89.7	59.4	0.53	Muddy fine sand	n	y	n	y	n	n	n	n	Sed surf appears muddy but SPI shows thin mud veneer over fine sand; dense large surf tubes+tube clusters (Diopatra?); many small shell frags
2001_6	A	8/28/2010	11:33	91.2	60.5	0.55	Red clay	y	y	y	n	n	n	y	n	Loose red clay w/ scattered clay clasts, pebbles and shell frags; a few burrow openings; large tubes not visible; very subtle assymetrical ripples
2001_8	B	8/28/2010	7:50	84.3	55.7	0.47	Rocks over sand+red clay	n	y	n	y	n	y	n	n	Sed type is highly variable=mixed DM=assorted gravel (pebbles+cobbles) over sand+patch of cohesive red clay; rocks covered with hydroids; sea star; some surf tubes
2002_1	A	8/28/2010	12:45	91	60.4	0.55	Rippled fine sand	y	y	n	y	n	n	n	n	Rippled clean fine sand w/ scattered individual large surf tubes (Diopatra)+a few tube clusters; assymetrical ripples; some shell frags+a few pebbles in trough between sand wave crests
2002_4	A	8/28/2010	12:52	96.6	64.1	0.62	Muddy fine sand	n	y	n	y	n	n	n	n	Fine sand w/ v. dense individual large surf tubes (Diopatra); tubes uniformly spaced across image; Podocerid stalks visible on some tubes; muddy surface veneer=fines trapped among tubes
2002_9	A	8/28/2010	8:20	94.2	62.3	0.59	Rippled fine sand	y	y	n	y	n	n	n	n	Fine sand w/ many tightly-spaced assymetrical ripples; dense large recumbent surf tubes (Diopatra); preferential accumulation of tubes+fines in troughs behind ripples
2002_10	A	8/28/2010	8:11	86.8	57.6	0.50	Rippled fine sand	y	y	n	y	n	n	n	n	Fine sand w/ many tightly-spaced assymetrical ripples; many large recumbent surf tubes (Diopatra); preferential accumulation of tubes+fines in troughs behind ripples; 2 burrowing anemones in upper right corner
2003_5	A	8/28/2010	9:44	87.3	57.9	0.51	Red clay	n	y	n	y	n	n	n	n	Image slightly fuzzy; red clay w/ scattered recumbent large tubes

APPENDIX C (CONTINUED)

Plan-View Raw Data

STATION	REP	Date	Time	Length of image (cm)	Height of image (cm)	Field of View imaged (m^2)	Sediment Type	Bedforms	Infauna	Burrows	Tubes	Tracks	Epifauna	Mudclasts	Debris	Comment
2003_10	A	8/27/2010	16:49	84.2	55.9	0.47	Rocks over red clay	n	n	n	y	n	y	y	n	Mixed gravel (mostly pebbles and cobbles) w/ red color; some red clay clasts/clumps; SPI shows rocks+clay clumps over cohesive red clay; hydroids on some of the rocks
2004_2	A	8/28/2010	11:12	81.6	54.2	0.44	Red clay	y	n	n	n	n	n	y	n	Red clay; surface is mostly smooth w/ low-relief ripples; tops of larger buried cohesive clasts are visible; many smaller clasts; evidence of bio is lacking=relatively fresh material
2004_6	A	8/28/2010	13:02	94.7	62.8	0.59	Muddy fine sand	n	y	n	y	n	n	n	n	Sed surf appears silty but SPI shows muddy fine to medium sand; silty veneer; dense large surf tubes (Diopatra), mostly recumbent; 1 burrowing anemone; Podocerid stalks
2004_9	A	8/28/2010	13:10	101.8	67.6	0.69	Rocks	n	n	n	n	n	y	n	n	Rocks=mixed gravel ranging from granules to boulders; encrusting epifauna=hydroids+bryozoans
2005_4	D	8/28/2010	8:04	96.5	63.9	0.62	Fine sand	y	y	n	y	n	n	n	n	Clean fine sand w/ discontinuous small assymetrical ripples; scattered clusters of large surf tubes (Diopatra), mostly recumbent and in troughs among ripples
2010-01	A	8/25/2010	16:44	85.2	56.6	0.48	Muddy fine sand	n	y	n	y	n	n	n	n	Muddy fine sand w/ dense large tubes+tube clusters (Diopatra?); numerous shell frags
2010-02	B	8/27/2010	15:33	85.3	56.7	0.48	Muddy fine sand	n	y	n	y	n	n	n	n	Muddy fine sand w/ numerous large tubes+tube clusters (Diopatra); many tubes appear to be recumbent; SPI shows clean fine sand w/ muddy surface veneer
2010-03	B	8/27/2010	15:23	81.2	53.8	0.44	Rocks on fine sand	n	n	n	n	n	y	n	n	Fine sand w/ rocks@surf; rocks range from pebbles to boulders; mix of pebbles and shell frags; boulder is covered w/ epifauna (hydroids, bryozoans, barnacles)
2010-04	A	8/27/2010	14:39	84.3	55.9	0.47	Silt-clay	n	y	n	y	n	n	n	n	Silt-clay w/ dense large tubes+tube clusters; silt-clay=muddy dredged material.
2010-05	D	8/27/2010	14:26	87.6	58	0.51	Rippled fine sand	y	y	n	y	n	n	n	n	Clean fine rippled sand; tightly-spaced assymetrical ripples; dense large surf tubes w/ uniform distribution across image (Diopatra or other)

