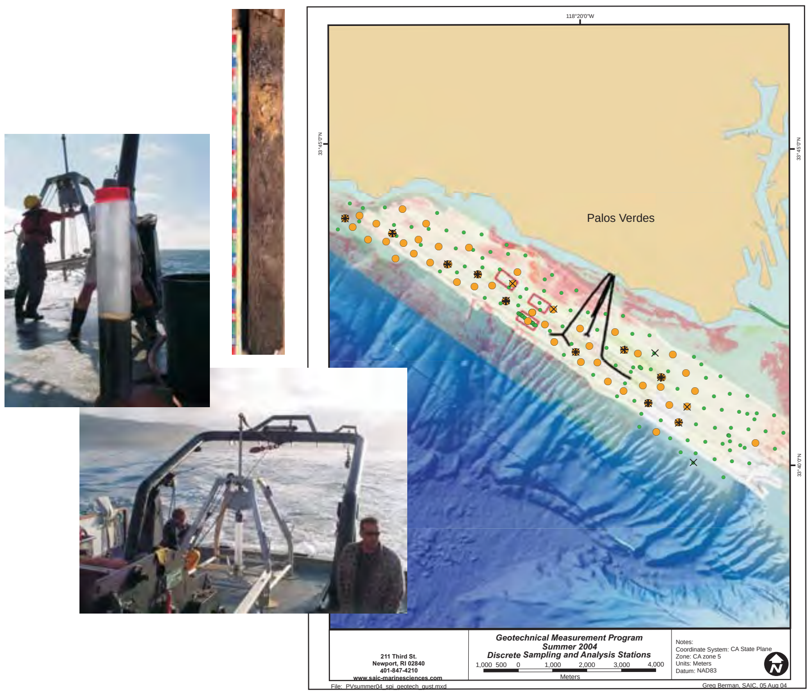
Data Report for the Summer 2004 Geotechnical Measurement Program Conducted on the Palos Verdes Shelf



June 2005

Prepared for:

U.S. Army Corps of Engineers
Los Angeles District
915 Wilshire Boulevard
Los Angeles, CA 90017

U.S. Environmental Protection Agency
Region IX
Superfund Division (SFD-7-1)
75 Hawthorne Street
San Francisco, CA 94105

Prepared by:

Science Applications International Corporation
221 Third Street
Newport, RI 02840

SAIC Report Number 676

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1.0 INTRODUCTION

A Preliminary Study Plan (PSP; SAIC 2004a) was developed under a prior Work Order to specify technical objectives and activities for the multi-disciplinary field investigations that were conducted from the late winter through the summer of 2004 to acquire data for scientific assessments and modeling of potential sediment resuspension and transport as it relates to possible future capping on the Palos Verdes (PV) Shelf. The PSP was reviewed and finalized by a technical team led by the U.S. Environmental Protection Agency (EPA), and including technical experts from the U.S. Army Corps of Engineers (USACE) and the U.S. Geological Survey (USGS). The PSP identified four main field sampling programs and also described the primary field components associated with each of those programs.

The four main elements of the 2004 field investigations on the PV Shelf are outlined below. Additional technical review meetings held prior to the start of the respective field programs further defined and refined the proposed sampling plans and techniques that had been developed within the PSP. Ultimately, draft Investigation Work Plans (IWP) reflecting the final sampling design were developed for each of these field programs and submitted to the EPA prior to the start of the field sampling effort. As outlined below, the initial field sampling and data acquisition operations have been completed for each of these four elements. Though the initial analysis and reporting requirements discussed below will focus on each of these four separate elements independently, it is expected that eventually the results from each of these elements will be examined collectively and combined within a synthesis report.

Element 1 - *Field investigation to assess the oceanographic conditions across the PV Shelf and Upper Slope***.** This field program began in late February 2004 with the initial deployment of oceanographic instrumentation and moorings as a joint collaboration between Science Applications International Corporation (SAIC) and the USGS. Instruments and moorings were serviced (e.g., cleaned, data downloaded, new batteries installed, etc.) periodically over the approximately four-month deployment period. All instrumentation was retrieved for the final time in early July 2004. Data processing, analysis, synthesis with Los Angeles County Sanitation District (LACSD) data, and eventual input to numerical models will be performed under subsequent work orders.

Element 2 - *Field investigation to assess spatial variations in geotechnical properties of sediments on the PV Shelf and Upper Slope*. This field program began in late June 2004 with the acquisition of acoustic side-scan sonar data. After a quick review of the side-scan sonar data, an extensive sediment profile and plan-view imaging survey was conducted in mid-July. The field program was completed in late July after eight days of gravity coring and related geotechnical analyses to assess the erodibility of near-surface sediments across the PV Shelf.

Element 3 - *Field investigation to characterize large bioturbating infaunal organisms and to conduct sediment dating on the PV Shelf*. This field program began in late July 2004 and extended through early August 2004. The primary field investigation entailed extensive box-coring operations and subsequent analysis of large bioturbating organisms. In addition, multiple gravity cores were collected at several of the key bioturbation sampling stations so that detailed radiometric dating analyses could be conducted.

Element 4 - Field *investigation on the existing pilot cap to assess the degree of Effluent-Affected-material resuspension that occurred during cap placement in 2000*. This field program extended over four days in mid-July 2004 and entailed the collection of numerous cores within Pilot Cap Cell SU. In addition, a small coring comparison survey was also conducted between the primary corer used during this program and the LACSD corer that has been used for many past PV sampling operations. Because of funding limitations, the extensive chemical and geotechnical laboratory analyses that will be conducted on these core samples was not included within the scope for the initial field program.

1.1 OBJECTIVES

The primary objective of the geotechnical field measurement element was to more completely and accurately map the geotechnical properties of the near-surface sediments across the PV Shelf and Upper Slope, specifically within the region that will later be modeled for predictions of erosion and transport of ambient sediments and cap material; this task has typically been referred to as the Geotechnical Measurement Program. Past broad-scale surveying and fine-scale sampling efforts on the PV Shelf have helped to characterize the extent of the contaminated sediment layers and also the general physical characteristics of the seafloor throughout this area (Continental Shelf Research 2002). For the 2004 measurement program, the goal was to more completely assess the potential erodibility of the near-surface sediment layer across the Shelf by providing a detailed analysis of the fine-scale differences and spatial variability in near-surface sediment properties (e.g., resistivity, grain-size, etc.). Specifically, the primary intent of the Geotechnical Measurement Program was to address the following questions set forth in the IWP:

1) ***What is the small-scale variability in the erodibility (and other geotechnical properties) of the near-surface sediments across the PV Shelf?***
2) ***How well can existing rapid sampling techniques be used to measure or predict the erodibility of the near-surface sediments?***
3) ***What is the extent of the seasonal differences in the geotechnical properties of the near-surface sediments (if a second field study is conducted in the alternate season)?***

The detailed geotechnical data generated through this effort will be used in conjunction with the data obtained from the oceanographic measurement program to address the questions above, which will be critical for the subsequent numerical modeling of sediment resuspension, transport, and cap stability.

2.0 METHODS

A PSP (SAIC 2004a) was developed under a prior Work Order to specify technical objectives and activities for multi-disciplinary field investigations that were conducted from the late winter through the summer of 2004 to acquire data for scientific assessments and modeling of potential sediment resuspension and transport as it relates to possible future capping on the PV Shelf. The PSP was reviewed and finalized by a technical team, led by the USEPA and including technical experts from the USACE and the USGS. The PSP identified four main field sampling programs and described the primary field components associated with each of those programs.

For the Geotechnical Measurement Program, additional technical review meetings were held in late winter and early spring to further define and refine the proposed sampling plans and techniques that had been developed within the PSP. Ultimately, a draft IWP reflecting the final sampling design was developed for the geotechnical field program and submitted to the EPA prior to the start of the field sampling effort. A final conference call with the members of the government's technical review group was held on 26 May 2004 to review and discuss the final sampling plans as they had been developed and presented in the draft IWP. During this meeting a general consensus was reached on the main field sampling elements outlined in the draft IWP and shortly after this meeting the IWP was finalized (SAIC 2004b). Because of late summer project commitments for key sub-contractors, it became evident during this final meeting that the sequence of field events needed to begin promptly in order to complete all of the elements that had been planned. An overview of the major scheduling milestones for the Geotechnical Program is provided in Table 2.0-1.

As part of the 2004 oceanographic measurement program on the PV Shelf, subcontracts had already been established for the charter of the three Southern California Marine Institute (SCMI) survey vessels (R/V *Seawatch,* R/V *Yellow Fin, and* R/V *Vantuna*) to support the various field survey activities throughout this project. In addition, interior laboratory space and exterior work areas at the SCMI were leased for a four-month period to provide adequate work areas for mobilization, equipment servicing, and sample processing activities. A 40-ft shipping container was leased and situated at the SCMI facility to provide additional secure storage space for both SAIC and subcontractor equipment. Additional mobilization activities included the shipping, testing, and final preparation of the required equipment for all of the varied sampling and survey activities. In addition, subcontracts were established with Oregon State University (OSU), the University of Virginia (UVA), and Applied Marine Sciences, Inc. (AMS) for key technical support during the different phases of the geotechnical measurement program.

The field measurement program was implemented in accordance with the specifications of the Final PSP (SAIC 2004a) and the Final IWP (SAIC 2004b) and was conducted from mid-June through late-July 2004 (Table 2.0-1). The field program began with the acquisition of acoustic side-scan sonar data. After a quick review of the side-scan sonar data, an extensive sediment profile and plan-view imaging survey was conducted in mid-July. The field program was completed in late July after eight days of gravity coring and related geotechnical analyses to assess the erodibility of near-surface sediments across the PV Shelf. A discussion of the data acquisition and initial processing methods employed during each of the major field elements is provided below.

Table 2.0-1. Summary of Geotechnical Survey and Sampling Operations along the Palos Verdes Shelf during the Summer 2004

Date	Day Type	Comments
6/22/2004	Mob	Mob side-scan sonar, sonar acquisition software, and deck winch at the SAIC facility in San Diego
6/23/2004	Transit / Mob	Transport survey gear to SCMI and mob aboard the *Yellowfin*
6/24/2004	Side-scan Survey	Conduct side-scan sonar survey operations along the PV Shelf aboard the *Yellowfin*
6/25/2004	Side-scan Survey	Conduct side-scan sonar survey operations along the PV Shelf aboard the *Yellowfin*
6/26/2004	Side-scan Survey	Conduct side-scan sonar survey operations along the PV Shelf aboard the *Yellowfin* Towfish cable problems at the end of the day / re-terminate wet connector overnight
6/27/2004	Side-scan Survey	Complete side-scan sonar survey operations along the PV Shelf aboard the *Yellowfin* Towfish problems continued / slip ring, winch cable problems continue
6/28/2004	Demob	Remove side-scan sonar gear and unspool side-scan cable in preparation for water sampling ops
7/7/2004	Mob / Transit	Travel to SCMI and begin to mob Sediment Profile and Plan-view camera systems on the *SeaWatch*
7/8/2004	Mob / Test	Complete the camera mob on the *SeaWatch* and collect sample images in LA Harbor
7/9/2004	SPI / Plan-view Survey	Conduct Sediment Profile and Plan-View Image survey ops on the PV Shelf aboard the *SeaWatch*
7/10/2004	SPI / Plan-view Survey	Conduct Sediment Profile and Plan-View Image survey ops on the PV Shelf aboard the *SeaWatch*
7/11/2004	SPI / Plan-view Survey	Conduct Sediment Profile and Plan-View Image survey ops on the PV Shelf aboard the *SeaWatch*
7/12/2004	SPI / Plan-view Survey	Complete Sediment Profile and Plan-View Image survey ops on the PV Shelf aboard the *SeaWatch*
7/13/2004	Demob	Remove camera frame and navigation equipment from the *SeaWatch* / prepare for shipping
7/13/2004	Mob	Mobilize OSU corer and navigation aboard the *Vantuna* / mob core handling lab within SCMI
7/14/2004	Core Sampling	Conduct geochemistry core sampling in Cell SU
7/15/2004	Core Sampling	Conduct geochemistry core sampling in Cell SU
7/16/2004	Core Sampling	Conduct geochemistry core sampling in Cell SU / demob OSU corer from the *Vantuna*
7/17/2004	Core Sampling	Conduct comparison core sampling using LACSD piston corer on the *Vantuna* / remob OSU corer Mobilize OSU corer and resistivity profiler and UVA Gust Chamber aboard the *Vantuna*
7/18/2004	Core Sampling	Conduct core sampling, resistivity profiling, Gust Chamber analyses, and sediment dating sampling
7/19/2004	Core Sampling	Conduct core sampling, resistivity profiling, Gust Chamber analyses, and sediment dating sampling
7/20/2004	Core Sampling	Conduct core sampling, resistivity profiling, Gust Chamber analyses, and sediment dating sampling
7/21/2004	Core Sampling	Conduct core sampling, resistivity profiling, Gust Chamber analyses, and sediment dating sampling
7/22/2004	Data Review	Review previous core sampling results and plan final four days of sampling and analyses
7/23/2004	Core Sampling	Conduct core sampling, resistivity profiling, Gust Chamber analyses, and sediment dating sampling
7/24/2004	Core Sampling	Conduct core sampling, resistivity profiling, Gust Chamber analyses, and sediment dating sampling
7/25/2004	Core Sampling	Conduct core sampling, resistivity profiling, Gust Chamber analyses, and sediment dating sampling
7/26/2004	Core Sampling	Complete core sampling, resistivity profiling, Gust Chamber analyses, and sediment dating sampling
7/27/2004	Demob	Remove coring gear and related analyses equipment from the *Vantuna* and prepare for shipment Demobilize SCMI core handling lab and prepare gear for shipment

Navigation and Survey Control

During all field sampling operations, the survey vessels were equipped with a Trimble DSM-212L Differential Global Positioning System (DGPS) receiver to provide precise navigation data. As a part of the earlier oceanographic measurement task, SAIC conducted a DGPS fixed-point comparison test against a local high-order geodetic control point to verify that the accuracy of the primary vessel navigation system was better than ±2 m. In addition, prior to departure from the dock on each field survey day, the proper operation of the navigation system was confirmed by comparing the output DGPS position with the offset position to a known point on the dock. During all survey and sampling operations, the DGPS navigation data were output at a rate of once per second to a survey control computer that was running Coastal Oceanographic's HYPACKMax® survey and data acquisition software. HYPACKMax® was used to control the survey operations and to provide the real-time data display and logging of the vessel navigation data. Prior to the field operations, HYPACKMax® was used to define a State Plane grid (California - Zone 5) around the survey area and to establish the various sampling schemes that were used during the subsequent field operations.

2.1 SIDE-SCAN SONAR SURVEY

Because review of the side-scan sonar data was necessary in order to plan all subsequent discrete sampling operations, this survey had to be completed in advance of the other planned operations. In addition, the mid-summer scheduling constraints on the elements involving OSU and UVA necessitated that the side-scan sonar survey be completed almost immediately after the decision was made to move ahead with the entire sampling program. The short lead time to mobilize this survey meant that many of the planned side-scan sonar systems that had been considered for this survey were unavailable when needed. Ultimately, we relied on a SAIC-owned Klein595® dual-frequency, side-scan sonar system used in conjunction with Chesapeake Technologies SonarWiz Map® topside acquisition package to display and digitally record the side-scan sonar data. This equipment was mobilized at an SAIC facility in San Diego along with a large SeaMac winch and 1,500m of armored side-scan sonar cable. The gear was transported from San Diego to SCMI on 23 June and then mobilized aboard the *R/V Yellowfin*. As indicated in Table 2.0-1, the side-scan sonar survey was completed over four field survey days from 24 June through 27 June through a series of survey lanes aligned parallel to the shore (Figure 2.1-1).

Because the side-scan sonar data were needed to help refine both the sediment profile and coring sampling plans, these data were initially processed soon after they were acquired. This initial processing effort focused solely on the lower frequency 100 kHz data and required some editing of the sonar data to improve the bottom-tracking and overall image quality. All of the sonar data were merged into an imagery mosaic using both the SonarWiz Map® post-processing tools and ArcView GIS tools. The initial side-scan sonar mosaic was exported as a geoTIFF file and then used within the Palos Verdes GIS project to help plan the subsequent sediment-profile and core sampling surveys.

Subsequent post-processing of the side-scan sonar data included additional editing of the 100 kHz mosaic, as well as the higher frequency 500 kHz data. Though the 500 kHz data provided less than full-bottom coverage due to range limitations, it did provide higher-resolution imagery data that was used to assist with the interpretation of fine-scale differences in sediment type. A final, fully edited imagery mosaic was created relying on the best available 100 or 500 kHz data. The final imagery mosaic and any other relevant target information were incorporated into the project GIS and data management system where it was easily cross-referenced and compared to other relevant data (e.g., sediment-profile and plan-view

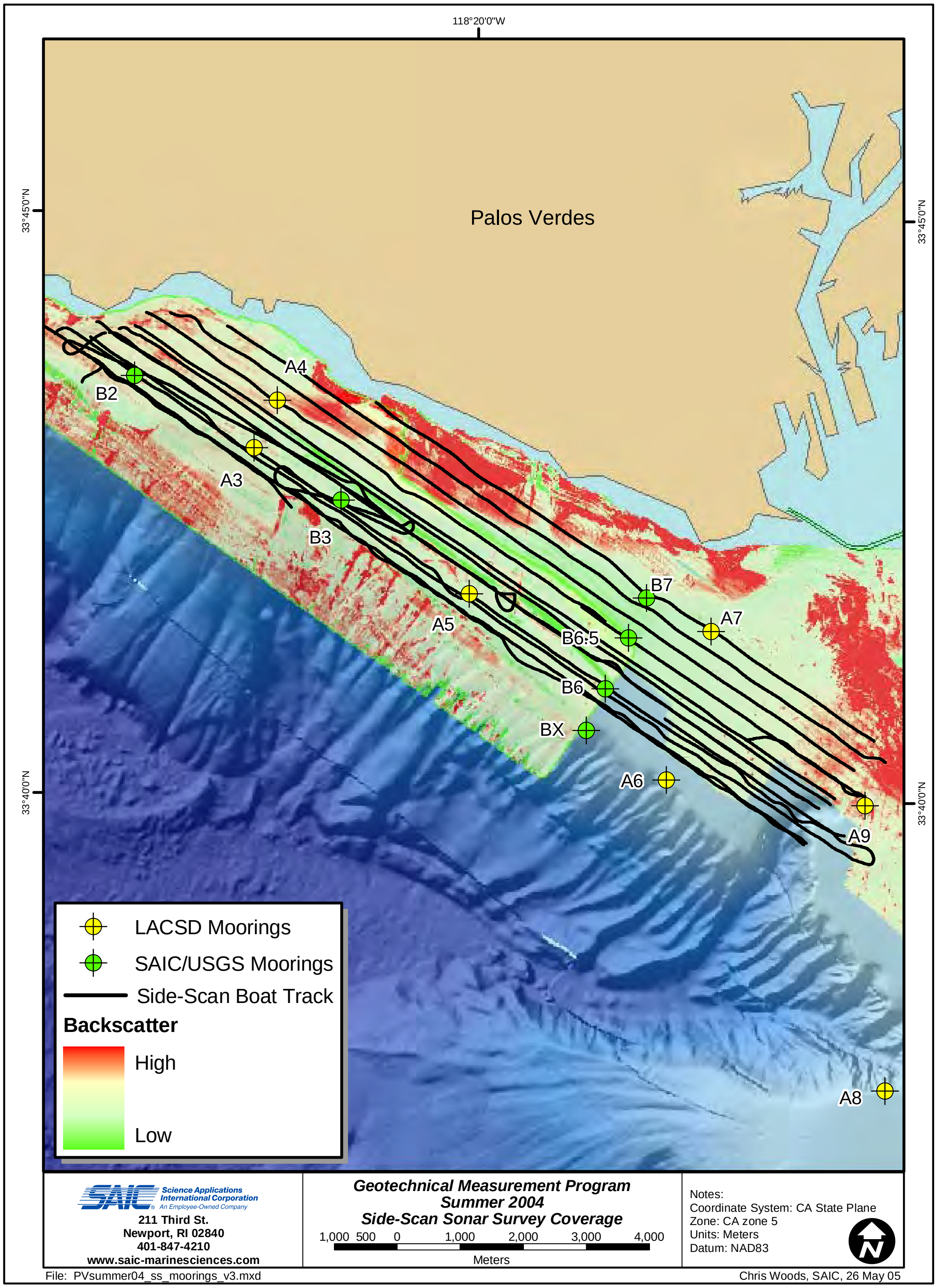


Figure 2.1-1. Overview of side-scan sonar survey lanes that were occupied during the 2004 Geotechnical Measurement Program.

images). In addition, individual high-resolution screen grabs of various features and areas of interest were created and then referenced to the smaller-scale mosaic image. The recent side-scan sonar imagery mosaic was also merged with and compared to the multibeam backscatter imagery that was acquired by the USGS in the late 1990s; these data have recently been made available through a USGS web-based data server.

2.2 SEDIMENT-PROFILE AND PLAN-VIEW IMAGING SURVEY

Prior to the start of the field work, the sampling module of the USEPA FIELDS (FIeld EnvironmentaL Decision Support - www.epa.gov/region5fields/) software was used to generate a statistically based sampling plan for the imaging survey. A boundary polygon around the primary area of interest on the PV Shelf was created in ESRI ArcMap and then used to define the designated sampling region within FIELDS. The FIELDS program was then used to generate an optimal distribution of a fixed number of sampling stations by minimizing the maximum distance between any two points within the sampling region. This initial selection of sampling points was then modified manually to ensure that it also encompassed other core sampling locations that were being occupied as part of either the Bioturbation or EA Resuspension tasks (Figures 2.2-1 and 2.2-2). Finally, based on the initial side-scan sonar mosaic, the imaging sampling plan was further modified to include several stations that were focused over areas of differing acoustic return; this was particularly relevant in the southeastern portions of the survey area where the side-scan sonar mosaic showed the seafloor to be far more variable in texture.