APPENDIX C (CONTINUED)

Plan-View Raw Data

STATION	REP	Date	Time	Length of image (cm)	Height of image (cm)	Field of View imaged (m^2)	Sediment Type	Bedforms	Infauna	Burrows	Tubes	Tracks	Epifauna	Mudclasts	Debris	Comment
2010-06	C	8/27/2010	14:33	87.3	57.9	0.51	Mixed sand and gravel	n	y	n	y	n	n	n	n	Mix of fine to coarse sand and gravel; gravel is mostly granules and pebbles; numerous mussel shells; muddy patch w/ a few large tubes@upper right
2010-07	A	8/27/2010	15:51	90.5	60.1	0.54	Fine sand	y	y	n	y	n	n	n	n	Clean fine sand w/ very small/subtle closely-spaced assymetrical ripples; numerous large surf tubes+ polychaete tube clusters across entire image
2010-08	A	8/27/2010	15:59	89.1	59	0.53	Fine sand	y	y	n	y	n	n	n	n	Clean fine sand w/ small/subtle closely-spaced assymetrical ripples; scattered large surf tubes (Diopatra or other?); image is somewhat fuzzy
2010-09	A	8/27/2010	16:26	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	High turbidity - laser dots and sediment surface not visible
2010-10	B	8/27/2010	16:10	87	57.7	0.50	Fine sand	y	y	n	y	n	n	n	n	Clean fine rippled sand; ripples are subtle and assymetrical; dense large surf tubes+tube clusters (Diopatra?); small patches of mud+detritus trapped among tubes
2010-11	A	8/27/2010	16:57	62.5	41.4	0.26	Rocks	n	n	n	n	n	y	n	n	Boulder-sized rocks covered w/ dense growth of epifauna (hydroids, bryozoans, etc.); boulders are very angular
2010-12	A	8/27/2010	14:03	84.5	56.1	0.47	Fine sand	y	y	n	y	n	n	n	n	Image somewhat fuzzy; SPI shows fine sand w/ patches and/or surface veneer of red clay; planview shows pebbles+shellf frags and a few scattered large surf tubes; ripple crest in upper left corner
2010-13	A	8/28/2010	9:07	ind	ind	ind	Rocks	ind	ind	ind	ind	ind	ind	ind	ind	Image is fuzzy; several cobble to boulder sized rocks are visible; SPI shows both silty DM (1 rep) and rocks (2 reps)
2010-14	A	8/28/2010	8:30	92.6	61.4	0.57	Fine sand	n	y	n	y	n	n	n	n	Fine sand w/ patches of red clay; red clay looks like surface veneer deposit (deposition of red clay fines); shell frags; dense large surf tubes+tube clusters (Diopatra or other)
2010-15	A	8/28/2010	9:14	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	High turbidity - laser dots and sediment surface not visible; SPI shows soft red clay DM