The sediment-profile and plan-view imaging survey was conducted to provide high-resolution imagery data of the seafloor across the PV Shelf. This survey was conducted using a SAIC-owned deployment frame that was configured with a digital sediment-profile image (DSPI) system and a downward-looking, film-based, plan-view camera system. All of the required field equipment was shipped to SCMI and then mobilized aboard the R/V *SeaWatch* on 7 and 8 July. The mobilization period included a test of the system within LA Harbor to ensure that both camera systems were working properly. The sediment-profile and plan-view imaging survey was completed over a four-day period from 9 July through 12 July (Table 2.0-1).

Approximately 170 stations were occupied during this survey, with at least three replicate sediment-profile and plan-view images collected at most stations (Table 2.2-1). These images captured sedimentary and biological conditions at the sediment-water interface to camera penetration depths ranging between 0 and 20 cm. Two representative sediment-profile images and one representative plan-view image were selected from the three collected at each sampling station for processing and analysis. All of the analyzed sediment-profile and plan-view image data were retained in pre-formatted spreadsheets and incorporated into the project GIS and data management system. Geo-referenced access to these imagery data was particularly beneficial during the detailed interpretation of the side-scan sonar imagery, as well as the review of the geotechnical results. The following sub-sections provide a more detailed overview of the both the sediment-profile and plan-view systems.

Table 2.2-1. Overview of all Sampling Stations Occupied during 2004 Geotechnical Measurement Program

Station	Latitude	Longitude	Other Names	Approximate Depth (m)	Data Types
NW_1	33.73434	-118.40496		25.0	SPI
NW_10	33.72927	-118.39653		57.2	SPI, C-RES
NW_11	33.72884	-118.39104		50.9	SPI
NW_12	33.72842	-118.38556		47.5	SPI
NW_13	33.72799	-118.38007		41.0	SPI
NW_14	33.72757	-118.37459		37.6	SPI
NW_15	33.72714	-118.36910		30.7	SPI
NW_16	33.72671	-118.36362		25.0	SPI
NW_17	33.72816	-118.40405	3-70m	68.9	SPI, C-RES, th-234
NW_18	33.72759	-118.40864		80.2	SPI
NW_19	33.72664	-118.39152	B2	58.0	SPI, C-RES, C-GEO, C-GUST
NW_2	33.73349	-118.39399		39.1	SPI
NW_20	33.72625	-118.39084		58.0	SPI
NW_21	33.72599	-118.39029		57.6	SPI
NW_22	33.72511	-118.38338	4-55m	54.3	SPI, C-RES, th-234
NW_23	33.72399	-118.35567		19.6	SPI
NW_24	33.72322	-118.36757	A4	36.0	SPI, C-RES
NW_25	33.72505	-118.39906		76.3	SPI, C-RES
NW_26	33.72462	-118.39358		69.6	SPI, C-RES
NW_27	33.72420	-118.38809		63.1	SPI, C-RES
NW_28	33.72377	-118.38261		56.3	SPI
NW_29	33.72335	-118.37712		51.5	SPI, C-RES
NW_3	33.73306	-118.38851		35.0	SPI, C-RES
NW_30	33.72292	-118.37163		42.9	SPI
NW_31	33.72250	-118.36615		36.8	SPI
NW_32	33.72207	-118.36066		29.3	SPI
NW_33	33.72165	-118.35518		25.4	SPI
NW_34	33.72122	-118.34969		23.7	SPI
NW_35	33.72155	-118.38486	4-70m	68.5	SPI, C-RES, th-234
NW_36	33.72039	-118.36325	5-40m	38.9	SPI
NW_37	33.71998	-118.39062		84.0	SPI, C-RES
NW_38	33.71913	-118.37965		68.6	SPI, C-RES
NW_39	33.71870	-118.37417		62.0	SPI, C-RES, C-GEO, C-GUST
NW_4	33.73221	-118.37754		28.3	SPI
NW_40	33.71828	-118.36868		54.1	SPI
NW_41	33.71785	-118.36320		45.1	SPI
NW_42	33.71743	-118.35771		39.3	SPI
NW_43	33.71700	-118.35223		36.7	SPI, C-RES
NW_44	33.71659	-118.37110	A3	64.7	SPI
NW_45	33.71612	-118.36469	5-55m	54.8	SPI, C-RES, C-GEO, C-GUST, th-234
NW_46	33.71381	-118.35363	27	41.9	SPI, C-RES, C-GEO
NW_47	33.71688	-118.37643		84.6	SPI
NW_48	33.71406	-118.37122		89.8	SPI, C-RES
NW_49	33.71296	-118.36584	5-70m	69.0	SPI, C-RES, th-234
NW_5	33.73316	-118.40087	3-40m	30.8	SPI
NW_50	33.71321	-118.36025		55.7	SPI, C-RES
NW_51	33.71278	-118.35476		45.7	SPI
NW_52	33.71236	-118.34928		39.0	SPI
NW_53	33.71037	-118.35128	PVCellCenter	46.1	SPI, th-234
NW_54	33.70920	-118.35583	B3	58.6	SPI, C-RES, C-GEO, C-GUST
NW_55	33.70995	-118.36234		74.6	SPI
NW_56	33.70857	-118.35730		64.3	SPI
NW_57	33.70814	-118.35181		55.9	SPI
NW_6	33.73133	-118.40188	3-55m	53.3	SPI, C-RES, th-234
NW_7	33.73058	-118.40649		61.6	SPI, C-RES, C-GEO, C-GUST, pb-210

Table 2..2-1., continued.

Station	Latitude	Longitude	Other Names	Approximate Depth (m)	Data Types
NW_8	33.72939	-118.38106	4-40m	38.9	SPI, C-RES
NW_9	33.72969	-118.40201		62.0	SPI
OUT_1	33.71615	-118.34126		22.7	SPI
OUT_10	33.70601	-118.32439		25.3	SPI
OUT_11	33.70559	-118.31890		23.2	SPI
OUT_12	33.70689	-118.34486		46.6	SPI
OUT_13	33.70618	-118.34752	7-55m	54.9	SPI, C-RES, th-234
OUT_14	33.70404	-118.34892	22	64.3	SPI, C-RES, th-234
OUT_15	33.70307	-118.34338		59.1	SPI, C-RES
OUT_16	33.70265	-118.33789		50.0	SPI
OUT_17	33.70222	-118.33241		44.4	SPI, C-RES
OUT_18	33.70180	-118.32692		39.2	SPI
OUT_19	33.70137	-118.32143		34.4	SPI, C-RES
OUT_2	33.71499	-118.34362		25.6	SPI
OUT_20	33.70094	-118.31595		29.9	SPI
OUT_21	33.70052	-118.31046		25.0	SPI
OUT_22	33.70146	-118.34174		61.5	SPI
OUT_23	33.69843	-118.34042		70.6	SPI, C-RES
OUT_24	33.69800	-118.33494		60.5	SPI
OUT_25	33.69758	-118.32945		53.7	SPI, C-RES
OUT_26	33.69715	-118.32397		47.9	SPI
OUT_27	33.69673	-118.31848		42.5	SPI, C-RES, C-GEO, C-GUST
OUT_28	33.69571	-118.31425	9-40m	40.7	SPI, C-RES
OUT_29	33.69586	-118.30896		34.4	SPI, C-GEO
OUT_3	33.71193	-118.34379		32.2	SPI
OUT_30	33.69566	-118.30325	B7	29.8	SPI, C-RES
OUT_31	33.69600	-118.33366	A5	65.1	SPI, C-RES, C-GEO, C-GUST
OUT_32	33.69522	-118.33740		81.4	SPI
OUT_33	33.69336	-118.33199		73.3	SPI, C-RES
OUT_34	33.69313	-118.32689		61.1	SPI, C-RES
OUT_35	33.69251	-118.32102		55.6	SPI
OUT_36	33.69208	-118.31553		50.2	SPI
OUT_37	33.69166	-118.31005		45.3	SPI
OUT_38	33.69123	-118.30456		41.4	SPI
OUT_39	33.69084	-118.31627	9-55m	52.9	SPI, th-234
OUT_4	33.71218	-118.33366		22.8	SPI
OUT_40	33.68964	-118.30685	B6.5	46.0	SPI, C-RES, C-GEO, C-GUST
OUT_41	33.69008	-118.32811		76.5	SPI
OUT_42	33.68829	-118.32355		73.0	SPI, C-RES
OUT_43	33.68787	-118.31807		63.3	SPI
OUT_44	33.68744	-118.31258		55.0	SPI, C-RES
OUT_45	33.68701	-118.30710		50.0	SPI, C-RES
OUT_46	33.68584	-118.31858	9-70m	70.5	SPI, C-RES, th-234
OUT_47	33.68448	-118.32052		82.1	SPI
OUT_48	33.68322	-118.31512		68.0	SPI
OUT_49	33.68268	-118.31078	B6	61.5	SPI, C-RES, C-GEO, C-GUST
OUT_5	33.71151	-118.33831		26.3	SPI
OUT_50	33.67988	-118.31288		75.8	SPI
OUT_51	33.67651	-118.31338		121.4	SPI
OUT_6	33.70876	-118.34515	12	42.0	SPI
OUT_7	33.70729	-118.34084		40.4	SPI, C-RES, C-GEO

Table 2.2-1., continued.

Station	Latitude	Longitude	Other Names	Approximate Depth (m)	Data Types
OUT_C	33.69199	-118.31319		47.3	SPI
OUT_D	33.69189	-118.31300		47.5	SPI
SE_1	33.69503	-118.29654		27.5	SPI
SE_10	33.68466	-118.29018	10-40m	39.9	SPI
SE_11	33.68237	-118.30415		52.0	SPI, C-RES
SE_12	33.68195	-118.29866		47.1	SPI, C-RES, C-GEO
SE_13	33.68152	-118.29318		43.6	SPI
SE_14	33.68109	-118.28769		40.8	SPI
SE_15	33.68067	-118.28221		37.9	SPI
SE_16	33.68024	-118.27672		35.1	SPI
SE_17	33.67982	-118.27123		33.2	SPI
SE_18	33.68014	-118.27972		36.6	SPI
SE_19	33.67879	-118.27732		36.0	SPI
SE_2	33.69299	-118.29423		31.5	SPI
SE_20	33.67815	-118.30668		64.5	SPI
SE_21	33.67773	-118.30120		53.7	SPI, C-RES, C-GEO, C-GUST
SE_22	33.67730	-118.29571		47.6	SPI
SE_23	33.67627	-118.28977		44.1	SPI
SE_24	33.67645	-118.28474		41.3	SPI
SE_25	33.67603	-118.27925		38.5	SPI
SE_26	33.67560	-118.27377		35.9	SPI
SE_27	33.67518	-118.26828		34.2	SPI, C-RES
SE_28	33.67446	-118.28549		42.6	SPI
SE_29	33.67440	-118.28537		42.6	SPI
SE_3	33.68996	-118.28811		33.9	SPI
SE_30	33.67434	-118.28525		42.5	SPI
SE_31	33.67283	-118.28501		43.3	SPI
SE_32	33.67250	-118.27710	BX	40.8	SPI, C-RES
SE_33	33.67507	-118.30822		85.1	SPI, C-RES
SE_34	33.67351	-118.30373		67.6	SPI
SE_35	33.67308	-118.29824		54.2	SPI
SE_36	33.67266	-118.29276		47.9	SPI
SE_37	33.67223	-118.28727		44.8	SPI
SE_38	33.67181	-118.28179		43.4	SPI
SE_39	33.67127	-118.28037		43.2	SPI
SE_4	33.69081	-118.29908		38.2	SPI, C-RES
SE_40	33.67096	-118.27082		39.9	SPI
SE_41	33.67054	-118.28501		46.1	SPI
SE_42	33.66986	-118.30046		71.8	SPI
SE_43	33.66958	-118.29569	10-55m	54.6	SPI, th-234
SE_44	33.66802	-118.28981		49.7	SPI
SE_45	33.66759	-118.28432		48.3	SPI
SE_46	33.66716	-118.27884		50.4	SPI
SE_47	33.66707	-118.29655	10-70m	68.3	SPI, C-GEO, th-234
SE_48	33.66337	-118.28686		55.4	SPI
SE_5	33.68950	-118.29270		36.7	SPI
SE_6	33.68659	-118.30161		45.6	SPI
SE_7	33.68616	-118.29613		42.2	SPI
SE_8	33.68531	-118.28516		36.9	SPI
SE_9	33.68489	-118.27967		34.5	SPI

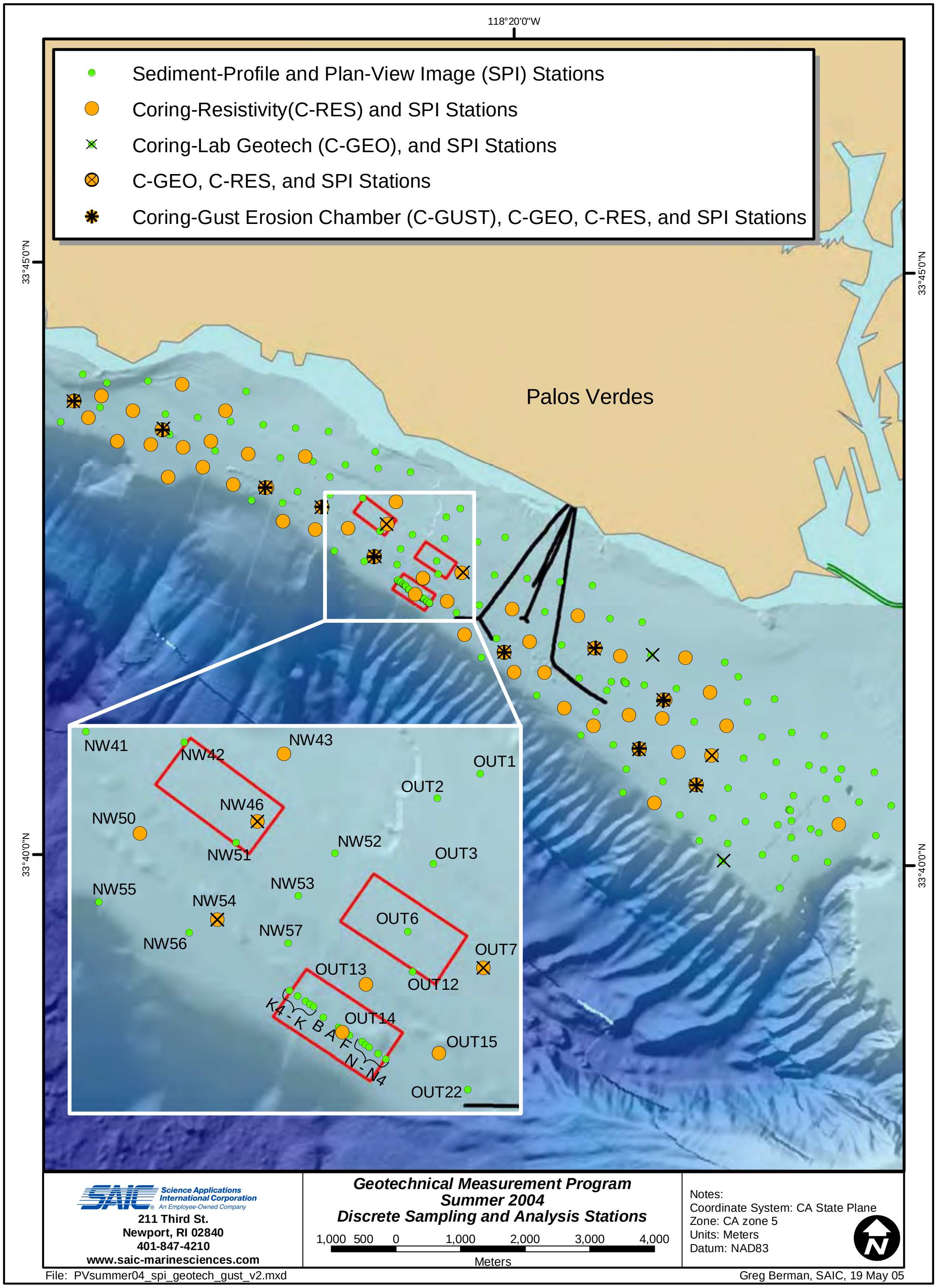


Figure 2.2-1. Overview of imaging and geotechnical discrete sampling stations that were occupied during the 2004 Geotechnical Measurement Program.

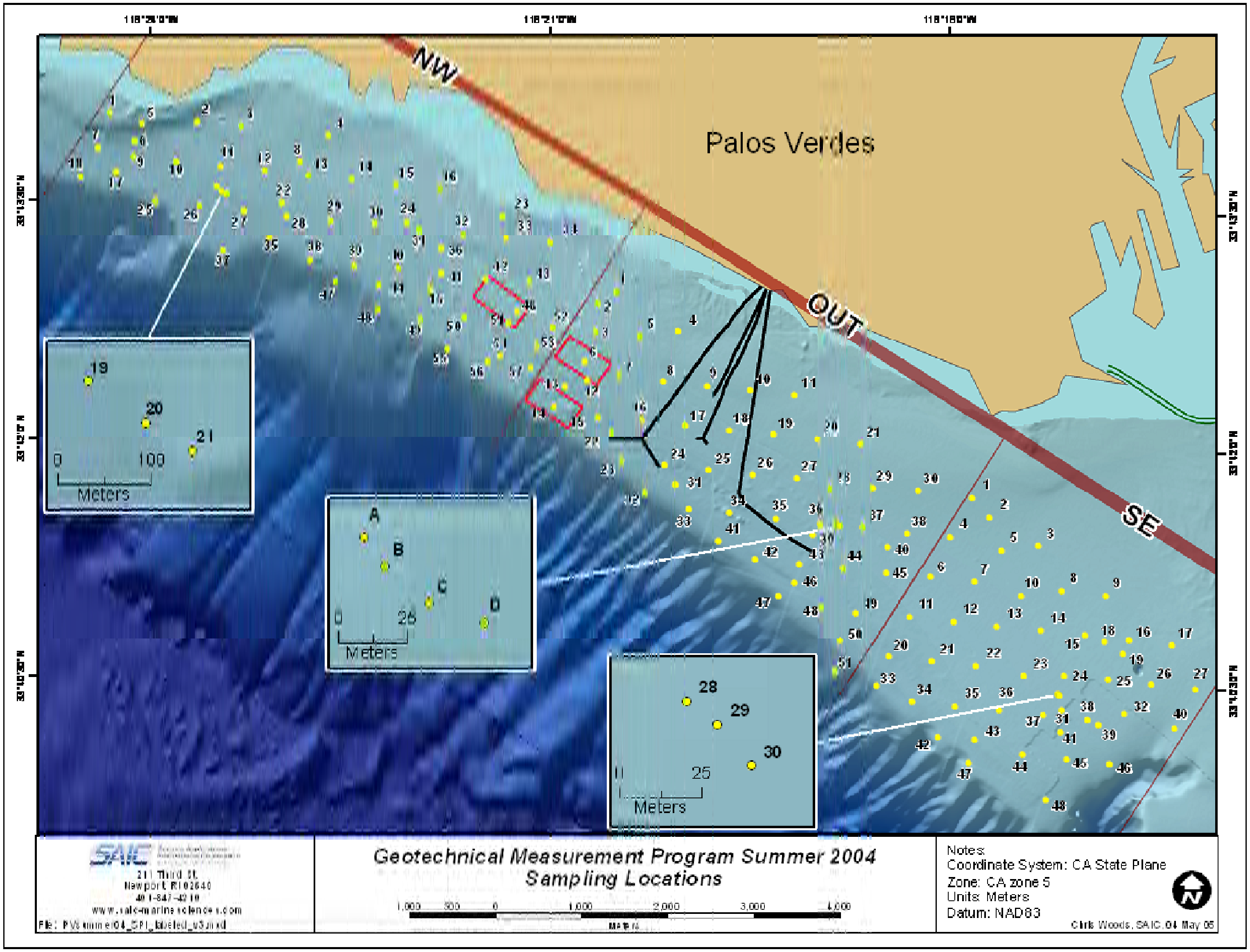


Figure 2.2-2. Overview of discrete sampling station naming convention used for the 2004 Geotechnical Measurement Program.

2.2.1 Sediment-Profile Imaging Methods

Data Acquisition

Remote Ecological Monitoring of the Seafloor (REMOTS®) with the Digital Sediment-Profile Imagery (DSPI) camera is a benthic sampling technique that provides a digital photograph of a cross-section of the surface and near-surface sediments. The REMOTS® hardware consists of a Benthos Model 3731 sediment-profile camera designed to obtain undisturbed, vertical, cross-section photographs (in-situ profiles) of the upper 15 to 20 cm of the seafloor (Figure 2.2-3). Each digital image provides a 20 cm-high (maximum) by 14 cm-wide "profile" of the surface and near-surface sediments for the rapid interpretation and mapping of data on physical and biological seafloor characteristics. The digital sediment-profile camera system allows nearly real-time review of the image quality and results. This facilitates obtaining suitable replicate images that can be downloaded and viewed, if necessary, while still on-station. In addition to timely viewing of images, the high-resolution digital images are easily integrated directly into the computer-aided digital analysis system.

A schematic diagram and deployment sequence during DSPI camera operation is provided in Figure 2.2-3. The camera consists of a wedge-shaped prism with a Plexiglas faceplate; light is provided by an internal strobe. The back of the prism has a mirror mounted at a 45-degree angle to reflect the profile of the sediment-water interface toward the camera, which is mounted horizontally on the top of the prism. The prism is filled with distilled water, through which the photographs are obtained. Because the object (sediment) to be photographed is directly against the faceplate, turbidity of the ambient seawater is not a limiting factor.

The REMOTS® frame is attached to the hydrowire on the vessel's winch. The camera prism is mounted on an assembly that can be moved up and down by producing tension or slack on the winch wire. As the camera is lowered, tension on the wire keeps the prism in the "up" position (Figure 2.2-3). When the camera frame contacts the bottom, slack on the wire allows the prism to vertically descend into the seafloor. The rate of descent of the optical prism into the sediment is controlled by a passive hydraulic piston. This allows the optical prism to descend at approximately 6 cm per second. The camera trigger is tripped by the prism assembly, activating a 13-second time delay on the shutter release, which gives the prism sufficient time to obtain maximum penetration before a photo is taken. A pinger is attached to the camera and outputs a constant 12-kHz signal of one ping per second; upon discharge of the camera strobe, the ping rate doubles for 10 seconds. Monitoring the pinger's signal using a hydrophone suspended from the vessel allows confirmation that the camera/strobe unit fired. Confirmation of a good-quality image can be obtained by downloading images from the digital camera once the frame is on board (SAIC 2004b).