APPENDIX C (CONTINUED)

Plan-View Raw Data

STATION	REP	Date	Time	Length of image (cm)	Height of image (cm)	Field of View imaged (m²)	Sediment Type	Bedforms	Infauna	Burrows	Tubes	Tracks	Epifauna	Mudclasts	Debris	Comment
2010-16	A	8/28/2010	12:35	90.8	60.3	0.55	Red clay clumps	n	n	n	y	n	y	y	n	Numerous large and small cohesive clay clasts and some pebbles+shell frags; v. high boundary roughness; a few long thin tube-like growths on large clast=tubes or hydroids, shrimp just above sediment surface
2010-17	B	8/28/2010	11:24	89.4	59.3	0.53	Rocks on red clay	n	y	n	y	n	y	n	n	Cobble-sized rocks over cohesive red clay; rocks covered w/ hydroids; several sea stars; shrimp in upper left corner; small tubes, mostly in upper right quadrant
2010-18	A	8/28/2010	10:26	96.6	64	0.62	Red clay	n	y	n	y	n	n	y	n	Image somewhat fuzzy; Numerous cohesive red clay clumps w/ unconsolidated red clay in interstitial spaces; SPI shows large tubes present
2010-19	A	8/28/2010	10:14	91.3	60.5	0.55	Muddy fine sand	n	y	n	y	n	n	n	n	Fine sand w/ patches of fines trapped among surf tubes; dense large surf tubes+tubes clusters (Diopatra?); numerous small white shells (Nucula?); several burrowing anemones
E0800	A	8/25/2010	16:06	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	High turbidity - laser dots and sediment surface not visible
G-1200	B	8/27/2010	15:14	84.1	55.8	0.47	Muddy fine sand	n	y	n	y	n	n	n	n	Muddy fine sand w/ dense large surf tubes+tube clusters (Diopatra?); left one-third of image obscured by turbidity
L1200	A	8/28/2010	8:59	94.1	62.4	0.59	Muddy fine sand	n	y	n	y	n	n	n	n	Muddy fine sand w/ dense large surf tubes+tube clusters (Diopatra?); SPI shows mud is red clay fines deposited as thin veneer of sand
NOREMED_1	A	8/28/2010	10:04	92.7	61.4	0.57	Medium to coarse sand	n	y	n	y	n	n	n	n	Medium to coarse sand w/ dense large surf tubes (Diopatra?); a few patches of gravel (granules+pebbles)
NOREMED_2	A	8/28/2010	17:57	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	High turbidity - laser dots and sediment surface not visible
NOREMED_3	A	8/28/2010	16:05	93.6	62.1	0.58	Muddy fine sand	n	y	n	y	n	y	n	n	Fine sand w/ gravel+shell frags; patch of mixed gravel (pebbles+1 cobble)@bottom of frame; hydroids growing on rocks; small tubes and/or tube clusters in finer sed at top

APPENDIX C (CONTINUED)

Plan-View Raw Data

STATION	REP	Date	Time	Length of image (cm)	Height of image (cm)	Field of View imaged (m^2)	Sediment Type	Bedforms	Infauna	Burrows	Tubes	Tracks	Epifauna	Mudclasts	Debris	Comment
NOREMED_4	A	8/28/2010	13:28	88.9	58.9	0.52	Silt-clay	n	y	n	y	n	n	n	n	Silt-clay w/ very dense large surf tubes+tube clusters (approaching tube mat status); Asabellides?; SPI shows silt-clay is surface layer of fine to medium sand
NOREMED_5	A	8/28/2010	16:32	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	High turbidity - laser dots and sediment surface not visible
P2800	A	8/28/2010	13:19	89.3	59.2	0.53	Silt-clay	n	y	n	y	n	n	n	n	Silt-clay w/ very dense large long smooth surf tubes+tube clusters; SPI shows silt-clay is surface layer over sand