As the camera is raised off the bottom, a wiper blade automatically cleans any sediment from the prism faceplate. The image is stored directly to the camera Microdrive, the strobe capacitor is recharged, and the camera can be lowered for another image. The digital images must be downloaded from the digital camera for viewing on board the vessel. If there are uncertainties in image quality pertaining to camera settings or difficulties determining camera penetration at a site, the images can be downloaded as soon as the camera is returned to the deck. Provided the camera settings have been confirmed and there are no evident problems obtaining two to three replicate images at each station, downloads would typically be conducted after collecting 60 images (or roughly 20 stations).

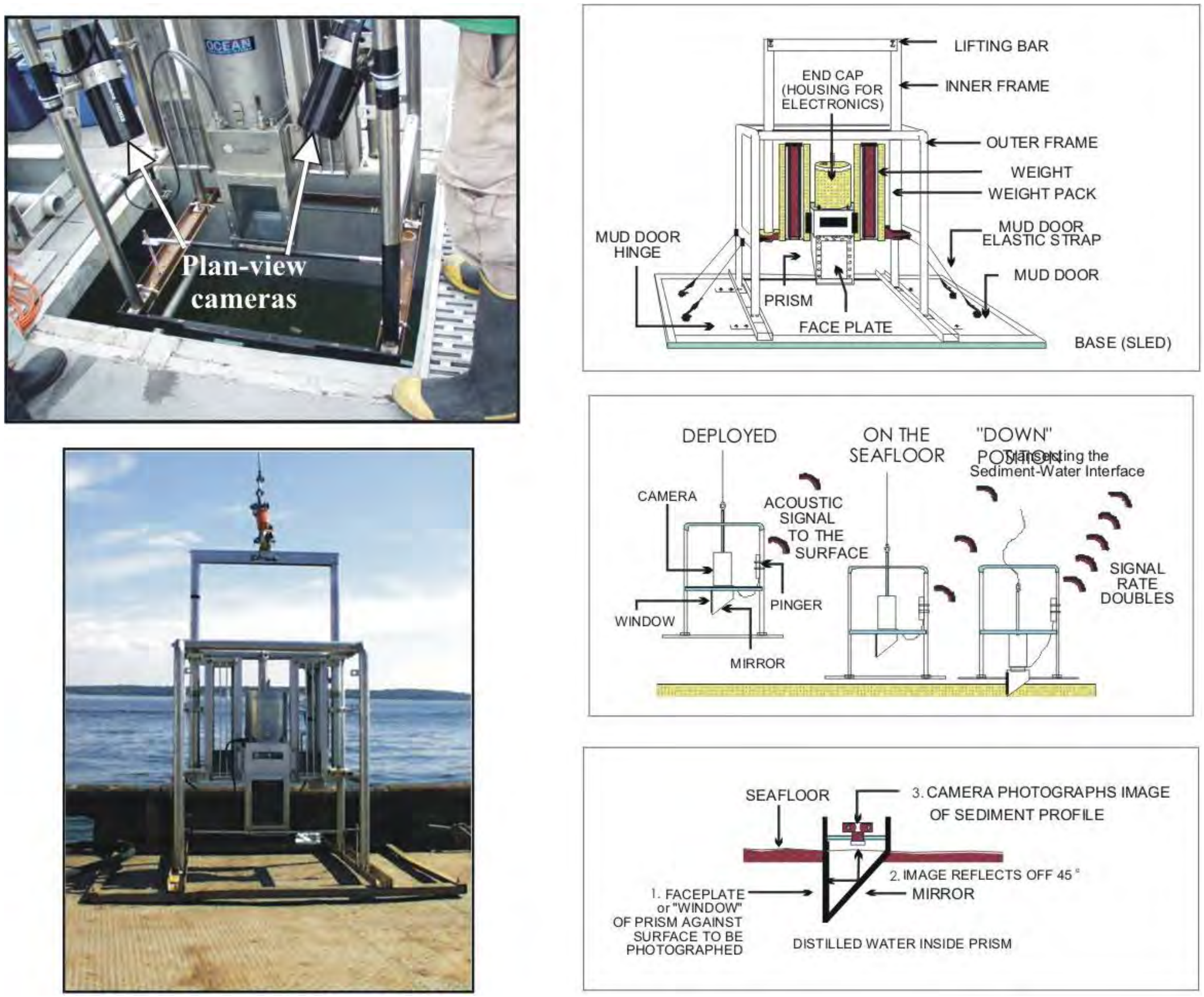


Figure 2.2-3. Schematic diagram of Benthos, Inc. Model 3731 REMOTS® sediment-profile camera and sequence of operation on deployment. Photographs show sediment-profile camera with plan-view camera attached.

Data Processing / Analysis

The final sediment-profile data were analyzed to provide a detailed assessment of the sedimentary environment and benthic habitat conditions over a broad area of the PV Shelf. The sediment-profile images were processed using an in-house computer-based image processing system (Visual Basic customized interface, with information stored in a Microsoft Access database) to consistently characterize the images and to catalogue all relevant quantitative and qualitative results (Figure 2.2-4). Computer-aided analysis of each REMOTS® image yields a suite of standard measured parameters, including sediment grain size major mode, camera prism penetration depth (an indirect measure of sediment bearing capacity/density), small-scale surface boundary roughness, depth of the apparent redox potential discontinuity (a measure of sediment aeration), infaunal successional stage, and Organism-Sediment Index (a summary parameter reflecting overall benthic habitat quality). A more thorough description of the various REMOTS® parameters is provided in Appendix D.

Based on extensive past REMOTS® sediment-profile survey experience in coastal waters, five basic benthic habitat types have been found to exist in open-water near shore environments:
AM = Ampelisca mat; SH = shell bed; SA = hard sand bottom; HR = hard rock/gravel bottom; and UN = unconsolidated soft bottom (SAIC 2003; Table 2.2-2). In addition, several sub-habitats types exist within these major categories. Each sediment-profile image obtained in the study was assigned within one of these five habitat categories.

The multi-parameter REMOTS® Organism-Sediment Index (OSI) has been developed to characterize benthic habitat quality relative to two end-member standards. The OSI values may range from −10 (azoic with low sediment-dissolved-oxygen and/or presence of methane gas in the sediment) to +11 (healthy, aerobic environment with deep RPD depths and advanced successional stages; see Rhoads and Germano 1982, 1986, for REMOTS criteria for these conditions). The OSI values are calculated using values assigned for the apparent RPD depth, successional status, and indicators of methane or low oxygen. Because the OSI is calculated using apparent RPD depths and successional stages, indeterminate apparent RPD depths and/or successional stages lead to indeterminate OSI values. The OSI is a sum of the subset indices shown in Table 2.2-3 and is calculated automatically by SAIC's image processing system after completion of the required SPI parameter measurements. The index has proven to be a useful index for helping to map disturbance gradients and to monitor ecosystem recovery after disturbance (Germano and Rhoads 1984, Revelas et al. 1987, Valente et al. 1992).

2.2.2 Plan-view Imaging Methods

The addition of a downward-looking plan-view camera to the REMOTS® frame provided a useful plan-view photograph of the seafloor over the same area that was imaged by the sediment-profile camera. The plan-view photographs provide qualitative assessments that add to the substrate information obtained with the sediment-profile images, including information on surface-sediment type, physical and biogenic surface features, and debris/objects that may be present at the surface (e.g., shells, rocks, etc.). The plan-view images are particularly valuable where substrate conditions prevent adequate penetration of the DSPI camera. More quantitative assessments may also be obtained from the plan-view images, as the surface area of the substrate included in the plan-view images can be calculated based on the height of the camera above the seafloor. Examples of quantitative information include spacing of physical roughness features such as ripples, and the amount of biogenic surface activity (e.g., number of worm holes, feeding voids, pellet mounds, etc.). The extent of this biogenic activity may have a strong bearing on the resistivity and erodibility measurements.

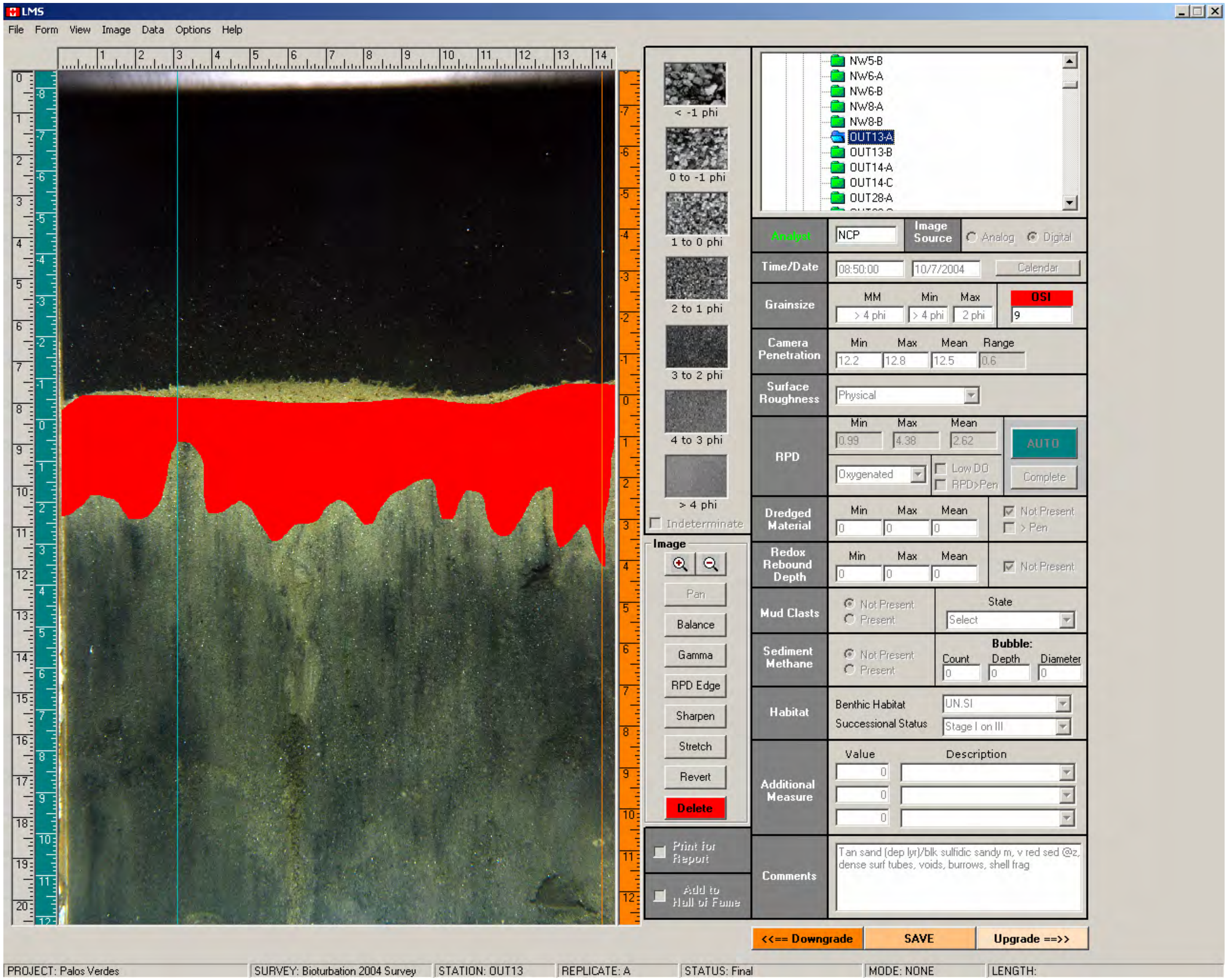


Figure 2.2-4. Sample sediment-profile image from the 2004 Geotechnical Measurement Program displaying the in-house computer-based image processing system (Visual Basic customized interface, with information stored in a Microsoft Access database) to consistently characterize the images and to catalogue all relevant quantitative and qualitative results

Table 2.2-2. Benthic Habitat Categories Assigned to Sediment-Profile Images Obtained in this Study.

Habitat AM: *Ampelisca* Mat Uniformly fine-grained (i.e., silty) sediments having well-formed amphipod (*Ampelisca* spp.) tube mats at the sediment-water interface.
Habitat SH: Shell Bed A layer of dead shells and shell fragments at the sediment surface overlying sediment ranging from hard sand to silts. Epifauna (e.g., bryozoans, tube-building polychaetes) commonly found attached to or living among the shells. Two distinct shell bed habitats: **SH.SI: Shell Bed over silty sediment -** shell layer overlying sediments ranging from fine sands to silts to silt-clay. **SH.SA: Shell Bed over sandy sediment -** shell layer overlying sediments ranging from fine to coarse sand.
Habitat SA: Hard Sand Bottom Homogeneous hard sandy sediments, do not appear to be bioturbated, bedforms common, successional stage mostly indeterminate because of low prism penetration. **SA.F: Fine sand -** uniform fine sand sediments (grain size: 4 to 3 phi). **SA.M: Medium sand -** uniform medium sand sediments (grain size: 3 to 2 phi). **SA.G: Medium sand with gravel -** predominately medium to coarse sand with a minor gravel fraction.
Habitat HR: Hard Rock/Gravel Bottom Hard bottom consisting of pebbles, cobbles and/or boulders, resulting in no or minimal penetration of the REMOTS camera prism. Some images showed pebbles overlying silty-sediments. The hard rock surfaces typically were covered with epifauna (e.g., bryozoans, sponges, tunicates).
Habitat UN: Unconsolidated Soft Bottom Fine-grained sediments ranging from very fine sand to silt-clay, with a complete range of successional stages (I, II and III). Biogenic features were common (e.g., amphipod and polychaete tubes at the sediment surface, small surface pits and mounds, large borrow openings, and feeding voids at depth). Several sub-categories: **UN.SS: Fine Sand/Silty -** very fine sand mixed with silt (grain size range from 4 to 2 phi), with little or no shell hash. **UN.SI: Silty -** homogeneous soft silty sediments (grain size range from >4 to 3 phi), with little or no shell hash. Generally deep prism penetration. **UN.SF: Very Soft Mud -** very soft muddy sediments (>4 phi) of high apparent water content, methane gas bubbles present in some images, deep prism penetration.

Table 2.2-3. Calculation of REMOTS® Organism Sediment Index Value.

A. CHOOSE ONE VALUE:

Mean RPD Depth	Index Value
0.00 cm	0
> 0 - 0.75 cm	1
0.75 - 1.50 cm	2
1.51 - 2.25 cm	3
2.26 - 3.00 cm	4
3.01 - 3.75 cm	5
> 3.75 cm	6

B. CHOOSE ONE VALUE:

Successional Stage	Index Value
Azoic	-4
Stage I	1
Stage I to II	2
Stage II	3
Stage II to III	4
Stage III	5
Stage I on III	5
Stage II on III	5

C. CHOOSE ONE OR BOTH IF APPROPRIATE:

Chemical Parameters	Index Value
Methane Present	-2
No/Low Dissolved Oxygen**	-4

REMOTS® ORGANISM-SEDIMENT INDEX = Total of above subset indices (A+B+C)

1.1.1.1 RANGE: -10 - +11

***** Note: This is not based on a Winkler or polarigraphic electrode measurement. It is based on the imaged evidence of reduced, low reflectance (i.e., high oxygen demand) sediment at the sediment-water interface.***

The plan-view camera system was mounted on the REMOTS® frame (Figure 2.2-3). Photographs were taken using a weighted tension trigger that was suspended below the REMOTS® frame. Just before the REMOTS® frame reached the bottom, the tension on the suspended trigger was released, and the plan-view camera and strobe fired simultaneously. The film was automatically advanced by a motor drive, and the strobe was immediately recharged for the next photograph. Three replicate photographs were acquired at each plan-view station, and one image per station was analyzed. At the end of each survey day, the exposed film was removed from the plan-view camera and developed to ensure that adequate image quality was obtained. Film handling and processing details were provided in the plan-view camera SOP included in Geotechnical IWP (SAIC 2004b).

The plan-view photograph analysis supplemented the more detailed and comprehensive REMOTS® characterization of the seafloor. The 35-mm plan-view slides that were selected for analysis were first scanned to produce digital images and then manually analyzed based on established image review protocols. The plan-view image data were analyzed to provide a detailed assessment of the sedimentary environment and benthic habitat conditions over a broad area of the PV Shelf. The plan-view analysis consisted of qualitative and quantitative descriptions of key sediment characteristics (e.g., sediment type, bedforms, and biological features) based on a manual review of the scanned 35 mm slides. Since the surface sediment descriptions are based on a somewhat subjective manual interpretation, only the obvious presence of rock, gravel, sand and/or fines was noted. Likewise, the presence of shell debris and any evidence of epifaunal or infaunal organisms (e.g., tubes, burrow openings, etc.) was recorded. A scale bar was included in the photographs; however, each photograph covered an area of seafloor measuring roughly 0.5 m x 0.7 m (roughly 0.3 m^2), allowing quantitative assessments of the size and abundance of surface features.

2.3 SEDIMENT CORING AND ANALYSIS SURVEY

While the side-scan sonar and sediment-profile imaging surveys were intended to provide a detailed broad-scale view of the sediment characteristics across the PV Shelf, the coring and subsequent analysis program was designed to provide detailed quantitative data on key sediment properties and characteristics (e.g., erodibility, resistivity, bulk density, etc.) As indicated in Table 2.0-1, the geotechnical sediment coring and analysis survey was conducted over a nine-day field effort from 18 July through 26 July. Mobilization for the geotechnical coring program on the R/V *Vantuna* was completed on 17 July, after completion of the LACSD piston corer comparison effort that was conducted as part of the EA Resuspension task. The Oregon State University (OSU) gravity corer and resistivity profiling device and the University of Virginia (UVA) Gust Chamber system were installed and tested on the deck of the R/V *Vantuna* prior to the start of the field sampling effort.

Over the nine-day sediment coring and analysis program, a total of 15 detailed geotechnical stations were sampled (Figure 2.2-1; Table 2.2-1). Though most of the detailed coring stations were subjected to both Gust Chamber and laboratory geotechnical analyses, the Gust Chamber analysis was not run at a few of these stations. At the detailed stations, up to five separate cores were analyzed for replicate resisitivity profiles, and at least two separate cores were analyzed for replicate Gust Chamber erosion results. A single Gust Chamber analysis run could take up to four hours to complete as the device incrementally increased through different shear stress levels from 0.01 Pa up to 0.40 Pa. Depending on the success in quickly obtaining a suitable Gust core, up to three Gust Chamber runs could be completed in a single field sampling day. Because of the length of time required to complete a single Gust Chamber run, the primary focus at the start of the sampling day was to first collect a core that was suitable for the Gust Chamber analysis. After the Gust Chamber erosion analysis was underway, the focus would then shift to obtaining cores to meet the other analysis needs (e.g., on-deck resistivity profiles, radiometric sediment dating, or laboratory geotechnical analyses). Whenever an on-going Gust Chamber analysis run was nearing completion, the coring focus would again shift to quickly collecting another suitable core for the Gust Chamber. In addition to the 15 detailed geotechnical analysis stations, another 38 stations were subjected to resistivity profiles only (Figure 2.2-1; Table 2.2-1).

2.3.1 Sediment Coring Methods

Quantitative sediment characteristic assessments were obtained from the core sampling and geotechnical analysis program that was conducted over a subset of the stations that were sampled during the sediment profile and plan-view imaging survey. At the detailed geotechnical sampling stations, multiple gravity cores were obtained using the OSU hydraulically damped gravity coring device that had proven reliable for collection of undisturbed samples of the upper sediments. These core samples were subjected to on-deck Gust chamber analyses to measure erodibility and on-deck resistivity profiling to assess porosity. In addition, one core sample from each of the detailed stations was sub-sampled into 4-cm intervals (either at SCMI or on the boat) for eventual laboratory geotechnical analyses.

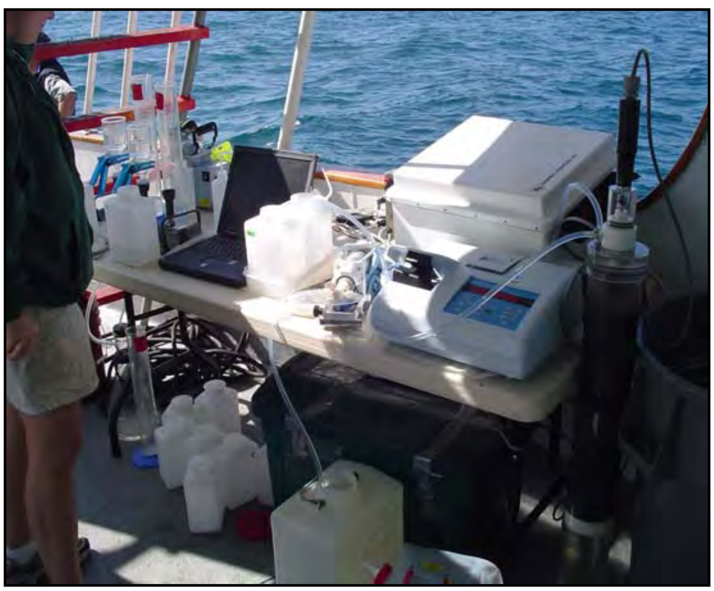
Core samples were collected using the OSU hydraulically-dampened gravity corer (Figure 2.3-1a) that was comprised of an aluminum support frame, a 10.8 cm-internal diameter by 95 cm-long polycarbonate barrel, and an 800 lb lead-weight stand. Upon contact with the seafloor the weight stand pushed the core barrel into the bed and simultaneously pulled a piston that forced water through a small valve. By regulating the valve opening, the descent rate of the core barrel could be controlled. Because of the slow descent rate (typically around 4 cm/s) the corer normally collected an undisturbed sample with an intact sediment-water interface and sediment-free overlying water column. Penetration was typically 30 to 75 cm, depending on the sediment type and the valve-opening setting.

2.3.2 Gust Chamber Methods

The UVA Gust erosion chamber (Gust and Muller, 1997) is a small, 10.25-cm diameter device that fits on the top of a core tube. It uses a calibrated, rotating upper plate to generate a known shear stress on the sediment surface (Figures 2.3-1b and 2.3-1c). Turbidity sensors and pumped samples of fluid from the erosion chamber permit the stresses to be related to erosion rates and the characteristics of eroded particles. The erosion chamber is capable of applying shear stresses in the range from 0.01 – 0.4 Pa to the sediment surface of the core. Each value of shear stress is typically maintained for 20 min. Water in the chamber is replaced by pumping ambient water into the chamber; water leaving the chamber passes through a turbidity sensor that records turbidity levels every second. The water is then collected in bottles and filtered on glass fiber filters that retain particles larger than 0.7μm. The filters are dried and weighed to obtain eroded sediment mass. Eroded mass divided by the volume of water filtered gives average suspended sediment concentration for the time interval during which the water sample was collected. Measured concentrations can be used to calibrate the turbidity measurements. After drying and weighing, the filters are combusted and reweighed to determine the organic fraction.

Before an experiment began, the sediment surface was adjusted until it was positioned 10 cm below the core tube top and then the erosion head was fitted directly onto the top of the core tube. A carboy of chilled ocean water was connected via tubing to the chamber. A second tube connected the chamber to a flow-through turbidity sensor and then emptied into 2-liter water collection bottles. The erosion chamber operation was controlled by a data logger connected to a laptop computer. The desired shear stress and the temperature of the ambient water were entered into the data-logger program on the computer and an output file name was assigned based on the sample station designation. Measurements began when the power was turned on via the program and the pump that controls the flow of water into the chamber was

A

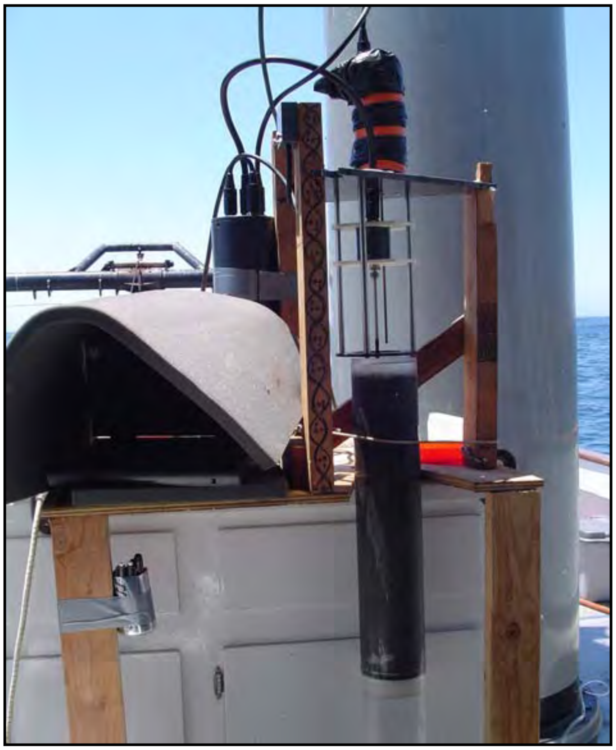


B

C

Figure 2.3-1. Sediment coring and Gust Chamber photographs taken aboard the R/V *Vantuna* during the geotechnical coring effort during the Summer 2004 Geotechnical Measurement Program. These photographs depict: A) the OSU hydraulically-damped gravity corer upon retrieval; B) the UVA Gust Chamber system during an erosion analysis run on a PV core sample; and C) a close-up view of a partially-extruded core sample connected to the UVA Gust chamber erosion head and turbidity monitor.

A



B

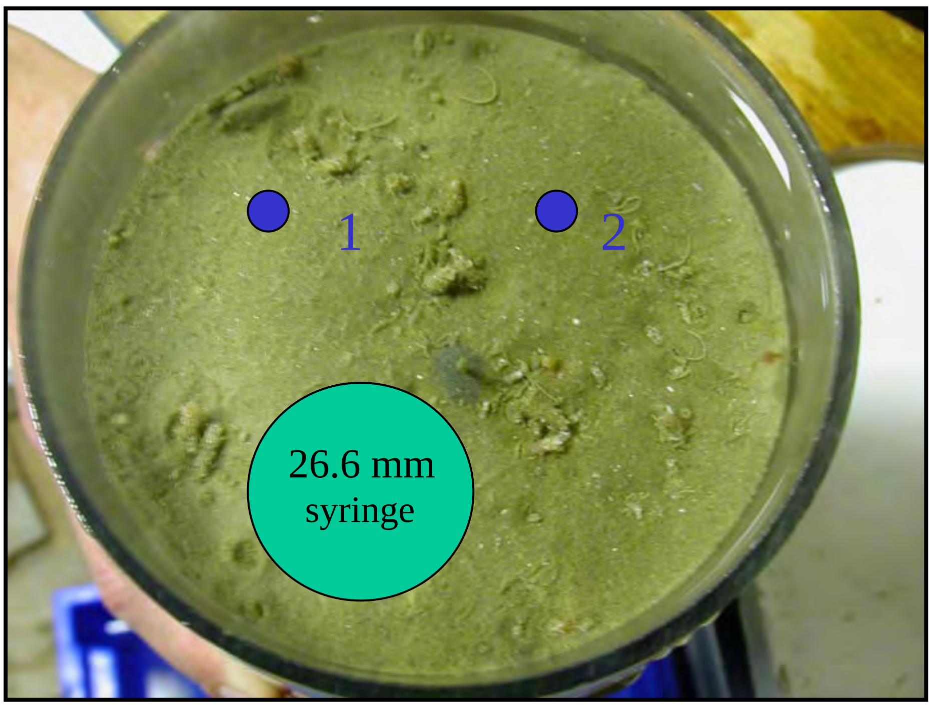


Figure 2.3-2. Resistivity profiling photographs taken aboard the R/V *Vantuna* during the geotechnical coring effort during the Summer 2004 Geotechnical Measurement Program. These photographs depict: A) the OSU resistivity profiling device with an extruded core positioned beneath the probe; and B) a schematic representation of the resisitivity core processing at sea with the blue dots indicating the approximate location of replicate resistivity profiles and the green circle showing the approximate location of the syringe sample taken for water content analysis (core diameter is 10.8 cm).

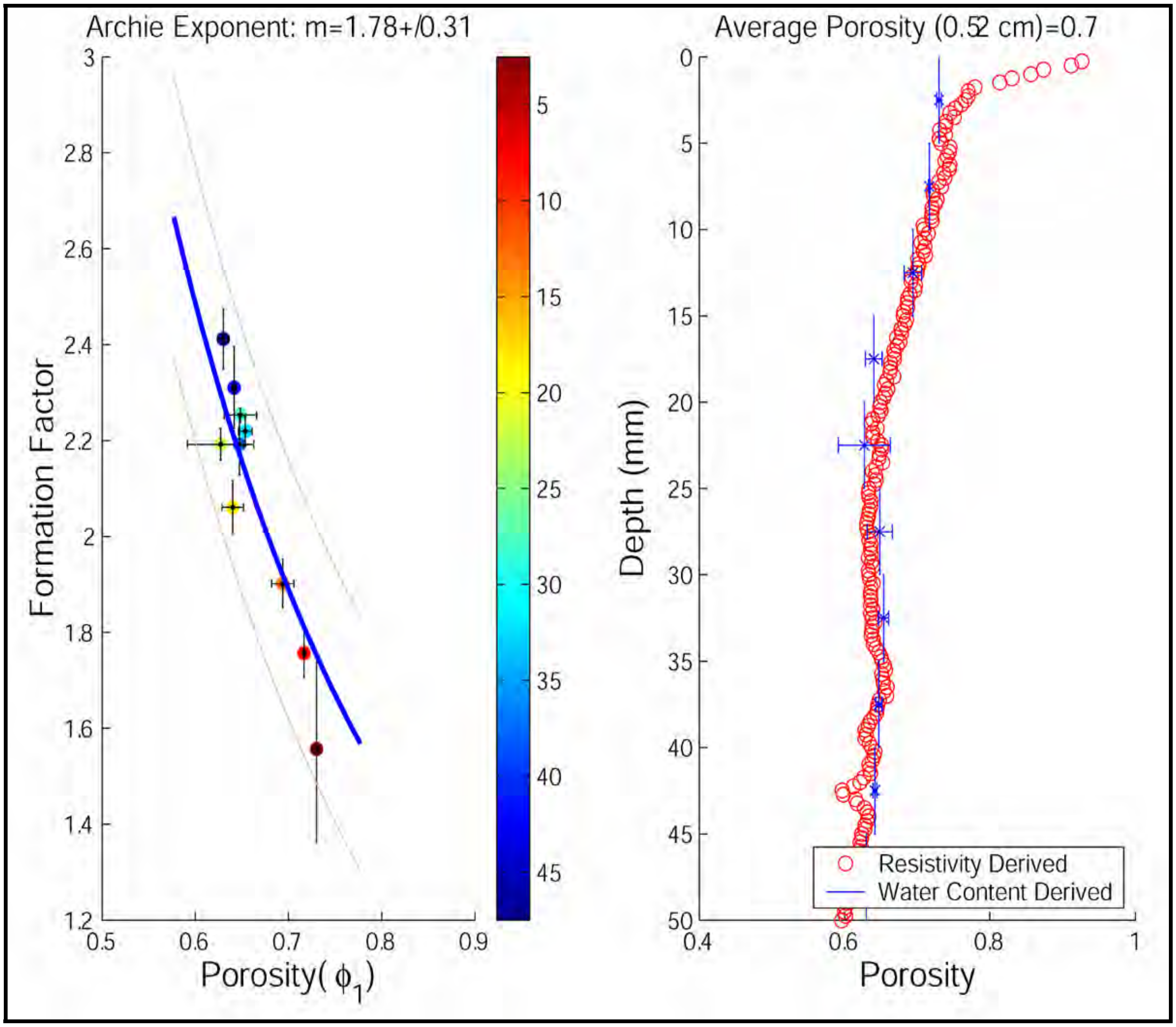


Figure 2.3-3. A) Example calculation of Archie's exponent for the upper 5 cm of sediment using gravimetric porosity measurements as the basis of the calibration. The blue line represents the least squares fit to Archie's equation and the two grey lines represent the upper and lower 95% confidence limits on the estimate of the Archie exponent. The x- and y- error bars represent one standard deviation of the water content-based porosity values and formation factor respectively. The color bar represents the depth interval of the gravimetric sample. B) The Archie exponent is applied to resistivity measurements to generate a calibrated porosity profile (red dots) and is compared with gravimetric porosity measurements.

started. Time, turbidity (in NTUs), and the rotation rate of the upper plate of the erosion chamber were recorded once a second to the output file. The rotation rate of the upper plate was pre-calibrated to the shear stress applied to the surface.

Quality was controlled by weighing each filter twice before and after filtering and after combustion; by spot checking results calculated in the spreadsheets against values determined by hand from the original data sheets; and by checking the results for outliers that might indicate an error in filter weights, data transcription, or spreadsheet manipulations. Blank filters (wetted but with no sediment filtered through) were also used as a check on the accuracy of the filter weights.

2.3.3 Resistivity Profiling Methods

Resistivity profiles were obtained using an In situ Resistivity Profiler (IRP; Wheatcroft, 2002). The IRP was used in the "Lab Mode", indicating that the resistivity measurements were made on board the survey vessel soon after the cores were collected using the hydraulically dampened gravity corer. The IRP is a Wenner-type probe, with four electrodes at the end of a roughly 0.5-cm-diameter probe (Figure 2.3-2a). The two outer electrodes drive a current, while the two inner electrodes sense the voltage. A motor attached to a lead screw is used to vertically move the probe through the overlying water (~2 cm deep) and into the sediment. As more and more non-conducting sediment enters the sensing volume (i.e., the porosity decreases), the resistance increases (see discussion below). Operation and control of the IRP, as well as data logging is handled through software on a dedicated notebook computer.

After a core was brought on deck, it was removed from the corer and two resistivity profiles were run as soon as possible (~ 10 min) using the IRP. During this field program, data were logged at 0.25-mm intervals and the profile length was typically 12 cm. After the two profiles were completed, the overlying water was siphoned off the top of the core and a cut-off 60-cm^3 syringe (26.6 mm inner diameter) was inserted vertically into the sediment (Figure 2.3-2b). After extraction, the sediment within the syringe was sectioned vertically at 0.5-cm intervals to a depth of 8 cm, corresponding to a volume of approximately 2.8 cm^3 per depth interval. The porosity of the 0.5-cm sections were later determined at the OSU onshore laboratory using standard wet weight/ dry weight gravimetric techniques (Manheim et al., 1974).

The relationship between resistivity and porosity in marine sediments has been extensively studied (e.g., Archie, 1942; Manheim et al., 1974; Andrews and Bennett, 1981; Martin et al., 1991; Wheatcroft, 2002). Archie (1942) related resistivity measurements to porosity using the following equation:

$$FF=\varphi-m$$

where FF, or formation factor, is the ratio of resistivity in the sediment (Rz) to the bottom water resistivity (Ro), φ is the sediment porosity, and m is the Archie exponent. The Archie exponent is an empirically derived number that varies according to the physical properties of the sediment. Changes in the Archie exponent are thought to reflect changes in the particle shape, ionic strength of the pore fluid, or chemical composition of the sediment itself. To calibrate the resistivity-based porosity profiles, the resistivity was bin-averaged (0.5-cm intervals) and compared with the water content measurements from the syringes at the same depth. Archie exponents were determined by least squares fit to Archie's equation (1) (Figure 2.3-3). Given the formation factor as a function of depth and m, vertical profiles of porosity were calculated.

2.3.4 Laboratory Geotechnical Analysis Methods

One core sample from each of the 15 detailed stations was sub-sampled into five 4-cm intervals for eventual laboratory geotechnical analyses. Most of the geotechnical analysis cores were returned to the SCMI core-handling facility for processing, which included core-splitting, photographing, describing, and sub-sampling. In addition, a few of the geotechnical cores were sub-sampled on the deck of the R/V *Vantuna* soon after they were collected. With the exception of one deep core obtained within pilot cap cell LU (Station NW-46) that was sub-sampled for the full 60 cm, all of the other cores were sub-sampled into five 4-cm intervals from the surface down to 20 cm. All of the sediment sub-sampling procedures adhered to the guidance outlined in the Geotechnical IWP (SAIC 2004b).

Ultimately, all of the sediment sub-samples were then sent to Applied Marine Sciences, Inc. (AMS) for laboratory geotechnical analyses of aggregate and disaggregate grain size, bulk density, water content, and total organic carbon (TOC). The laboratory analysis procedures followed the Standard Operating Procedures (SOPs) that were outlined in the IWP (SAIC 2004b). After the laboratory analyses were completed, pre-formatted spreadsheet files were generated by AMS that provided a summary of all of the analysis results at each of the stations. All of the geotechnical analysis results were incorporated into the project GIS and data management system, where they were used to supplement the other analyses (e.g., erosion and resisitivity) that were completed at the detailed coring stations.

3.0 RESULTS

3.1 SIDE-SCAN SONAR RESULTS

The side-scan sonar data acquired in late June provided nearly full-bottom acoustic imagery coverage over the main areas of interest along the PV Shelf and Upper Slope (Figure 3.1-1). Most of the small sonar coverage gaps that are evident in the mosaic were caused by the presence of the numerous moored instruments that were deployed along the Shelf by SAIC, USGS, and LACSD at the time of this survey. Many of these instrument locations included a sub-surface mooring package with little or no surface representation. To avoid a towfish collision with one of these sub-surface arrays that would likely damage both the towfish connection and the array, survey lanes were often altered to remain well clear of the recorded position of these moorings. Because 100 to 200 m of armored side-scan sonar cable were usually deployed to attain the required towfish depth, there was also some uncertainty associated with the exact position of the towfish behind the survey vessel (particularly during turns). During the course of this survey, there were no accidental collisions between the towfish and a moored array. On 25 June, the real-time side-scan sonar data were used to help locate a stranded USGS bottom array that was being recovered by a small ROV deployed from the R/V *SeaW atch.*

In general, the side-scan sonar records were of good quality and served their intended purpose of identifying seafloor objects as well as areas of differing sediment composition. There were widespread dense schools of small fish that were periodically evident in the sonar records. In most instances, these schools covered only a small area and their acoustic signature could be clearly differentiated from regular seafloor acoustic returns. In addition, several large schools of dolphin were encountered periodically throughout the course of the survey. Though the dolphin themselves were not evident in the sonar records, they did generate acoustic noise that created significant interference across the entire sonar record; the level of dolphin interference increased with their proximity to the towfish and the numbers of dolphin present. The sporadic areas of dolphin interference were clearly evident in the sonar data, but had no major impact on our ability to interpret these data.

Because the side-scan sonar data were needed to help refine both the sediment profile and coring sampling plans, these data were initially processed soon after they were acquired. This initial processing effort focused solely of the lower frequency 100 kHz data and required some editing of the sonar data to improve the bottom-tracking and overall image quality. All of the individual sonar lane files were merged into a complete imagery mosaic and exported as a geoTIFF file. This mosaic geoTIFF file was used within the Palos Verdes GIS project to help plan the subsequent sampling surveys.

Additional post-processing and analysis of the side-scan sonar were also conducted well after the completion of the other geotechnical field sampling efforts. Some of this additional post-processing effort was focused on refining the bottom-tracking and layback application within each individual sonar lane to improve the exported mosaic file. The 500-kHz data were also analyzed in greater detail to determine if the higher resolution data provided any increased ability to distinguish subtle bed-form differences in the sonar data. Though the 500-kHz data did provide better-detailed images of bottom features (e.g., pipeline, reef structure, etc.) nearer to the towfish track (generally within 75 m), the reduced range coverage limited the usefulness of this data for broader-scale seafloor interpretation. To assist with the physical interpretation of the sonar imagery data, the extensive collection of sediment-profile and plan-view imagery data were overlaid on the final side-scan mosaic images. In addition, the side-scan sonar mosaic was compared with the USGS multibeam backscatter imagery that was acquired from 1996 through 1999.

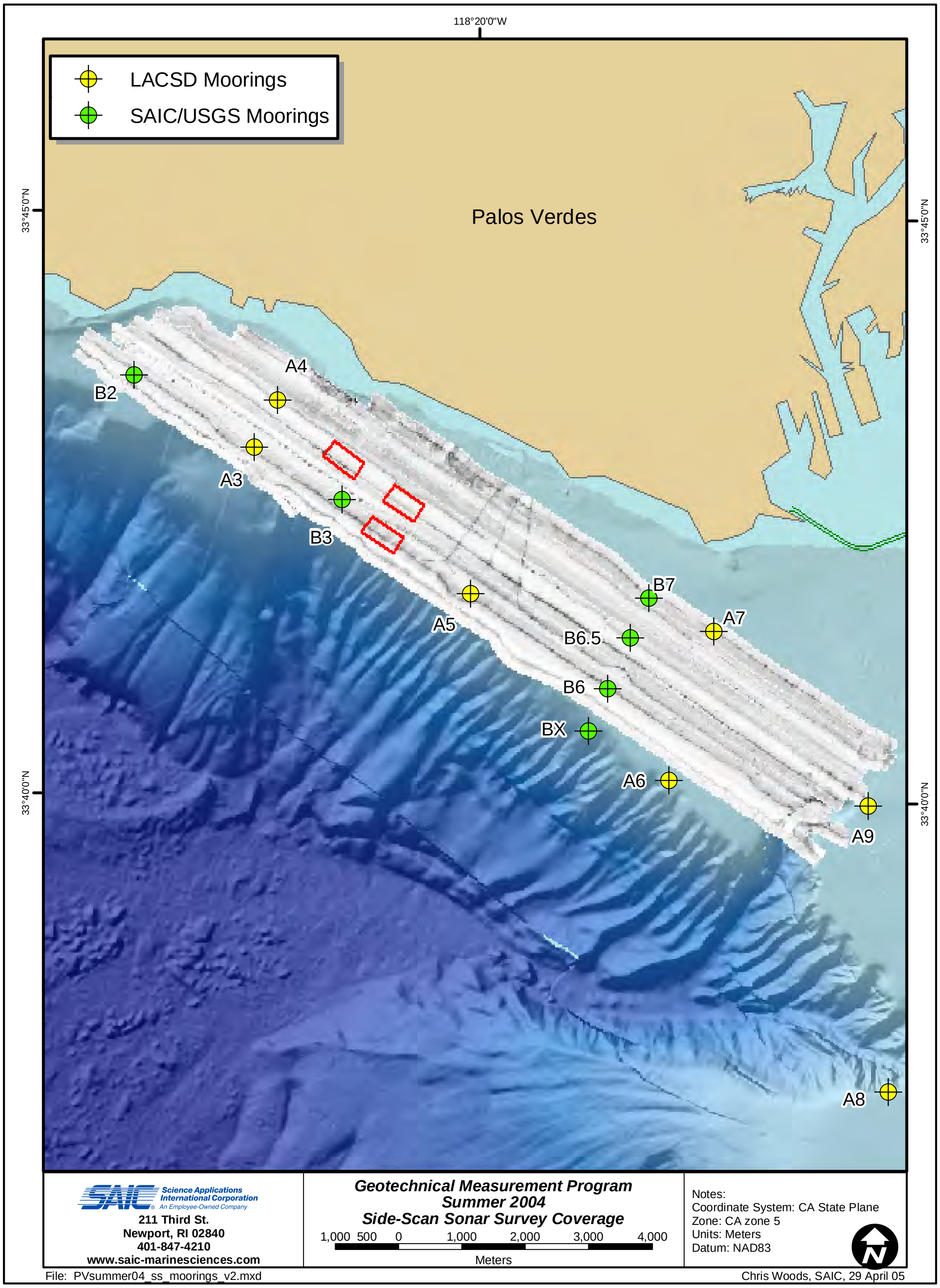


Figure 3.1-1. Map showing the side-scan sonar mosaic acquired in late June providing full-bottom acoustic imagery coverage over the main areas of interest along the PV Shelf and Upper Slope. The outfall pipes are depicted in the side-scan mosaic.