APPENDIX D

Number of Individuals of each Taxon per m^2 at each of the 20 Stations

Taxa	**2010-03**	**2010-01**	**7**	**2010-10**	**2010-08**	**2010-07**	**2010-06**	**2010-05**	**G-1200**	**2010-02**	**E0800**	**20**	**24**	**34**	**31**	**01**	**02**	**09**	**17**	**40**
Ennucula tenuis	650	38500	5075	475	50	50	250	25	45200	1150	8425	0	50	250	10700	75	2550	25425	200	115500
Polygordius (LPIL)	25	0	275	75	525	100	0	275	0	3400	500	200	3550	15925	250	250	0	675	175	0
Asabellides oculata	350	675	300	2275	150	750	250	1525	800	250	100	1900	300	550	525	250	0	350	25	0
Polynoidae (LPIL)	0	50	0	0	0	0	9450	25	0	0	0	0	0	0	0	0	0	0	0	50
Ampelisca abdita	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8575
Tubificidae (LPIL)	0	200	550	75	0	0	1375	400	0	500	50	75	0	1975	0	0	100	625	25	200
Glycera (LPIL)	0	0	250	0	375	325	825	1725	0	500	0	325	550	550	300	50	0	125	150	0
Unciola irrorata	450	2075	0	275	375	125	75	325	400	450	0	100	50	250	50	100	75	525	150	175
Levinsenia gracilis	0	150	0	0	0	0	0	0	300	0	575	50	0	0	125	0	600	300	0	3050
Mediomastus (LPIL)	0	1175	525	0	50	0	125	225	425	0	1650	25	0	0	0	25	125	150	0	0
Pseudunciola obliquua	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4500	0	0	0	0
Monticellina baptisteae	0	0	0	0	0	0	0	0	0	0	0	0	0	50	0	0	3300	0	25	25
Cirratulidae (LPIL)	0	75	0	0	25	0	100	0	100	0	0	0	0	125	0	25	1250	1350	50	200
Clymenella torquata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2125	775	0	50
Cossura soyeri	0	0	0	0	0	0	0	0	425	0	0	0	0	0	0	0	575	0	0	1825
Pellucistoma (LPIL)	0	125	725	25	325	75	0	0	150	50	0	0	0	0	400	0	75	450	25	200
Maldanidae (LPIL)	0	0	0	0	0	0	0	0	25	0	50	0	0	50	25	0	1150	1075	0	225
Tharyx acutus	0	0	125	0	0	0	25	0	125	0	225	0	0	200	25	75	725	875	0	25
Edotia montosa	25	50	50	575	100	300	200	225	25	0	0	200	250	0	100	75	0	0	175	0
Tellina (LPIL)	125	750	50	0	0	50	250	75	575	125	50	50	0	0	0	100	0	0	50	0
Tellina agilis	100	75	225	225	25	0	0	200	0	400	0	125	150	0	625	50	0	50	0	0
Aricidea catherinae	25	350	325	0	0	25	75	25	50	50	100	0	0	150	75	0	500	225	0	150
Eusarsiella zostericola	0	125	50	0	0	0	0	0	475	50	250	0	0	0	75	0	300	500	0	300
Capitellidae (LPIL)	0	0	175	0	250	275	700	100	0	25	200	0	100	0	75	0	25	25	0	0
Glycera robusta	0	0	75	0	50	100	850	0	0	50	25	0	375	0	325	0	0	0	0	0
Scoletoma hebes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	75	0	925	750	0	0