The Whites Point outfall pipes exhibited a strong acoustic return that was easily distinguishable from the surrounding seafloor sediments. In addition, because these pipes were generally oriented perpendicular to the main survey lanes and also extended across most of the survey region, they provided a useful feature for evaluating (and improving) the lane-to-lane positioning consistency of the side-scan sonar imagery. The mosaic depiction of these outfall pipes agreed well with the digitized boundaries of the pipes as provided by the LACSD (Figure 3.1-1).

In addition to the widespread areas of generally softer, fine-grained sediments that comprised most of the overall survey region, there were two distinct types of hard-bottom zones detected within the study area. In the nearshore area around and to the north of the outfall pipes, there was a large and generally continuous region of higher reflectance sediments. The inshore portions of this high reflectance area appeared to be comprised primarily of rocky patches and coarse sand and gravel deposits (Figure 3.1-2). Based on the sediment-profile and plan-view imagery data, the offshore portions of this higher-reflectance area were comprised of generally medium- to coarse-grained sand (Figure 3.1-3).

In addition to the inshore high-reflectance areas, isolated but numerous high-reflectance features were also identified in the offshore, southeastern portion of the study area, as well as a single, prominent feature in the offshore, northwest region (Figure 3.1-4). These hard-bottom patches presented a distinct boundary with the surrounding seafloor sediments and generally exhibited a circular morphology ranging from 30 to 60 m in diameter. Though the patches were generally isolated features, they sometimes fell in close proximity (< 20 m apart) to one another, forming somewhat longer, linear features on the seafloor. A more detailed discussion on the composition of these isolated hard-bottom patches is presented in the plan-view results section (3.2.2).

The USGS conducted high-resolution multibeam surveys of the LA Margin from 1996 through 1999 and have provided online access to the xyz acoustic backscatter data. Though these high-resolution backscatter data were not originally intended for publication, the USGS was required to provide them through a previous Freedom of Information Act request; because of this, the USGS web-site clearly states that the backscatter data may contain data-collection and processing artifacts. Despite this caveat, the older multibeam backscatter data generally corresponded well with the recent side-scan sonar data (Figure 3.1-5). In addition to the well-defined outfall pipe features, the numerous higher reflectance regions (primarily inshore and to the southeast) also correlated well between the two datasets.

In general, side-scan sonar data will provide higher resolution and better defined seafloor imagery (particularly in deeper water), primarily because of the improved beam grazing angles obtained through the towed sonar transducer. Conversely, multibeam backscatter data will provide more accurate imagery positioning due to the precisely known location of the ship-mounted multibeam transducer. Because of the complementary strengths of the two data types, the multibeam backscatter data proved particularly useful for confirming the position of the numerous, small-scale side-scan sonar features that were identified (Figure 3.1-5). The consistent agreement in the depiction of the patchy hard-bottom areas between the side-scan sonar and backscatter datasets indicates that these are not migratory or short-lived features, at least over the five- to eight-year time span between these surveys.

In addition to the areas with strong side-scan sonar and backscatter agreement, there were also some areas where the side-scan sonar and backscatter data contradicted each other. As mentioned above, the backscatter data were not thoroughly post-processed and likely contained some data-collection and processing artifacts. Some of the backscatter artifacts were obvious and predictable, such as the varying cross-track intensities associated with weaker backscatter returns in the outer beams. Other more random backscatter artifacts were less frequent, and may have been associated with water-column interference

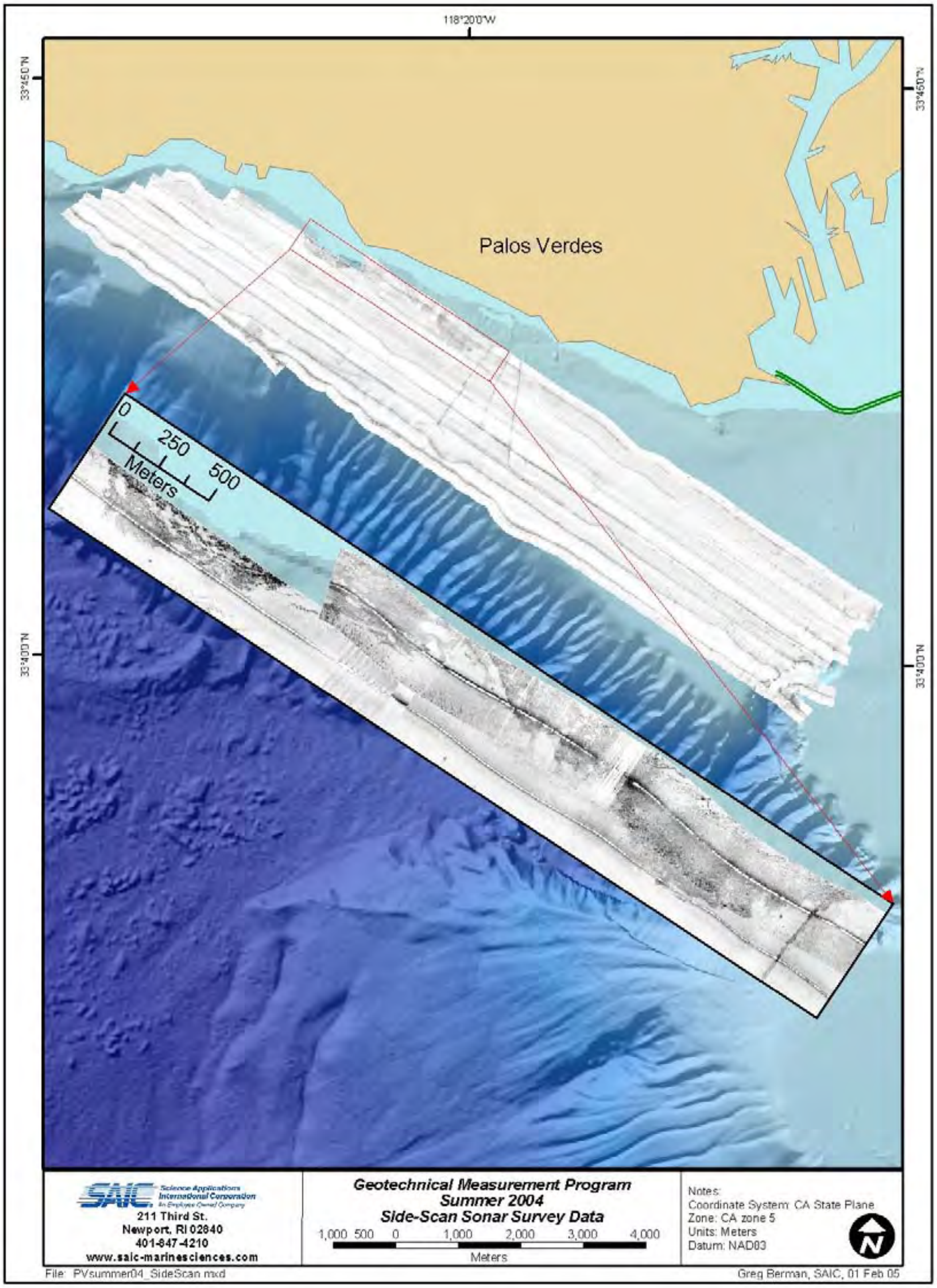


Figure 3.1-2. Map of the side-scan sonar mosaic showing a region of higher reflectance sediments within the nearshore area around and to the north of the outfall pipes. Inshore areas appeared to be comprised of rocky patches, coarse sand, and gravel deposits.

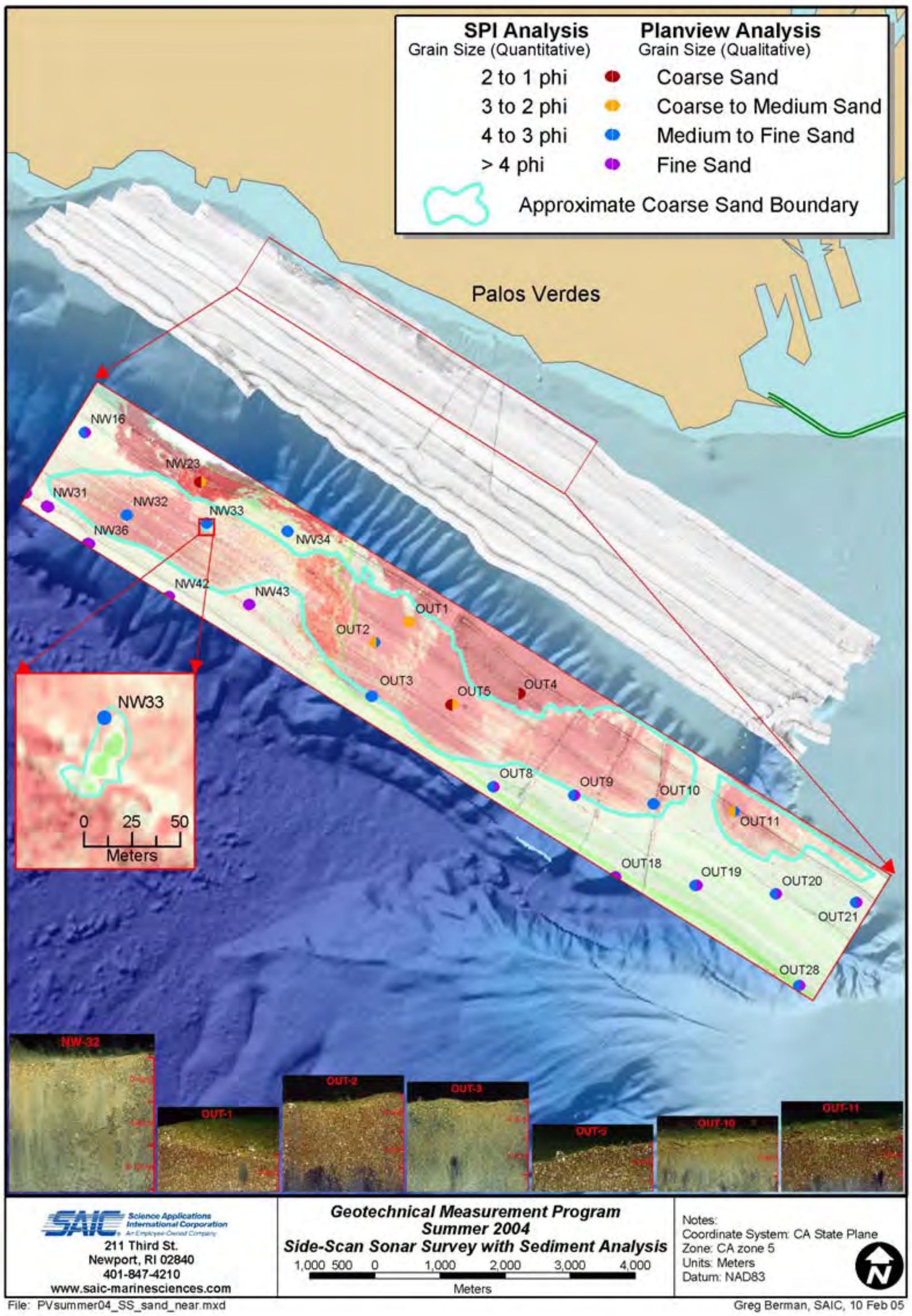


Figure 3.1-3. Sediment–profile and plan-view imaging data ground-truth the offshore, higher reflectance areas found in the side-scan sonar data.

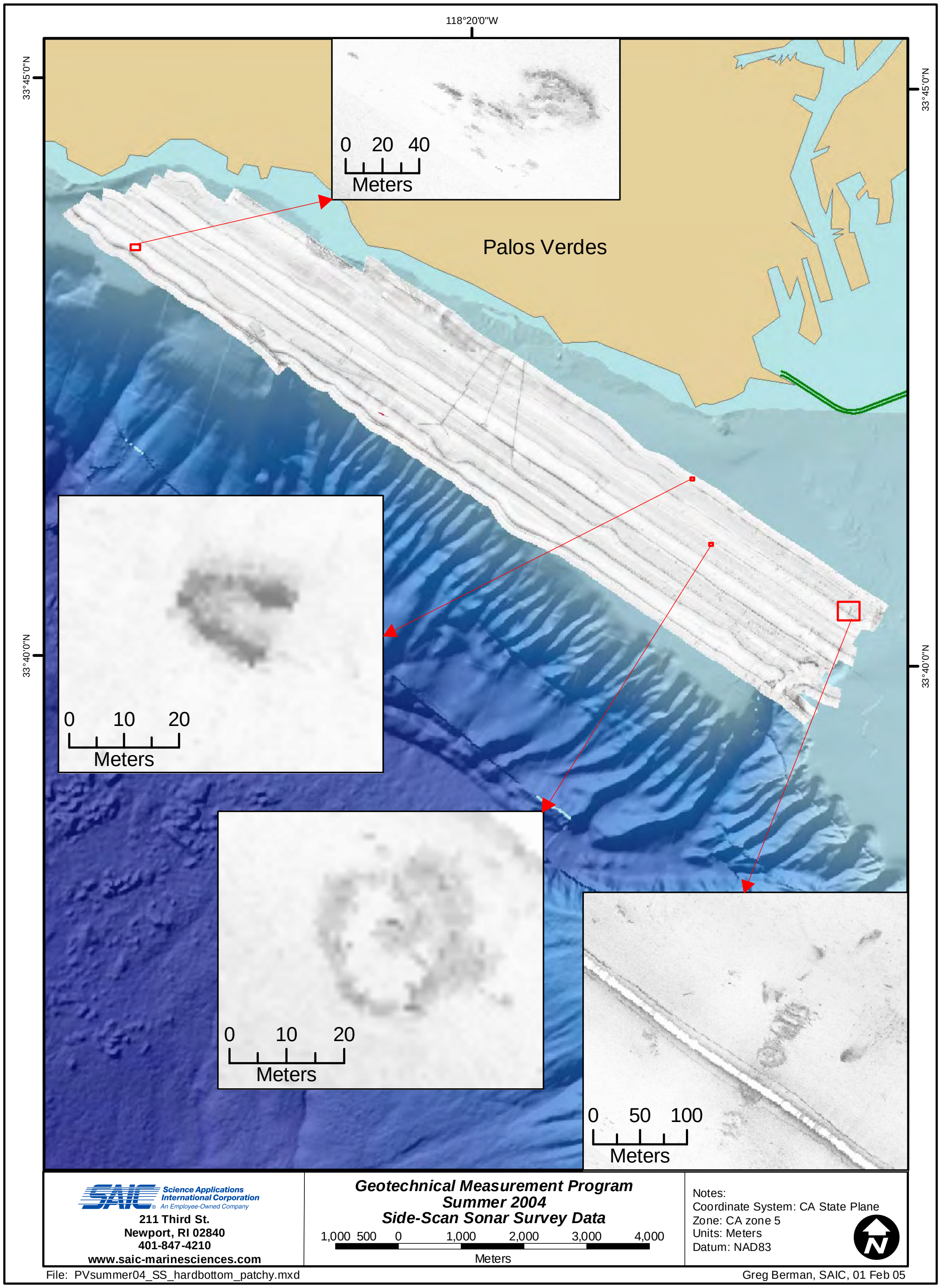


Figure 3.1-4. Enlarged views of isolated high-reflectance features detected in the side-scan sonar mosaic showing circular hard-bottom features (high acoustic return) against the surrounding seafloor (faint acoustic return).

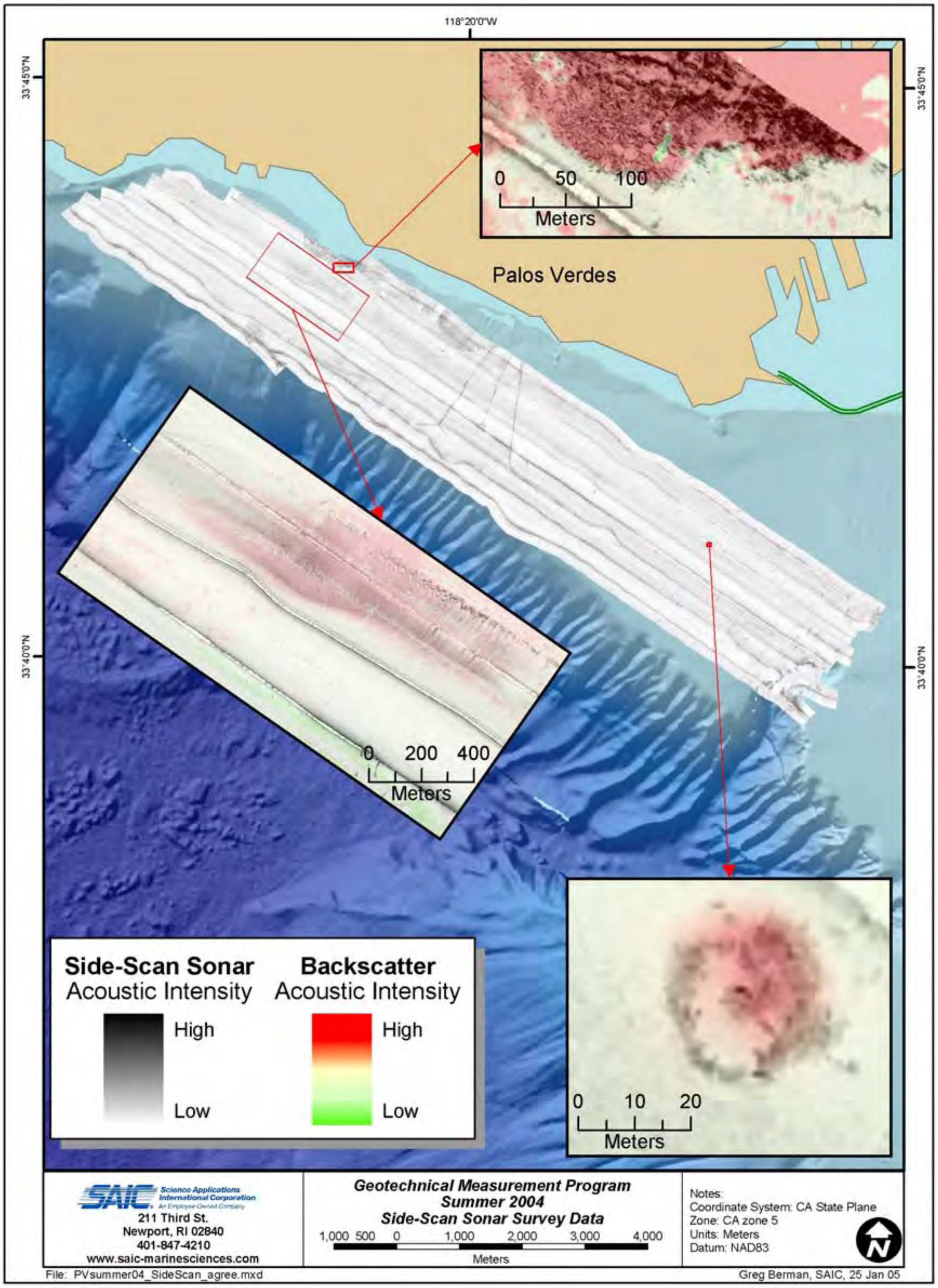


Figure 3.1-5. Composite graphic displaying the Summer 2004 side-scan sonar mosaic overlaid on the USGS multibeam backscatter data. Numerous higher reflectance regions (patchy hard-bottom areas) correlated well between the backscatter and side-scan sonar data

and/or incomplete data smoothing. While high-reflectance side-scan sonar data could be corroborated with hard-bottom sediment-profile and plan-view images over all of their overlapping sampling areas, some high-intensity backscatter areas were contradicted by the soft-bottom sediment-profile and plan-view images (Figure 3.1-6). It is likely that some additional post-processing of the multibeam backscatter data would be beneficial before further application to the broad-scale physical characterization of the PV Shelf.

In addition to confirming the presence and location of the sporadic higher-reflectance side-scan sonar features, the backscatter data were also useful for helping to refine the interpretation of some of the lower reflectance areas that comprised a large portion of the overall survey region. Use of the backscatter data in conjunction with the side-scan sonar data allowed for greater distinction and boundary definition in some areas of relatively subtle differences in reflectivity or intensity. The middle inset in Figure 3.1-5 shows how slightly higher-reflectance side-scan sonar returns were corroborated by slightly higher backscatter intensities over the same area of the seafloor. A sediment-profile image (NW-32) confirmed that this area was comprised of sandier sediments than the surrounding lower reflectance areas. Because this somewhat sandier seafloor area exhibited much lower reflectivity than the nearby inshore hard-bottom areas, this subtle reflectivity difference would have been more difficult to detect without the use of complimentary acoustic datasets. Though well outside the scope of this basic data reporting effort, a more thorough analysis of the complimentary side-scan sonar and multibeam backscatter datasets, along with confirming imagery data, may yield additional useful boundary distinctions within other seafloor areas of generally similar sediment type across the PV Shelf.

3.2 SEDIMENT PROFILE AND PLAN-VIEW IMAGE RESULTS

In accordance with the approved sampling plan, approximately 170 separate sediment-profile imaging (SPI) and plan-view imaging stations were occupied during the July 2004 survey, with three replicate images collected at each station (Figures 2.2-1 and 2.2-2). These images adequately captured sedimentary and biological conditions at the sediment-water interface to camera penetration depths ranging between 0 and 20 cm. The sediment-profile images were captured digitally and stored for future analysis utilizing specialized software to extract valuable information that will be used to evaluate sediment composition and habitat conditions at each station. Plan-view images collected in conjunction with the sediment-profile images were primarily analyzed for surface features on the seafloor (i.e., bedforms, burrows, epifauna, etc.) that may have a bearing on the sedimentary environment and physical sediment properties.

Sediment-profile and plan-view imaging results from the July 2004 survey of the PV Shelf are presented below. To simplify presentation, stations were grouped into three major regions (NW, OUT, and SE) based on general station location relative to the outfalls. The complete set of SPI results for the entire survey is provided in Appendix A; these results are summarized in Tables 3.2-1, 3.2-2, and 3.2-3. The complete set of plan-view data is provided in Appendix B.

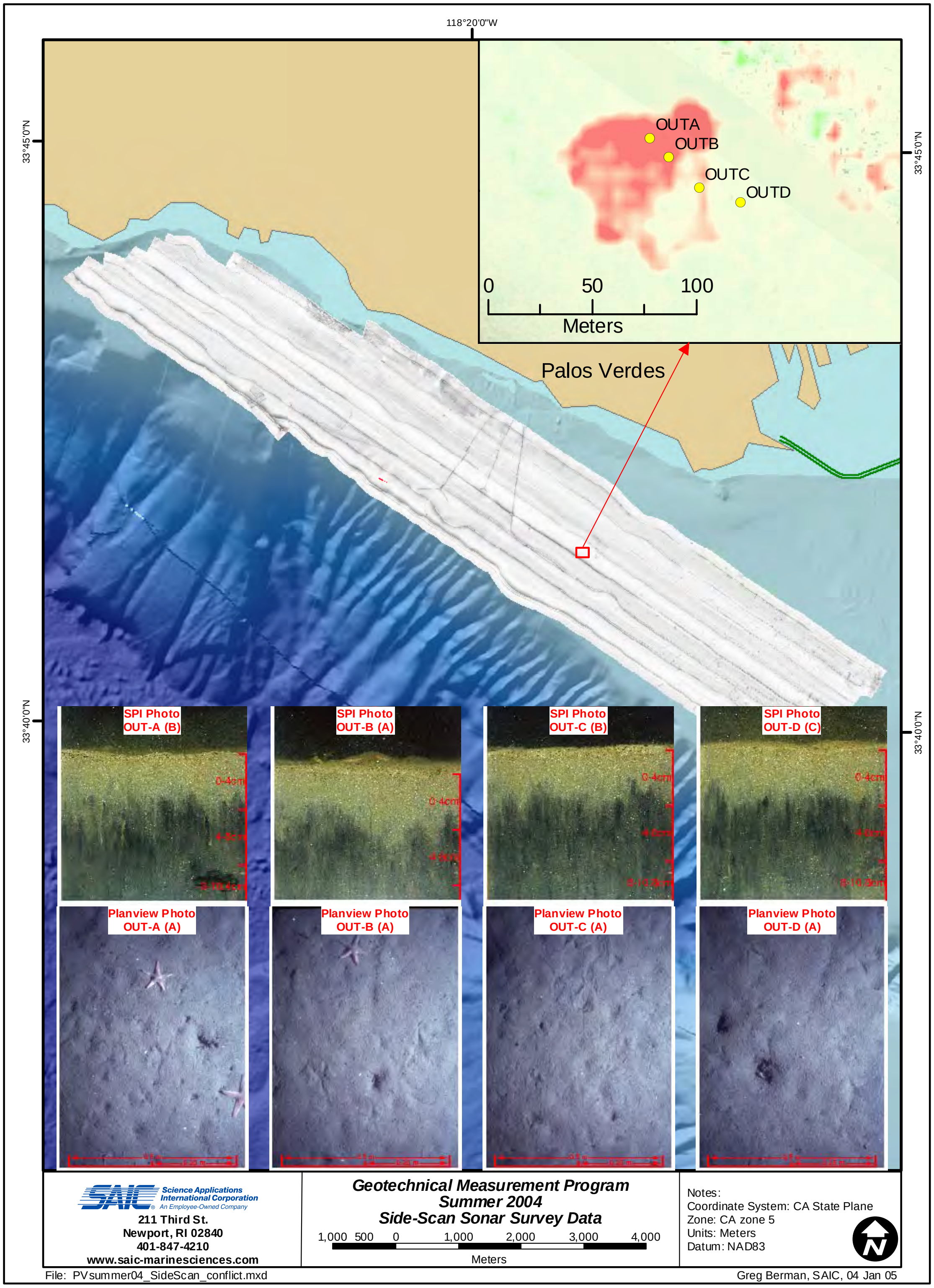


Figure 3.1-6. Sediment-profile and plan-view images relative to the side-scan sonar mosaic. High intensity backscatter returns suggest a hard bottom environment, however both sediment-profile and plan-view images display a soft-bottom habitat.

Table 3.2-1. Summary of SPI Results for the NW Stations, Palos Verdes July 2004 Survey

Station	Grain Size Major Mode (# replicates)	Camera Penetration Mean (cm)	Boundary Roughness Mean (cm)	Benthic Habitat (# replicates)	Successional Stages Present (# replicates)	RPD Mean (cm)	Methane Present	OSI Mean
NW1	2 to 1 phi (2)	6.06	0.77	SA.M (2)	ST I (2)	6.06	No	7.00
NW10	> 4 phi (2)	11.88	2.41	UN.SI (2)	ST I on III (2)	2.11	No	8.50
NW11	> 4 phi (2)	12.41	1.65	UN.SI (2)	ST I on III (2)	2.74	No	9.50
NW12	> 4 phi (2)	12.56	2.15	UN.SI (2)	ST I on III (2)	2.62	No	9.00
NW13	> 4 phi (2)	12.82	1.07	UN.SI (2)	ST I on III (2)	2.45	No	8.50
NW14	> 4 phi (2)	12.33	1.10	UN.SI (2)	ST I on III (2)	1.71	No	8.00
NW15	> 4 phi (2)	12.20	0.94	UN.SI (2)	ST I on III (2)	2.47	No	9.00
NW16	4 to 3 phi (2)	10.39	1.55	UN.SI (2)	ST I (1), ST I on III (1)	1.84	No	6.00
NW17	> 4 phi (2)	12.02	2.41	UN.SI (2)	ST I on III (2)	3.58	No	10.50
NW18	> 4 phi (2)	8.53	2.05	UN.SI (2)	ST I (1), ST I on III (1)	2.40	No	6.50
NW19	> 4 phi (1), 4 to 3 phi (1)	11.34	1.24	UN.SI (2)	ST I on III (2)	3.00	No	9.50
NW2	> 4 phi (1), 4 to 3 phi (1)	11.27	1.74	UN.SI (2)	ST I on III (2)	2.07	No	8.00
NW20	> 4 phi (2)	10.86	2.33	UN.SI (2)	ST I on III (2)	2.27	No	8.50
NW21	> 4 phi (1)	12.13	0.38	UN.SI (1)	ST I on III (1)	1.70	No	8.00
NW22	> 4 phi (1), 4 to 3 phi (1)	12.83	1.95	UN.SI (2)	ST I on III (2)	3.52	No	10.00
NW23	2 to 1 phi (2)	0.58	1.11	SA.M (2)	INDET (2)	1.16	No	INDET
NW24	> 4 phi (2)	13.80	1.08	UN.SI (2)	ST I on III (2)	2.97	No	9.50
NW25	> 4 phi (2)	11.85	1.22	UN.SI (1), UN.SS (1)	ST I on III (2)	1.82	No	8.00
NW26	> 4 phi (2)	12.03	1.52	UN.SI (2)	ST I on III (2)	2.48	No	9.00
NW27	> 4 phi (2)	12.35	2.07	UN.SI (2)	ST I on III (2)	2.67	No	9.00
NW28	> 4 phi (2)	11.49	0.92	UN.SI (2)	ST I on III (2)	2.41	No	9.00
NW29	> 4 phi (2)	12.56	1.35	UN.SI (2)	ST I on III (2)	2.55	No	9.00
NW3	> 4 phi (2)	12.43	1.82	UN.SI (2)	ST I on III (2)	2.27	No	8.50
NW30	> 4 phi (2)	12.90	0.79	UN.SI (2)	ST I on III (2)	2.70	No	9.00
NW31	> 4 phi (2)	12.47	1.33	UN.SI (2)	ST I on III (2)	2.22	No	8.50
NW32	> 4 phi (1), 4 to 3 phi (1)	11.76	0.73	UN.SI (1), UN.SS (1)	ST I on III (2)	2.81	No	9.50
NW33	4 to 3 phi (2)	11.49	0.96	UN.SI (1), UN.SS (1)	ST I on III (2)	3.14	No	9.50
NW34	4 to 3 phi (2)	11.06	1.93	UN.SI (2)	ST I (1), ST I on III (1)	2.51	No	6.50
NW35	> 4 phi (2)	10.89	3.91	UN.SI (2)	ST I on III (2)	3.08	No	9.50
NW36	> 4 phi (2)	12.81	0.99	UN.SI (2)	ST I on III (2)	3.78	No	10.50
NW37	> 4 phi (1), 4 to 3 phi (1)	13.57	3.10	UN.SI (2)	ST I on III (2)	3.59	No	10.50
NW38	> 4 phi (2)	11.60	0.82	UN.SI (2)	ST I on III (2)	2.37	No	9.00
NW39	> 4 phi (2)	11.68	2.29	UN.SI (2)	ST I on III (2)	2.58	No	9.00
NW4	> 4 phi (1), 4 to 3 phi (1)	12.18	1.38	UN.SI (2)	ST I on III (2)	3.28	No	9.50
NW40	> 4 phi (2)	12.52	1.17	UN.SI (1), UN.SS (1)	ST I on III (2)	2.32	No	9.00
NW41	> 4 phi (2)	12.32	0.89	UN.SI (2)	ST I on III (2)	2.27	No	8.50
NW42	> 4 phi (2)	10.43	1.60	UN.SI (2)	ST I on III (2)	2.00	No	8.00
NW43	> 4 phi (2)	11.10	1.34	UN.SI (2)	ST I on III (1), ST III (1)	2.03	No	8.00
NW44	> 4 phi (2)	12.37	2.03	UN.SI (2)	ST I on III (2)	2.14	No	8.50
NW45	> 4 phi (1), 4 to 3 phi (1)	13.40	1.35	UN.SI (1), UN.SS (1)	ST I on III (2)	3.11	No	10.00
NW46	> 4 phi (2)	11.58	1.37	UN.SI (2)	ST I on III (2)	2.82	No	9.50
NW47	> 4 phi (2)	12.50	1.47	UN.SI (2)	ST I on III (2)	2.61	No	9.00
NW48	> 4 phi (2)	13.18	3.89	UN.SI (2)	ST I on III (2)	4.22	No	10.50
NW49	> 4 phi (2)	14.01	1.90	UN.SI (2)	ST I on III (2)	3.30	No	10.00
NW50	> 4 phi (2)	11.48	1.06	UN.SI (2)	ST I on III (2)	2.30	No	8.50
NW51	> 4 phi (2)	11.64	0.86	UN.SI (2)	ST I on III (2)	2.55	No	9.00
NW52	4 to 3 phi (2)	10.50	1.46	UN.SI (1), UN.SS (1)	ST I on III (2)	1.85	No	8.00
NW53	> 4 phi (2)	10.97	1.34	UN.SI (2)	ST I on III (2)	2.28	No	9.00
NW54	> 4 phi (2)	12.64	1.38	UN.SI (2)	ST I on III (2)	3.16	No	9.50
NW55	> 4 phi (2)	12.02	1.67	UN.SI (2)	ST I on III (2)	1.86	No	7.50
NW56	> 4 phi (2)	12.15	1.00	UN.SI (1), UN.SS (1)	ST I on III (2)	2.43	No	8.50
NW57	> 4 phi (2)	11.75	0.94	UN.SI (2)	ST I on III (2)	2.51	No	9.00
NW5	3 to 2 phi (1), 4 to 3 phi (1)	10.07	0.44	SA.F (1), UN.SS (1)	ST I (1), ST I on III (1)	3.98	No	8.50
NW6	> 4 phi (2)	11.59	1.62	UN.SI (2)	ST I on III (2)	2.63	No	9.00
NW8	> 4 phi (2)	13.15	1.49	UN.SI (2)	ST I on III (2)	3.07	No	9.50
NW7	> 4 phi (2)	11.65	1.64	UN.SI (2)	ST I on III (2)	2.43	No	8.50
NW9	> 4 phi (2)	12.17	1.11	UN.SI (2)	ST I on III (2)	2.04	No	8.00
AVG		11.65	1.51			2.65		8.80
MAX		14.01	3.91			6.06		10.50
MIN		0.58	0.38			1.16		6.00

Table 3.2-2. Summary of SPI Results for the OUT Stations, Palos Verdes July 2004 Survey

Station	Grain Size Major Mode (# replicates)	Camera Penetration Mean (cm)	Boundary Roughness Mean (cm)	Benthic Habitat (# replicates)	Successional Stages Present (# replicates)	RPD Mean (cm)	Methane Present	OSI Mean
OUT1	3 to 2 phi (2)	3.75	1.80	SA.F (1), SA.M (1)	ST I (2)	3.12	No	6.00
OUT10	4 to 3 phi (2)	5.53	0.74	UN.SS (2)	ST I (2)	2.72	No	5.00
OUT11	3 to 2 phi (2)	4.99	0.48	SA.F (2)	ST I (2)	3.09	No	6.00
OUT12	> 4 phi (2)	11.09	1.05	UN.SI (2)	ST I on III (2)	2.63	No	9.00
OUT13	> 4 phi (2)	11.77	1.07	UN.SI (2)	ST I on III (2)	2.81	No	9.00
OUT14	4 to 3 phi (2)	10.02	0.99	UN.SI (1), UN.SS (1)	ST I on III (2)	2.95	No	9.50
OUT15	> 4 phi (2)	12.84	0.82	UN.SI (2)	ST I on III (2)	2.37	No	8.50
OUT16	> 4 phi (2)	10.90	1.49	UN.SI (2)	ST I on III (2)	2.55	No	8.50
OUT17	> 4 phi (2)	11.52	1.19	UN.SI (2)	ST I on III (2)	2.32	No	9.00
OUT18	> 4 phi (2)	10.22	0.84	UN.SI (2)	ST I (1), ST I on III (1)	2.82	No	7.50
OUT19	> 4 phi (1), 4 to 3 phi (1)	8.83	0.40	UN.SI (2)	ST I (1), ST I on III (1)	2.68	No	7.00
OUT2	3 to 2 phi (1), 4 to 3 phi (1)	7.79	1.50	UN.SS (2)	ST I (1), ST I on III (1)	3.99	No	8.50
OUT20	> 4 phi (1), 4 to 3 phi (1)	8.51	0.47	UN.SI (1), UN.SS (1)	ST I (2)	2.98	No	5.50
OUT21	4 to 3 phi (2)	5.98	1.61	UN.SI (1), UN.SS (1)	ST I (2)	2.51	No	5.00
OUT22	> 4 phi (2)	13.40	1.00	UN.SI (2)	ST I on III (2)	2.68	No	9.50
OUT23	> 4 phi (2)	14.12	1.06	UN.SI (2)	ST I on III (2)	4.14	No	10.00
OUT24	> 4 phi (2)	12.03	1.14	UN.SI (2)	ST I on III (2)	2.38	No	8.50
OUT25	> 4 phi (2)	10.33	0.70	UN.SI (2)	ST I on III (2)	2.72	No	9.00
OUT26	4 to 3 phi (2)	9.93	0.67	UN.SI (2)	ST I (1), ST I on III (1)	2.88	No	7.00
OUT27	> 4 phi (1), 4 to 3 phi (1)	11.02	1.75	UN.SS (2)	ST I (1), ST I on III (1)	3.07	No	8.00
OUT28	> 4 phi (1), 4 to 3 phi (1)	10.22	1.16	UN.SS (2)	ST I (1), ST I on III (1)	2.39	No	6.50
OUT29	4 to 3 phi (2)	9.37	0.85	UN.SS (2)	ST I (2)	2.16	No	4.50
OUT3	4 to 3 phi (2)	9.11	0.72	UN.SS (2)	ST I (2)	2.21	No	4.50
OUT30	4 to 3 phi (2)	6.30	1.26	UN.SS (2)	ST I (1), ST I on III (1)	2.20	No	6.00
OUT31	> 4 phi (2)	11.30	1.23	UN.SS (2)	ST I on III (2)	2.71	No	9.00
OUT32	> 4 phi (2)	15.66	1.89	UN.SI (2)	ST I on III (2)	2.13	No	8.50
OUT33	> 4 phi (2)	11.69	2.55	UN.SI (2)	ST I on III (2)	2.50	No	9.00
OUT34	> 4 phi (2)	11.13	0.85	UN.SI (2)	ST I on III (2)	2.34	No	8.50
OUT35	> 4 phi (1), 4 to 3 phi (1)	9.94	0.57	UN.SI (2)	ST I on III (2)	2.72	No	9.00
OUT36	> 4 phi (2)	9.64	0.73	UN.SI (2)	ST I on III (2)	2.90	No	9.00
OUT37	4 to 3 phi (2)	9.70	0.99	UN.SS (2)	ST I on III (2)	2.94	No	9.50
OUT38	> 4 phi (1), 4 to 3 phi (1)	9.52	0.59	UN.SI (1), UN.SS (1)	ST I on III (2)	2.72	No	9.00
OUT39	> 4 phi (1), 4 to 3 phi (1)	10.37	0.77	UN.SI (1), UN.SS (1)	ST I on III (2)	3.49	No	10.00
OUT4	N/A (2)	0.00	0.00	HR (2)	INDET (2)	INDET	No	INDET
OUT40	> 4 phi (2)	9.99	1.04	UN.SI (2)	ST I on III (2)	2.60	No	9.00
OUT41	> 4 phi (2)	13.52	1.24	UN.SI (2)	ST I on III (1), ST I (1)	2.28	No	6.50
OUT42	> 4 phi (2)	12.24	1.63	UN.SI (2)	ST I (1), ST I on III (1)	2.91	No	7.00
OUT43	> 4 phi (2)	10.77	1.14	UN.SI (2)	ST I on III (2)	2.79	No	9.00
OUT44	> 4 phi (2)	10.66	1.09	UN.SI (2)	ST I on III (2)	3.51	No	10.00
OUT45	> 4 phi (1), 4 to 3 phi (1)	10.29	1.71	UN.SI (2)	ST I on III (2)	2.92	No	9.50
OUT46	> 4 phi (1), 4 to 3 phi (1)	10.83	2.38	UN.SI (1), UN.SS (1)	ST I on III (2)	3.54	No	10.50
OUT47	> 4 phi (2)	11.28	1.55	UN.SI (2)	ST I on III (2)	2.69	No	9.00
OUT48	> 4 phi (2)	9.72	0.99	UN.SI (2)	ST I (1), ST I on III (1)	2.91	No	7.50
OUT49	4 to 3 phi (2)	10.62	2.18	UN.SS (2)	ST I (1), ST I on III (1)	4.05	No	8.50
OUT5	2 to 1 phi (1), 3 to 2 phi (1)	3.76	1.63	SA.M (2)	ST I (2)	3.76	No	6.50
OUT50	> 4 phi (2)	9.99	0.91	UN.SI (2)	ST I (1), ST I on III (1)	2.91	No	7.50
OUT51	> 4 phi (2)	10.90	0.84	UN.SI (2)	ST I on III (2)	1.98	No	8.00
OUT6	> 4 phi (1), 4 to 3 phi (1)	7.86	1.00	UN.SI (1), UN.SS (1)	ST I (2)	2.51	No	5.00
OUT7	> 4 phi (1), 4 to 3 phi (1)	9.97	2.35	UN.SI (1), UN.SS (1)	ST I on III (2)	3.16	No	9.50
OUT8	4 to 3 phi (2)	10.03	0.97	UN.SI (2)	ST I (1), ST I on III (1)	2.58	No	7.00
OUT9	4 to 3 phi (2)	11.14	2.28	UN.SS (2)	ST I (1), ST I on III (1)	3.18	No	7.50
OUTA	> 4 phi (2)	10.39	0.75	UN.SI (2)	ST I on III (2)	2.86	No	9.00
OUTB	> 4 phi (1), 4 to 3 phi (1)	9.09	0.57	UN.SI (2)	ST I on III (2)	2.80	No	9.00
OUTC	> 4 phi (2)	10.02	0.64	UN.SI (2)	ST I (1), ST I on III (1)	2.83	No	7.00
OUTD	> 4 phi (2)	10.84	0.87	UN.SI (2)	ST I (1), ST I on III (1)	2.84	No	7.00
AVG		9.86	1.14			2.82		7.94
MAX		15.66	2.55			4.14		10.50
MIN		0.00	0.00			1.98		4.50

Table 3.2-3. Summary of SPI Results for the SE Stations, Palos Verdes July 2004 Survey