Number of Individuals of each Taxon per m^2 at each of the 20 Stations

Taxa	**2010-03**	**2010-01**	**7**	**2010-10**	**2010-08**	**2010-07**	**2010-06**	**2010-05**	**G-1200**	**2010-02**	**E0800**	**20**	**24**	**34**	**31**	**01**	**02**	**09**	**17**	**40**
Pitar morrhuanus	0	725	75	0	0	0	0	0	400	0	0	0	0	0	0	0	250	100	0	75
Scoletoma (LPIL)	0	50	25	0	0	0	0	0	75	0	375	0	0	0	25	0	0	0	0	1025
Spisula solidissima	0	0	0	175	150	125	75	300	0	125	0	100	250	0	0	225	0	25	0	25
Ampharetidae (LPIL)	0	50	325	150	25	75	25	25	100	50	200	0	0	25	175	0	125	25	0	100
Aphelochaeta marioni	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1250	225	0	0
Aricidea (LPIL)	50	0	0	0	0	25	0	75	0	0	525	0	0	50	0	0	0	300	25	325
Aphelochaeta (LPIL)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1250	0	0	0
Bivalvia (LPIL)	0	75	200	75	0	0	0	100	100	75	100	25	0	50	50	0	200	150	0	50
Ninoe nigripes	0	25	0	0	0	0	0	0	25	0	125	0	0	0	50	0	125	200	0	700
Pholoe minuta	0	150	50	0	0	0	0	0	75	0	25	0	0	0	0	0	600	150	0	200
Scoletoma acicularum	100	125	25	50	50	50	25	25	25	125	100	50	0	200	125	0	0	0	50	25
Harmothoe imbricata	0	150	0	0	25	0	100	0	50	0	250	0	0	100	50	0	0	50	0	325
Nemertea (LPIL)	25	50	125	50	0	25	0	50	50	50	0	75	50	0	175	25	100	150	25	50
Rhepoxynius hudsoni	0	50	0	125	250	0	0	0	0	0	0	500	0	0	75	0	0	0	75	0
Dipolydora caulleryi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1025	0	0	25
Spio filicornis	0	0	0	0	0	0	0	75	0	0	0	25	0	0	125	0	0	650	0	0
Spiophanes bombyx	25	25	50	25	25	100	0	25	25	50	0	150	75	0	125	25	75	25	25	0
Chiridotea tuftsi	0	0	0	200	0	0	0	0	0	0	0	0	0	0	0	600	0	0	25	0
Monticellina dorsobranchialis	0	75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	725	0	0	25
Nephtys incisa	25	50	25	0	0	25	0	0	225	0	0	0	0	0	0	0	250	175	0	50
Periploma papyratium	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	250	375	0	150
Clinocardium ciliatum	25	75	0	25	0	0	25	25	50	0	75	0	0	0	25	0	0	50	0	350
Mytilus edulis	225	175	0	25	0	0	0	0	0	75	100	0	0	0	75	0	0	0	0	25
Polydora cornuta	0	25	350	0	0	0	25	0	50	0	0	50	25	50	0	0	0	0	0	0
Diastylis polita	25	0	0	50	0	0	0	0	0	0	0	0	0	0	375	0	0	100	0	0

APPENDIX D (CONTINUED)