Station	Grain Size Major Mode (# replicates)	Camera Penetration Mean (cm)	Boundary Roughness Mean (cm)	Benthic Habitat (# replicates)	Successional Stages Present (# replicates)	RPD Mean (cm)	Methane Present	OSI Mean
SE1	4 to 3 phi (2)	8.99	1.05	UN.SS (2)	ST I (1), ST I on III (1)	2.36	No	6.50
SE10	4 to 3 phi (2)	9.77	1.83	UN.SS (2)	ST I (1), ST I on III (1)	3.20	No	8.00
SE11	4 to 3 phi (2)	10.02	0.68	UN.SI (1), UN.SS (1)	ST I (1), ST I on III (1)	3.26	No	7.50
SE12	4 to 3 phi (2)	9.52	1.11	UN.SS (2)	ST I (1), ST I on III (1)	3.24	No	8.00
SE13	4 to 3 phi (2)	9.48	0.82	UN.SI (1), UN.SS (1)	ST I (1), ST I on III (1)	3.05	No	7.50
SE14	4 to 3 phi (2)	8.18	1.04	UN.SS (2)	ST I (1), ST I on III (1)	2.70	No	7.00
SE15	4 to 3 phi (2)	4.44	1.17	UN.SI (1), UN.SS (1)	ST I (2)	2.38	No	5.00
SE16	4 to 3 phi (2)	4.69	0.95	UN.SS (2)	ST I (1), ST I on III (1)	2.28	No	6.50
SE17	3 to 2 phi (2)	2.84	2.95	SA.F (2)	ST I (2)	3.18	No	6.00
SE18	4 to 3 phi (2)	5.96	0.86	UN.SS (2)	ST I (2)	2.66	No	5.00
SE19	4 to 3 phi (1), N/A (1)	2.85	0.92	SH.SA (1), UN.SS (1)	INDET (1), ST I on III (1)	2.77	No	9.00
SE2	4 to 3 phi (2)	9.41	0.87	UN.SS (2)	ST I on III (2)	2.82	No	9.00
SE20	4 to 3 phi (2)	10.23	1.21	UN.SI (1), UN.SS (1)	ST I (1), ST I on III (1)	2.89	No	7.50
SE21	4 to 3 phi (2)	8.91	1.00	UN.SS (2)	ST I on III (2)	3.27	No	10.00
SE22	4 to 3 phi (2)	9.47	1.19	UN.SS (2)	ST I (1), ST I on III (1)	2.44	No	7.00
SE23	4 to 3 phi (2)	7.57	0.71	UN.SS (2)	ST I on III (2)	2.64	No	9.00
SE24	4 to 3 phi (2)	9.66	0.53	UN.SS (2)	ST I (1), ST I on III (1)	2.21	No	6.50
SE25	4 to 3 phi (2)	3.12	0.99	UN.SS (2)	ST I (2)	2.15	No	4.00
SE26	3 to 2 phi (2)	2.41	2.27	SA.F (2)	INDET (1), ST I (1)	2.19	No	5.00
SE27	3 to 2 phi (2)	2.48	1.63	SA.F (2)	ST I (2)	2.11	No	4.50
SE28	4 to 3 phi (2)	7.74	1.31	UN.SS (2)	ST I on III (2)	2.93	No	9.50
SE29	3 to 2 phi (1), 4 to 3 phi (1)	7.09	1.54	SA.F (1), UN.SS (1)	ST I (1), ST I on III (1)	3.37	No	8.00
SE3	4 to 3 phi (2)	10.74	0.78	UN.SI (2)	ST I on III (2)	2.80	No	9.00
SE30	4 to 3 phi (2)	4.36	0.75	UN.SS (2)	ST I (2)	2.65	No	5.00
SE31	4 to 3 phi (2)	6.36	1.50	UN.SI (1), UN.SS (1)	ST I on III (2)	3.08	No	9.50
SE32	3 to 2 phi (2)	1.92	0.90	SA.F (2)	INDET (2)	2.23	No	INDET
SE33	> 4 phi (2)	10.04	0.53	UN.SI (2)	ST I on III (2)	2.39	No	9.00
SE34	4 to 3 phi (2)	6.39	0.99	UN.SS (2)	ST I (1), ST I on III (1)	2.97	No	7.50
SE35	3 to 2 phi (1), 4 to 3 phi (1)	6.06	0.67	UN.SS (2)	ST I (1), ST I on III (1)	3.41	No	8.00
SE36	4 to 3 phi (2)	5.92	3.16	UN.SS (2)	ST I (2)	2.40	No	4.50
SE37	3 to 2 phi (1), 4 to 3 phi (1)	4.77	1.95	SA.F (1), UN.SS (1)	ST I (1), ST I on III (1)	2.78	No	7.50
SE38	3 to 2 phi (1), 4 to 3 phi (1)	4.20	0.52	SA.F (1), UN.SS (1)	ST I (2)	2.57	No	5.00
SE39	4 to 3 phi (2)	4.29	1.64	UN.SS (2)	ST I on III (2)	2.71	No	9.00
SE4	> 4 phi (2)	9.55	2.79	UN.SI (2)	ST I on III (2)	3.52	No	10.50
SE40	3 to 2 phi (2)	2.09	0.93	SA.F (2)	INDET (2)	2.11	No	INDET
SE41	4 to 3 phi (1), N/A (1)	2.31	0.41	HR (1), UN.SS (1)	INDET (1), ST I (1)	1.19	No	5.00
SE42	4 to 3 phi (2)	8.38	0.75	UN.SS (2)	ST I on III (2)	2.68	No	9.00
SE43	4 to 3 phi (2)	5.13	0.97	SA.F (2)	ST I (2)	2.59	No	5.00
SE44	3 to 2 phi (2)	4.27	0.70	SA.F (2)	ST I (2)	2.72	No	5.00
SE45	3 to 2 phi (2)	3.28	0.57	SA.F (2)	ST I (2)	2.57	No	5.00
SE46	3 to 2 phi (2)	4.97	0.77	SA.F (1), UN.SS (1)	ST I (1), ST I on III (1)	2.72	No	7.00
SE47	4 to 3 phi (2)	6.78	0.67	UN.SS (2)	ST I (2)	3.57	No	6.00
SE48	4 to 3 phi (2)	4.61	0.54	UN.SS (2)	ST I (2)	3.18	No	6.00
SE5	4 to 3 phi (2)	6.92	1.11	UN.SS (2)	ST I on III (2)	3.02	No	9.50
SE6	4 to 3 phi (2)	9.44	1.51	UN.SS (2)	ST I (1), ST I on III (1)	3.34	No	8.00
SE7	> 4 phi (1), 4 to 3 phi (1)	9.24	0.88	UN.SI (1), UN.SS (1)	ST I (1), ST I on III (1)	2.76	No	7.50
SE8	4 to 3 phi (2)	10.04	0.48	UN.SS (2)	ST I (1), ST I on III (1)	3.08	No	7.50
SE9	4 to 3 phi (2)	10.37	0.72	UN.SS (2)	ST I on III (2)	2.38	No	9.00
AVG		6.61	1.12			2.74		7.17
MAX		10.74	3.16			3.57		10.50
MIN		1.92	0.41			1.19		4.00

3.2.1 Sediment-Profile Image Results

Physical Sediment Characteristics

Analysis of the SPI images from the 2004 survey indicated that surface sediments at a majority of the stations were fine-grained, tan and gray sandy silt, with major modes of > 4 and 4 to 3 phi (Tables 3.2-1 through 3.2-3; Figures 3.2-1 and 3.2-2). However, a significant component of very fine sand was found at various stations located southeast of the outfall (Stations SE), displaying grain size major modes of 4 to 3 phi (silty sand) and 3 to 2 phi (fine sand; Table 3.2-1 and Figures 3.2-1 and 3.2-2). Inshore stations near the outfall (Stations OUT) and north of the outfall (Stations NW) typically displayed more variable and coarser-grained sediments (2 to 1 phi; Figure 3.2-3). In addition, many OUT stations and nearby NW stations exhibited subsurface layers of black, sulfidic (or reduced) sediment beneath layers of oxidized sediment, suggesting an increased degree of organic loading (Figures 3.2-2B and 3.2-4B).

While a variety of benthic habitats were observed over the PV Shelf, the most common were classified as UN.SI (unconsolidated silty sediment) and UN.SS (fine sand mixed with silt; Figures 3.2-2 and 3.2-5). The primary benthic habitat classification for the NW stations was UN.SI however, some stations exhibited silty sediments with a high apparent proportion of very fine sand (benthic habitat type UN.SS; Table 3.2-1; Figure 3.2-3). Benthic habitats at the OUT stations were classified by benthic habitat type UN.SI, as well as benthic habitat type UN.SS; Table 3.2-2; Figure 3.2-5). Inshore stations typically displayed harder bottom conditions, with fine sand (habitat type SA.F) and hard bottom conditions (benthic habitat type HR) present at various stations (Figures 3.2-3 and 3.2-6). A variety of benthic habitat types were detected at stations within the SE area (UN.SI, UN.SS, SA.F, SH.SA, and HR), with benthic habitat type UN.SS the most common type observed (Table 3.2-3; Figure 3.2-5). Hard bottom conditions were detected in one replicate image of Station SE-41 and OUT-4 characterized by a hard coralline bottom (Figure 3.2-6).

The penetration depth of the sediment-profile camera prism typically serves as a relative measure of sediment density or compaction. Mean camera penetration measurements for the NW stations ranged from 0.6 cm at Station NW-23, characterized by medium sand, to 14.0 cm at Station NW-49 comprised of softer sediments (Table 3.2-1). Based on the fully-weighted camera configuration, the overall average penetration of 11.7 cm at the NW stations indicated moderately firm sediments, likely due to the modest sand content. Mean camera penetration measurements for the OUT stations were slightly lower, ranging from 0.0 cm at Station OUT-4 (hard bottom conditions) to 15.7 cm at Station OUT-32 (Table 3.2-2). The overall average of 9.9 cm likewise indicated moderately firm sediments. The SE stations displayed the lowest mean camera penetration values, ranging from 1.9 cm at Station SE-32 to 10.7 cm at Station SE-3 (overall average of 6.6 cm; Table 3.2-3). These lower camera prism penetration measurements reflected the presence of more compact sand or hard bottom conditions at numerous stations (Figure 3.2-4A). As a result of low camera prism depths, the analysis of key parameters (e.g., Redox Potential Discontinuity [RPD], successional stage, and Organism-Sediment Index [OSI]) was prevented in various replicate images in the SE region.

Boundary roughness values, a measure of small-scale surface relief, were generally low for all the sampled stations. Replicate-averaged boundary roughness values for the NW stations ranged from 0.4 cm at Station N-21 to 3.9 cm at Station NW-35, with an overall average of 1.5 cm (Table 3.2-1). Values in this range reflect a moderate amount of surface relief due primarily to physical processes (e.g., sand ripples, mud clasts). Replicate-averaged boundary roughness values for the OUT stations ranged from 0.4 cm at Station OUT-19 to 2.6 cm at Station OUT-33, with an overall average of 1.1 cm, indicating a relatively small amount of surface relief (Table 3.2-2). Similar to the NW stations, surface roughness was attributed to physical factors in the majority of the OUT images.

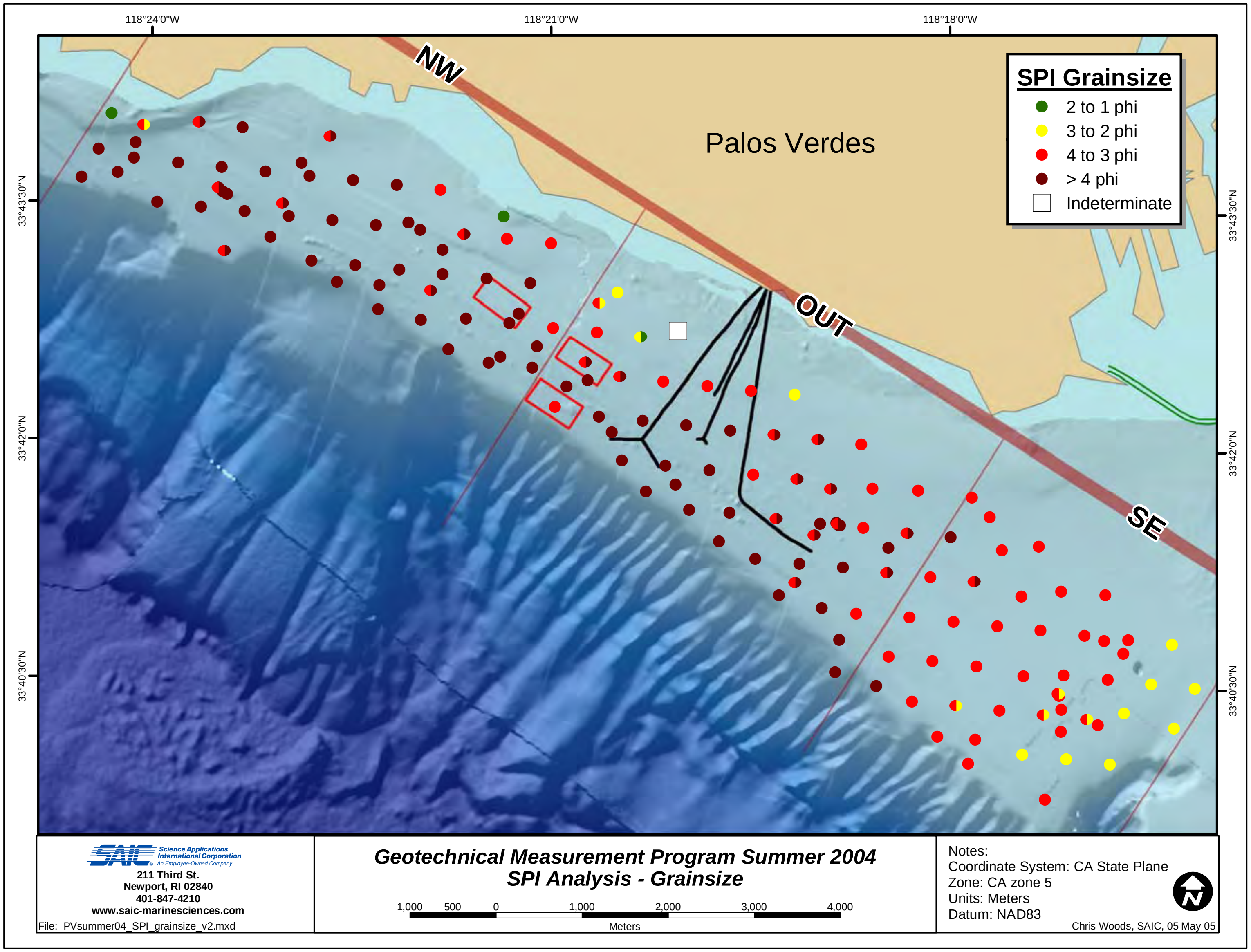


Figure 3.2-1. Map showing the grain size major mode (in phi units) at the July 2004 SPI stations over the Palos Verdes Shelf.

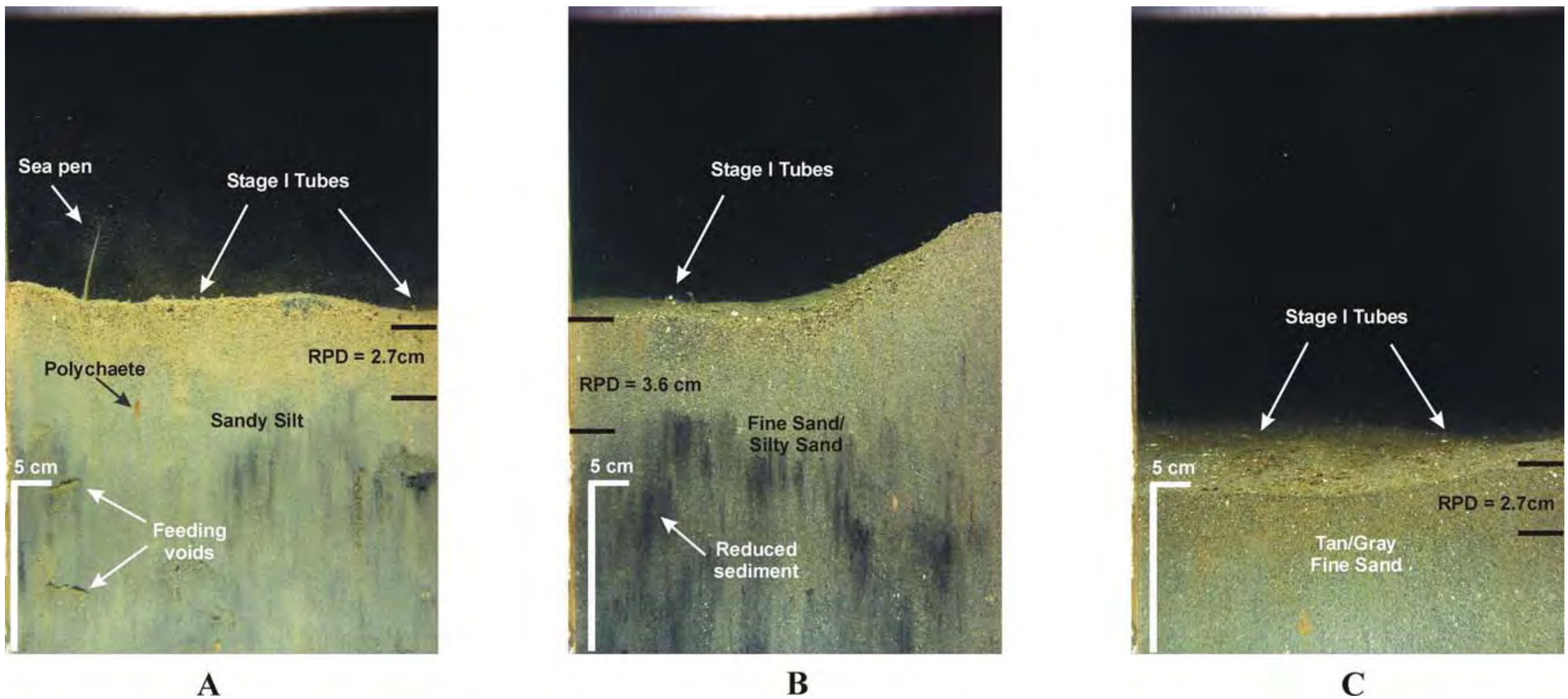


Figure 3.2-2. Sediment-profile images from Station NW-7 (A), OUT-9 (B), and SE-46 (C), illustrating various sediment types observed over the Palos Verdes Shelf. Fine-grained sediments (benthic habitat UN.SI and grain size major mode of >4 phi) comprised the majority of NW stations (A). Fine-grained sediments with a sand component (benthic habitat UN.SS and grain size major mode of 4 to 3 phi) characterized many OUT stations (B). The SE stations displayed the highest component of fine sand (benthic habitat SA.F and grain size major mode of 3 to 2 phi; C).

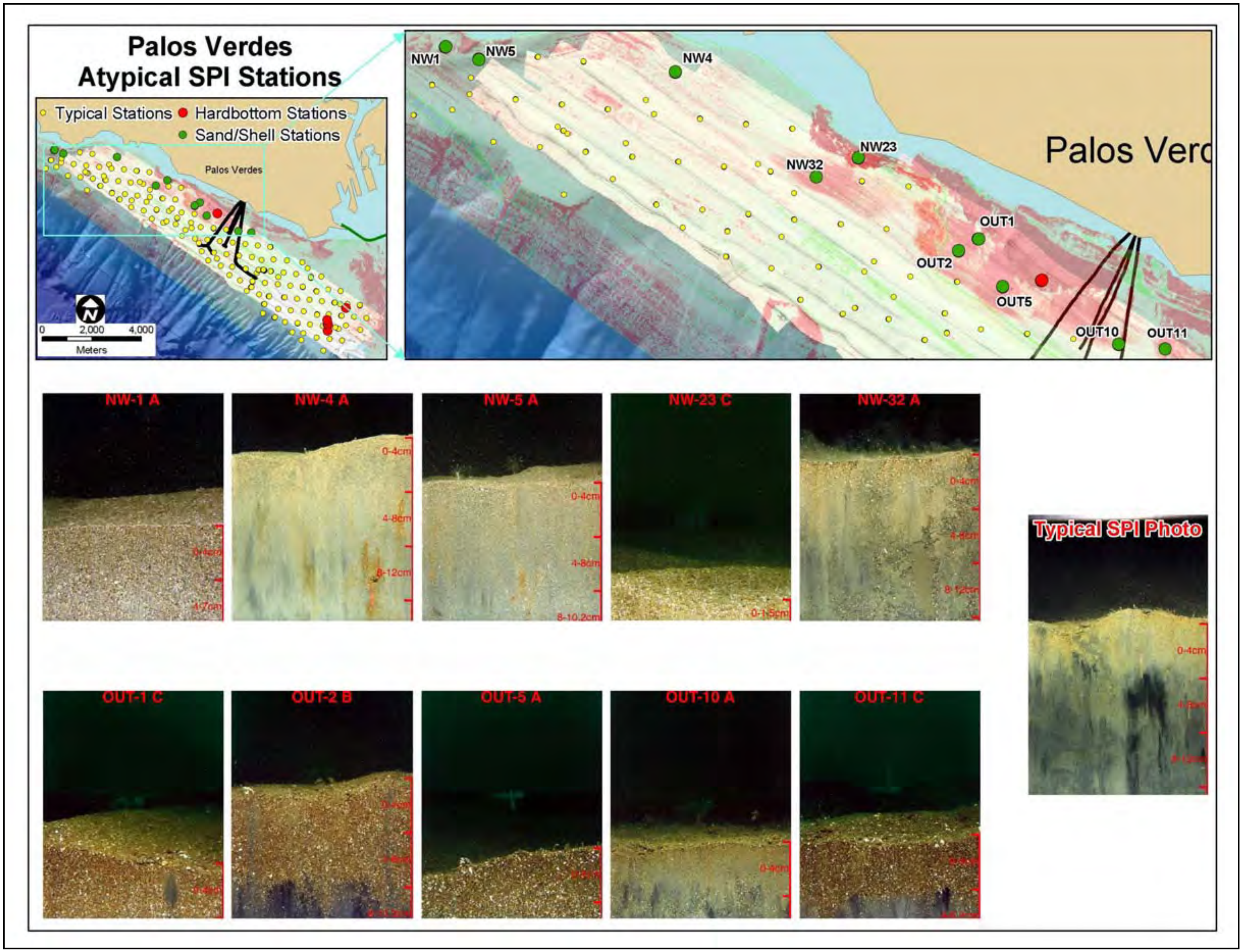
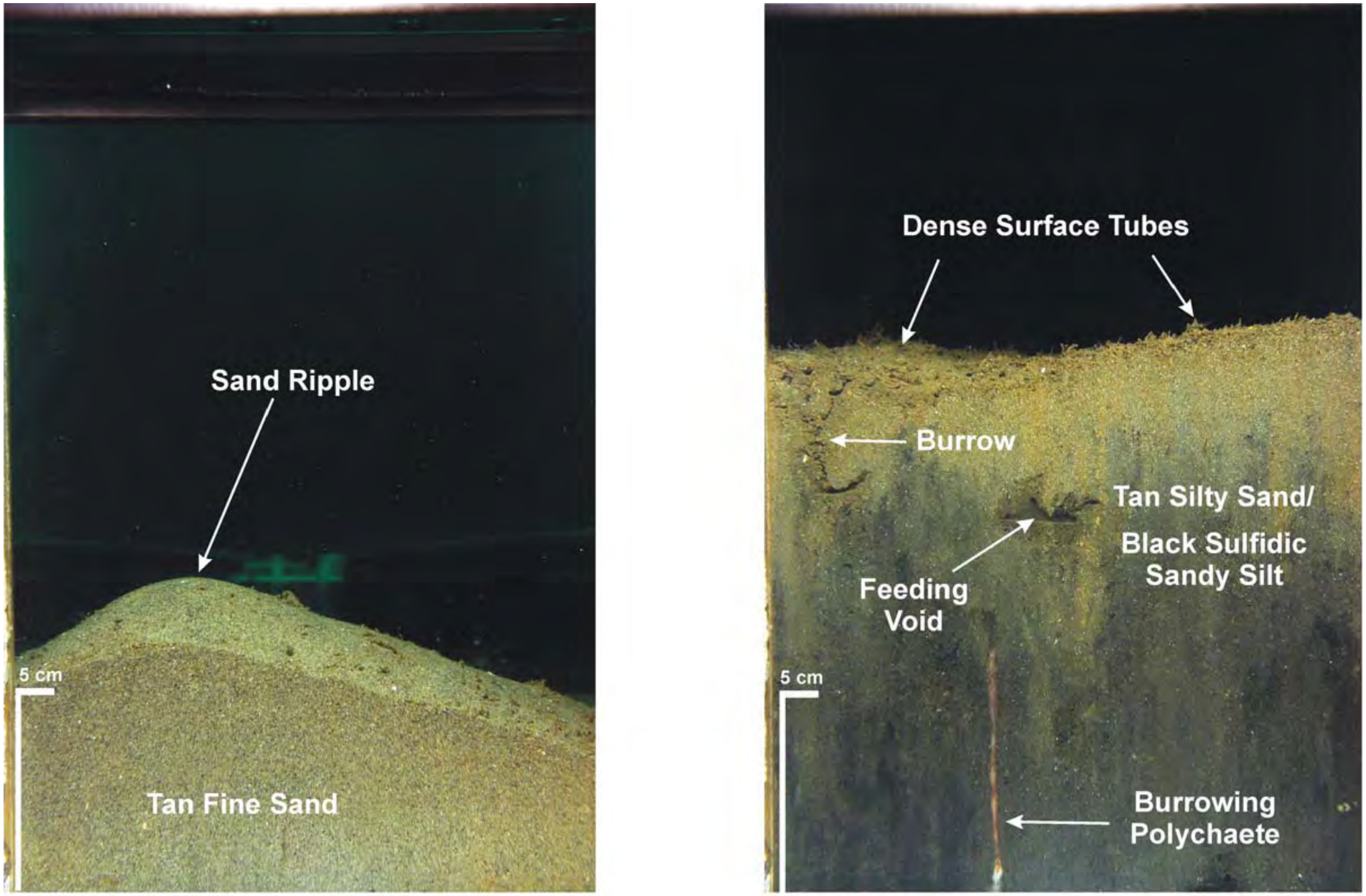


Figure 3.2-3. Atypical SPI images from the various inshore NW and OUT stations displaying coarser grained sediments. Relative locations of the sampling locations are indicated on the overview graphic at the top of this figure. The graphic in the upper right-hand corner shows the side-scan sonar and multibeam backscatter imagery in the immediate vicinity of these stations.