Number of Individuals of each Taxon per m^2 at each of the 20 Stations

Taxa	2010-03	2010-01	7	2010-10	2010-08	2010-07	2010-06	2010-05	G-1200	2010-02	E0800	20	24	34	31	01	02	09	17	40
Glycera dibranchiata	100	25	25	25	0	50	50	0	0	0	50	25	25	50	75	0	0	0	25	0
Leptocheirus pinguis	0	0	0	0	0	0	0	0	25	0	0	0	0	0	0	0	75	25	0	400
Rhepoxynius (LPIL)	0	0	0	0	0	200	0	0	0	0	0	0	0	0	0	325	0	0	0	0
Actiniaria (LPIL)	0	0	0	0	0	0	0	25	0	0	0	0	0	25	0	0	50	400	0	0
Goniadella gracilis	0	0	0	0	0	0	0	0	0	0	0	0	25	425	0	0	0	0	0	0
Unciola (LPIL)	0	0	50	0	25	0	25	0	0	175	0	50	0	0	0	0	0	0	0	125
Ampharete finmarchica	25	0	0	25	0	0	25	0	25	0	150	0	0	50	25	0	25	0	0	25
Nephtyidae (LPIL)	0	0	25	0	0	25	0	25	25	25	0	125	0	50	0	25	0	0	25	25
Phyllodocidae (LPIL)	0	75	25	0	0	25	25	100	0	0	0	0	0	50	25	0	0	0	25	25
Ceriantharia (LPIL)	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	325
Nephtys (LPIL)	25	0	0	25	0	25	0	0	0	0	0	0	50	0	25	175	0	0	25	0
Pherusa affinis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	25	0	300
Protohaustorius wigleyi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	350	0	0	0	0
Sabellidae (LPIL)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	350	0	0	0
Yoldia (LPIL)	0	225	0	0	0	0	0	0	100	0	0	0	0	0	25	0	0	0	0	0
Yoldia limatula	0	50	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	200	0	0
Ilyanassa trivittata	25	25	50	0	0	0	0	25	25	0	0	25	0	0	75	0	0	0	0	50
Owenia fusiformis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	250	0	0	50
Prionospio (LPIL)	0	0	50	0	0	0	0	0	0	0	50	0	0	0	25	0	75	100	0	0
Terebellidae (LPIL)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	300
Chiridotea excavata	0	0	0	0	0	0	0	0	0	0	0	50	225	0	0	0	0	0	0	0
Yoldia sapotilla	0	0	100	0	0	0	0	0	0	0	25	0	0	0	0	0	75	0	0	75
Ampelisca (LPIL)	75	25	0	25	25	0	0	0	25	0	0	0	0	25	0	0	0	25	0	25
Erichthonius brasiliensis	0	0	0	0	0	0	0	200	0	0	0	0	0	0	0	0	0	0	0	50
Leptocheirus (LPIL)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	200	0	0	50
Phoronis (LPIL)	0	0	0	25	0	0	0	0	125	0	75	0	0	0	0	0	0	0	0	0

APPENDIX D (CONTINUED)

Number of Individuals of each Taxon per m^2 at each of the 20 Stations

Taxa	2010-03	2010-01	7	2010-10	2010-08	2010-07	2010-06	2010-05	G-1200	2010-02	E0800	20	24	34	31	01	02	09	17	40
Thyasira gouldii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100	0	0	125
Aricidea wassi	0	0	25	25	50	25	25	0	0	0	0	0	0	0	0	25	0	25	0	0
Corophiidae (LPIL)	0	125	0	0	0	50	0	25	0	0	0	0	0	0	0	0	0	0	0	0
Enchytraeidae (LPIL)	0	0	0	0	0	0	0	0	0	0	0	0	0	200	0	0	0	0	0	0
Fimbriosthenelais (LPIL)	0	0	0	25	0	25	0	0	0	0	0	0	0	0	0	50	0	100	0	0
Glyceridae (LPIL)	0	75	125	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Parougia caeca	0	0	0	0	25	0	25	50	0	0	0	25	0	50	0	25	0	0	0	0
Photis (LPIL)	0	0	0	0	0	0	0	0	75	0	0	0	0	0	0	0	25	0	0	100
Phyllodoce (LPIL)	25	50	0	0	0	0	0	0	25	25	0	0	0	0	0	0	50	0	0	0
Tanaissus psammophilus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	175	0	0	0	0
Ampelisca vadorum	0	0	0	0	0	0	0	0	0	0	100	25	0	0	0	0	25	0	0	0
Dulichia porrecta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	50	0	75
Ensis directus	0	0	0	75	0	0	0	0	0	0	0	25	25	0	25	0	0	0	0	0
Harpinia propinqua	0	0	0	0	0	0	0	0	0	0	150	0	0	0	0	0	0	0	0	0
Tellinidae (LPIL)	0	0	0	0	0	0	0	0	0	75	75	0	0	0	0	0	0	0	0	0
Anachis lafresnayi	25	0	0	0	0	0	0	0	0	0	0	75	0	0	0	0	0	0	0	25
Arctica islandica	0	25	0	0	0	0	0	0	0	0	0	0	0	0	50	0	0	50	0	0
Asteroidea (LPIL)	0	0	0	0	25	0	25	0	0	0	0	25	0	0	0	50	0	0	0	0
Chone infundibuliformis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100	0	0	25
Exogone hebes	0	0	0	0	0	0	0	0	0	0	0	0	0	125	0	0	0	0	0	0
Ischyrocerus anguipes	0	0	0	0	0	0	25	0	0	0	0	100	0	0	0	0	0	0	0	0
Mediomastus californiensis	0	0	0	0	0	0	0	50	75	0	0	0	0	0	0	0	0	0	0	0
Cancer irroratus	0	25	25	0	0	0	25	0	0	0	25	0	0	0	0	0	0	0	0	0
Cossuridae (LPIL)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100	0	0	0
Diastylis sculpta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	75	0	0	25	0	0

APPENDIX D (CONTINUED)

Number of Individuals of each Taxon per m^2 at each of the 20 Stations

Taxa	2010-03	2010-01	7	2010-10	2010-08	2010-07	2010-06	2010-05	G-1200	2010-02	E0800	20	24	34	31	01	02	09	17	40
Gastropoda (LPIL)	0	0	0	0	0	0	0	0	25	0	50	0	0	0	0	0	0	25	0	0
Pectinidae (LPIL)	0	0	0	25	0	25	0	25	0	0	0	25	0	0	0	0	0	0	0	0
Phoxocephalidae (LPIL)	0	0	0	50	0	0	0	0	0	0	0	25	0	0	0	0	0	0	0	25
Podoceridae (LPIL)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100
Polycirrus (LPIL)	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0	0	75	0	0	0
Scalibregma inflatum	25	0	0	0	0	0	0	0	0	0	50	25	0	0	0	0	0	0	0	0
Sigalionidae (LPIL)	0	0	0	0	25	0	25	0	0	0	0	0	0	0	0	25	25	0	0	0
Syllidae (LPIL)	0	0	0	0	0	0	25	0	0	0	50	0	0	0	0	0	0	25	0	0
Aoridae (LPIL)	0	0	0	0	0	0	0	0	0	25	25	0	0	0	0	0	0	0	0	25
Cossura (LPIL)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	75	0	0
Diastylidae (LPIL)	75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ischyroceridae (LPIL)	0	50	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leitoscoloplos (LPIL)	25	0	25	0	0	0	0	0	0	0	0	0	0	0	25	0	0	0	0	0
Mysidae (LPIL)	0	0	0	0	0	0	50	0	0	0	0	0	0	0	0	25	0	0	0	0
Notocirrus spiniferus	0	0	0	0	0	0	0	0	0	0	0	75	0	0	0	0	0	0	0	0
Oxyurostylis smithi	0	0	0	0	0	0	25	0	0	0	25	25	0	0	0	0	0	0	0	0
Acteocina canaliculata	0	0	0	0	0	0	0	0	50	0	0	0	0	0	0	0	0	0	0	0
Apocorophium acutum	0	0	0	50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diastylis (LPIL)	0	0	0	0	0	0	0	0	50	0	0	0	0	0	0	0	0	0	0	0
Dipolydora socialis	0	0	0	0	0	0	0	0	0	0	50	0	0	0	0	0	0	0	0	0
Drilonereis longa	0	0	0	0	0	0	0	0	0	0	25	0	0	0	0	0	25	0	0	0
Echinoidea (LPIL)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	0	0	0	0
Hippomedon serratus	0	0	0	0	0	25	0	0	0	0	0	0	0	0	0	25	0	0	0	0
Mactridae (LPIL)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	0
Mediomastus ambiseta	0	0	0	0	0	0	0	0	0	0	50	0	0	0	0	0	0	0	0	0
Monocorophium (LPIL)	0	0	0	0	0	0	0	0	0	0	50	0	0	0	0	0	0	0	0	0

APPENDIX D (CONTINUED)

Number of Individuals of each Taxon per m^2 at each of the 20 Stations

Taxa	2010-03	2010-01	7	2010-10	2010-08	2010-07	2010-06	2010-05	G-1200	2010-02	E0800	20	24	34	31	01	02	09	17	40
Nephtys bucera	0	0	0	0	0	25	0	0	0	0	0	0	25	0	0	0	0	0	0	0
Pherusa (LPIL)	0	0	0	0	0	0	25	0	0	0	0	0	0	25	0	0	0	0	0	0
Pherusa plumosa	0	0	0	0	0	0	0	0	0	0	0	0	0	50	0	0	0	0	0	0
Pholoe (LPIL)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	0	0
Pleurogonium (LPIL)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0	25
Podocopida (LPIL)	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25
Sabellaria vulgaris	0	0	0	25	0	0	0	0	0	0	25	0	0	0	0	0	0	0	0	0
Aeginellidae (LPIL)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25
Ampeliscidae (LPIL)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0	0	0	0
Arabella iricolor	0	0	0	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0
Argissa hamatipes	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Axiothella catenata	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0	0	0	0	0
Brada villosa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25
Calyptraea centralis	0	0	0	0	0	0	0	0	0	0	0	25	0	0	0	0	0	0	0	0
Calyptraeidae (LPIL)	0	0	0	0	0	0	0	0	0	0	25	0	0	0	0	0	0	0	0	0
Caulleriella sp. J	0	0	0	0	0	0	0	0	0	0	0	25	0	0	0	0	0	0	0	0
Chaetopteridae (LPIL)	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chiridotea (LPIL)	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0	0	0	0	0	0
Crangon septemspinosa	0	0	0	0	0	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0
Crepidula (LPIL)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0	0	0
Crepidula plana	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Decapoda (LPIL)	0	0	0	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0
Goniadidae (LPIL)	0	0	0	0	0	0	0	0	0	0	25	0	0	0	0	0	0	0	0	0
Hartmania moorei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0	0
Hypereteone fauchaldi	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leucon americanus	0	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

APPENDIX D (CONTINUED)

Number of Individuals of each Taxon per m^2 at each of the 20 Stations

Taxa	**2010-03**	**2010-01**	**7**	**2010-10**	**2010-08**	**2010-07**	**2010-06**	**2010-05**	**G-1200**	**2010-02**	**E0800**	**20**	**24**	**34**	**31**	**01**	**02**	**09**	**17**	**40**
Lumbrineridae (LPIL)	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lyonsia hyalina	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0	0
Lysianassidae (LPIL)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25
Magelona (LPIL)	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Magelona pettiboneae	0	0	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Metopella angusta	0	0	0	0	0	0	0	0	0	0	0	25	0	0	0	0	0	0	0	0
Microphthalmus (LPIL)	0	0	0	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0
Microprotopus raneyi	0	0	0	0	0	0	0	0	0	0	0	25	0	0	0	0	0	0	0	0
Monocorophium acherusicum	0	0	0	0	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0
Monocorophium tuberculatum	0	0	0	0	0	0	0	0	0	0	0	25	0	0	0	0	0	0	0	0
Mytilidae (LPIL)	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nereiphylla fragilis	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oenonidae (LPIL)	0	0	0	0	0	0	0	0	0	0	25	0	0	0	0	0	0	0	0	0
Onuphidae (LPIL)	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0	0	0	0	0
Pandora (LPIL)	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0	0	0	0	0
Pectinaria gouldii	0	0	0	0	0	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0
Phyllodoce mucosa	0	0	0	0	0	0	0	0	0	0	0	25	0	0	0	0	0	0	0	0
Politolana (LPIL)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0
Proceraea cornuta	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pseudoleptocuma minor	0	0	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rictaxis punctostriatus	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scoloplos (LPIL)	0	0	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Siliqua costata	0	0	0	0	0	0	0	0	0	0	0	25	0	0	0	0	0	0	0	0
Spio (LPIL)	0	0	0	0	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0
Spiochaetopterus oculatu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25

APPENDIX D (CONTINUED)

Number of Individuals of each Taxon per m^2 at each of the 20 Stations

Taxa	2010-03	2010-01	7	2010-10	2010-08	2010-07	2010-06	2010-05	G-1200	2010-02	E0800	20	24	34	31	01	02	09	17	40
Spionidae (LPIL)	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stenothoidae (LPIL)	0	0	0	0	0	0	0	0	0	0	0	25	0	0	0	0	0	0	0	0
Terebellides stroemi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25
Thraciidae (LPIL)	0	0	0	0	0	0	0	0	0	0	25	0	0	0	0	0	0	0	0	0
Travisia parva	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0	0	0
Turbellaria (LPIL)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0	0	0