A B

Figure 3.2-4. Sediment-profile images from Station OUT-24 (A) and SE-17 (B) displaying surface roughness at the sediment surface. Image A illustrates physical surface roughness as a result of bedforms (sand ripples) at the sediment-water interface. Biogenic surface roughness was detected in image B, with dense surface tubes (tubicolous polychaetes) and a burrow opening at the sediment-water interface. Black sulfidic or reduced sediment is present in the subsurface sediments of image B.

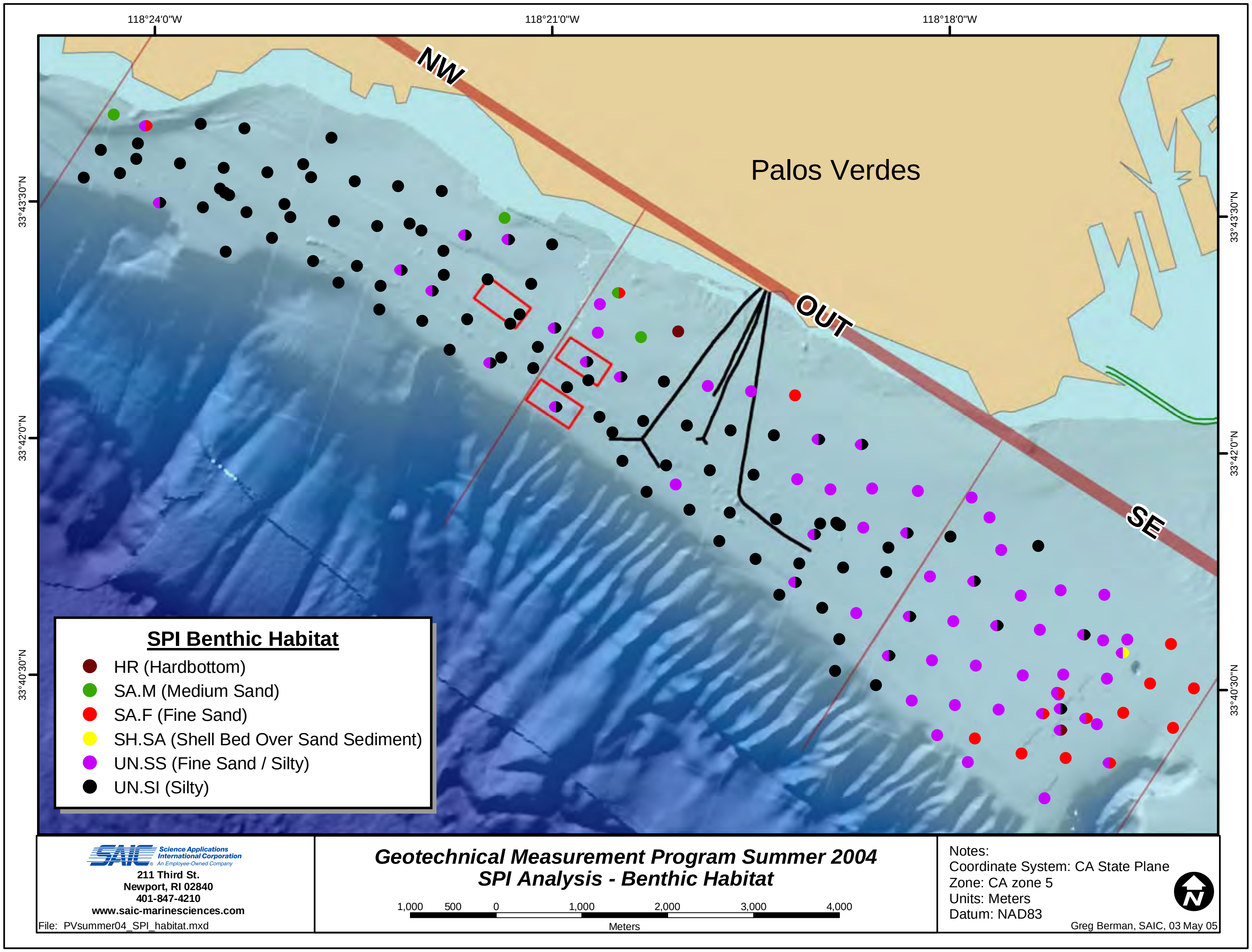


Figure 3.2-5. Benthic habitat classifications at the July 2004 SPI stations over the Palos Verdes Shelf.

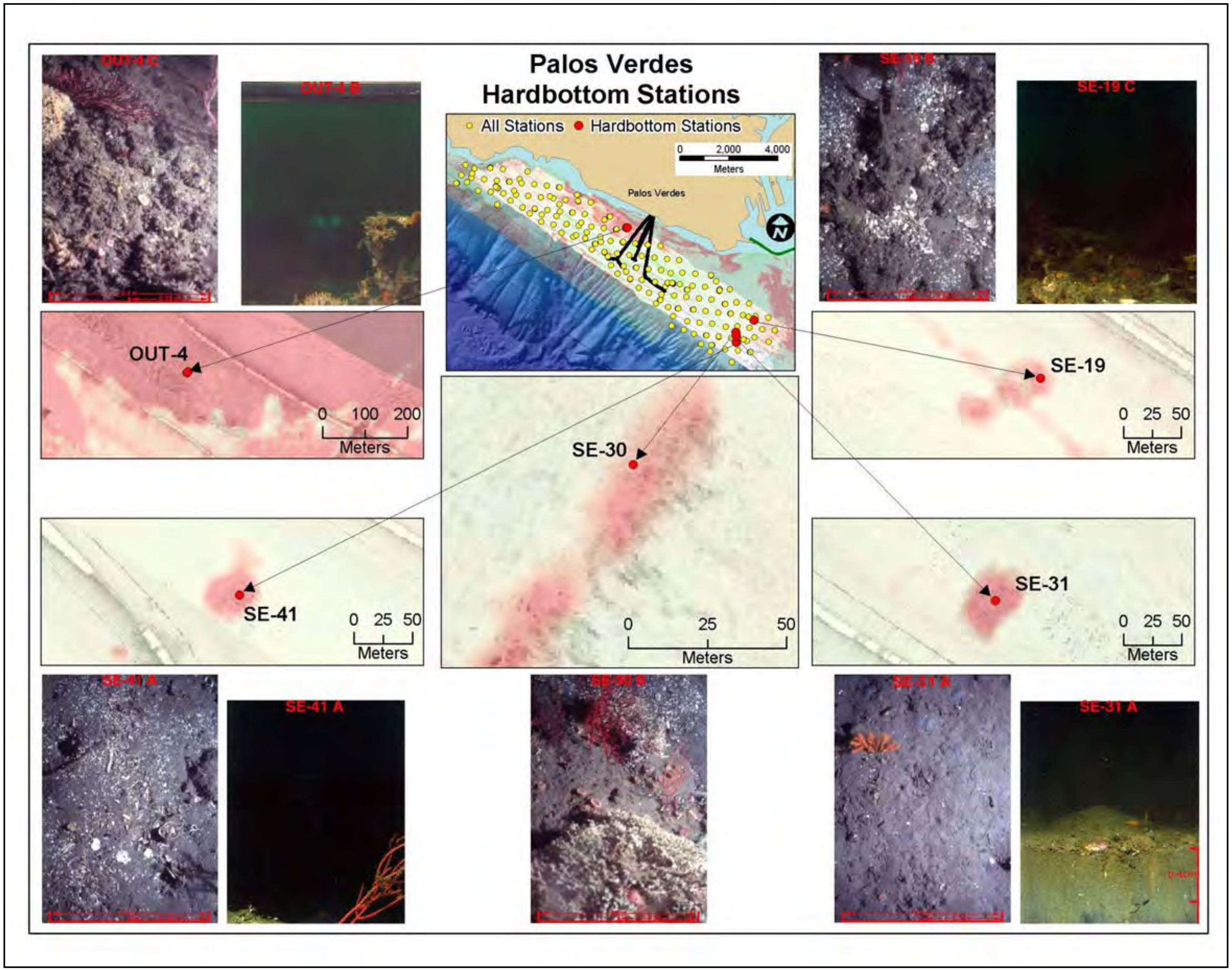


Figure 3.2-6. Sediment-profile and plan view images from the various OUT and SE stations displaying hard bottom conditions. Relative locations of the sampling locations are indicated on the overview graphic at the top of this figure. The graphics show the side-scan sonar and multibeam backscatter imagery in the immediate vicinity of these stations.

The SE Stations displayed boundary roughness values with a range of 0.4 cm at Station SE-41 to 3.2 cm at Station SE-36 (Table 3.2-3). The overall average of 1.2 cm was similarly indicative of small-scale surface relief due to physical factors (Table 3.2-3; Figure 3.2-4A). Dense assemblages of tubicolous polychaetes and biogenic structures such as burrow openings and fecal mounds at the sediment surface resulted in biogenic surface roughness for various replicate images over the surveyed area (Figure 3.2-4B).

Biological Characteristics

Three parameters were used to assess overall benthic habitat quality within the survey area: apparent Redox Potential Discontinuity (RPD) depth, infaunal successional status, and Organism Sediment Index (OSI). These three parameters were mapped on station location plots to outline the biological conditions at each station (Figures 3.2-7, 3.2-9, and 3.2-10).

The redox potential discontinuity (RPD) depth measured in each image provided an estimate of the apparent depth of oxygen penetration into the surface sediment. The mean apparent RPD depths at stations within the PV Shelf sample area were moderately deep, with the majority of the stations displaying RPD depths between 2.0 and 4.0 cm (Figures 3.2-7 and 3.2-8). In general, the deepest RPD depths occurred at stations located on the outermost margin of the PV Shelf. Conversely, the shallowest RPD depths were generally observed at stations within the NW sample area. Various replicate images characterized by sand had RPD depths that were measured beyond camera prism penetration (i.e., RPD > pen).

Replicate-averaged RPD depths for the NW stations ranged from 1.2 cm at Station NW-23 to 6.1 cm at Station NW-1 (Table 3.2-1; Figure 3.2-7). The overall average RPD value of 2.7 cm was indicative of relatively well-oxygenated surface sediments. At Station NW-23, characterized by medium sand, oxidation was attributed to physical mixing of the uppermost sediment layer related to periodic bed-load transport of the sand. At stations characterized by finer-grained material, aeration of the sediment and corresponding increases in the RPD depth were attributed to bioturbation activities of infaunal organisms (Figure 3.2-8A). Replicate-averaged RPD depths within the OUT sample area ranged from 2.0 cm at Station OUT-51 to 4.1 cm at Station OUT-23, with an overall average of 2.8 cm, indicative of relatively well-oxygenated surface sediments (Table 3.2-2; Figure 3.2-7). Similarly, mean apparent RPD depths ranged from 1.2 cm at Station SE-41 to 3.6 cm at Station SE-47 within the SE sample area (Table 3.2-3; Figure 3.2-7). The overall average RPD value of 2.7 cm was likewise indicative of well oxygenated surface sediments. None of the replicate images obtained within the PV Shelf sample area showed any evidence of apparent low dissolved-oxygen conditions, visible redox rebounds, or methane gas entrained within the sediment.

Infaunal successional status indicated the presence of an advanced benthic community across the PV Shelf. Stage I polychaetes were observed at the sediment surface together with Stage III feeding voids at depth (Stage I on III successional status) at the majority of the stations (Figure 3.2-9). A higher occurrence of only Stage I taxa was observed in the sandier stations located in the SE and inshore OUT sample areas (Figure 3.2-8C). Evidence of Stage III activity included active feeding voids produced by head-down, deposit-feeding infauna in the subsurface sediments, as well as the actual imaging of errant polychaetes within the sediment matrix (Figures 3.2-2 and 3.2-8A&B). When present, Stage III organisms were accompanied by Stage I polychaetes at the sediment-water interface in all but one station. This situation is not unusual in productive seafloor areas receiving relatively high inputs of organic matter, sufficient to maintain a diverse benthic population of both suspension- and deposit-feeders. Various stations (inshore and SE stations) were given an indeterminate successional status designation due to hard bottom conditions.

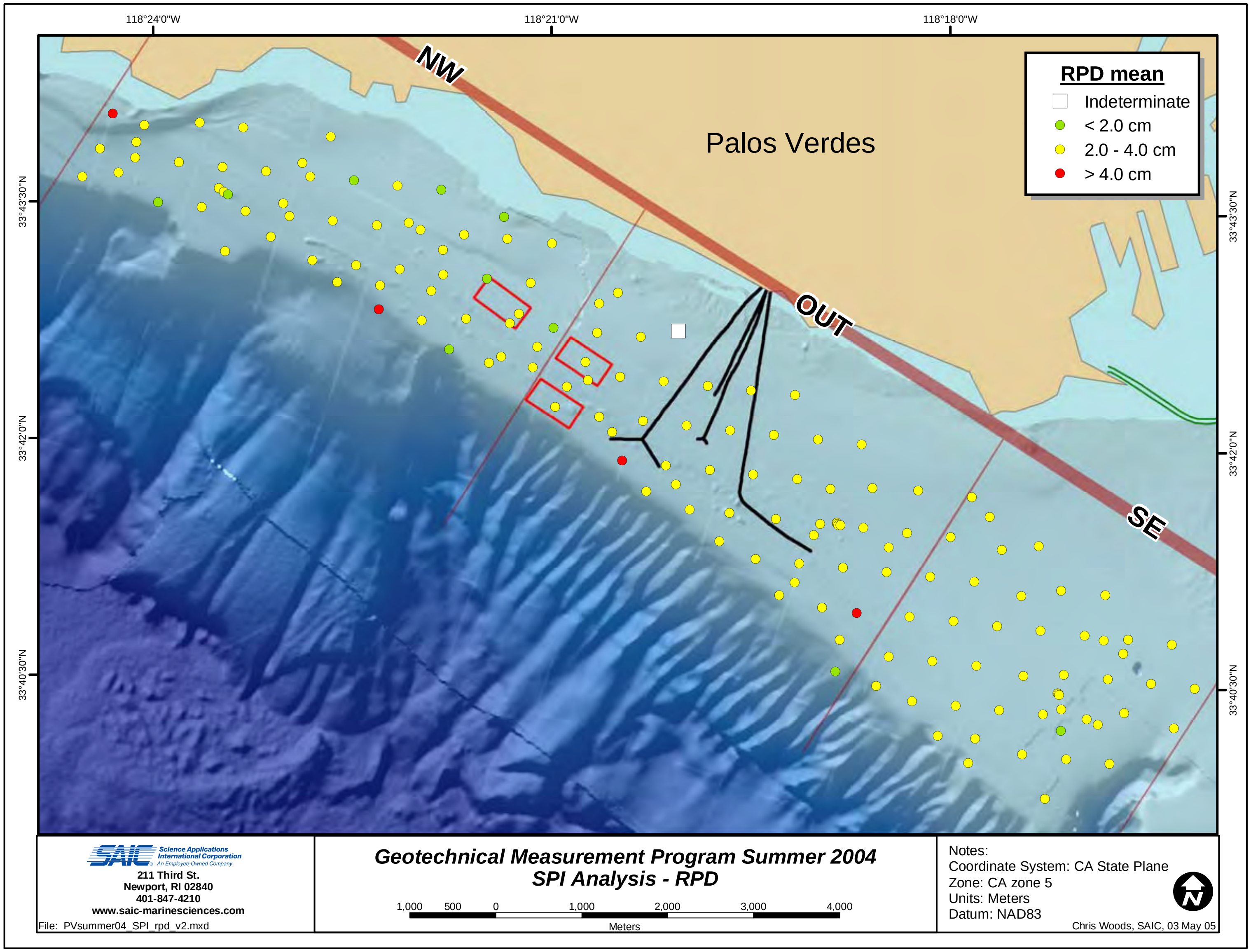


Figure 3.2-7. Mean apparent RPD depths (cm) at the July 2004 SPI stations over the Palos Verdes Shelf.

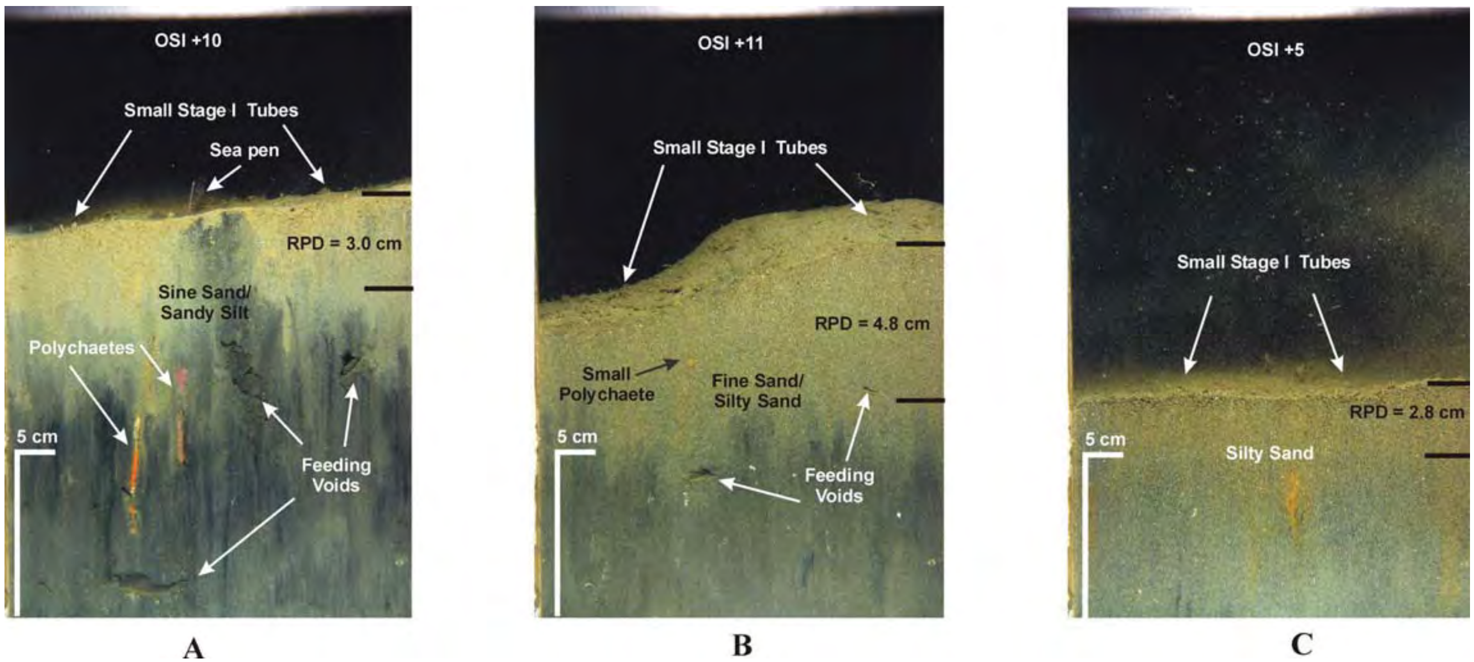


Figure 3.2-8. Sediment-profile images illustrating various benthic habitat conditions from Stations NW-45 (A), OUT-49 (B) and SE-18 (C). Relatively well-developed mean RPD depths and advanced successional status (Stage I on III) resulted in an OSI value of +10 for Station NW-45 (A) and +11 for Station OUT-49 (B) indicative of undisturbed benthic habitat quality. The presence of only Stage I tubicolous polychaetes at the surface of the sandy sediments resulted in an OSI of +5.0 indicative of disturbed benthic habitat quality at Station SE-18.

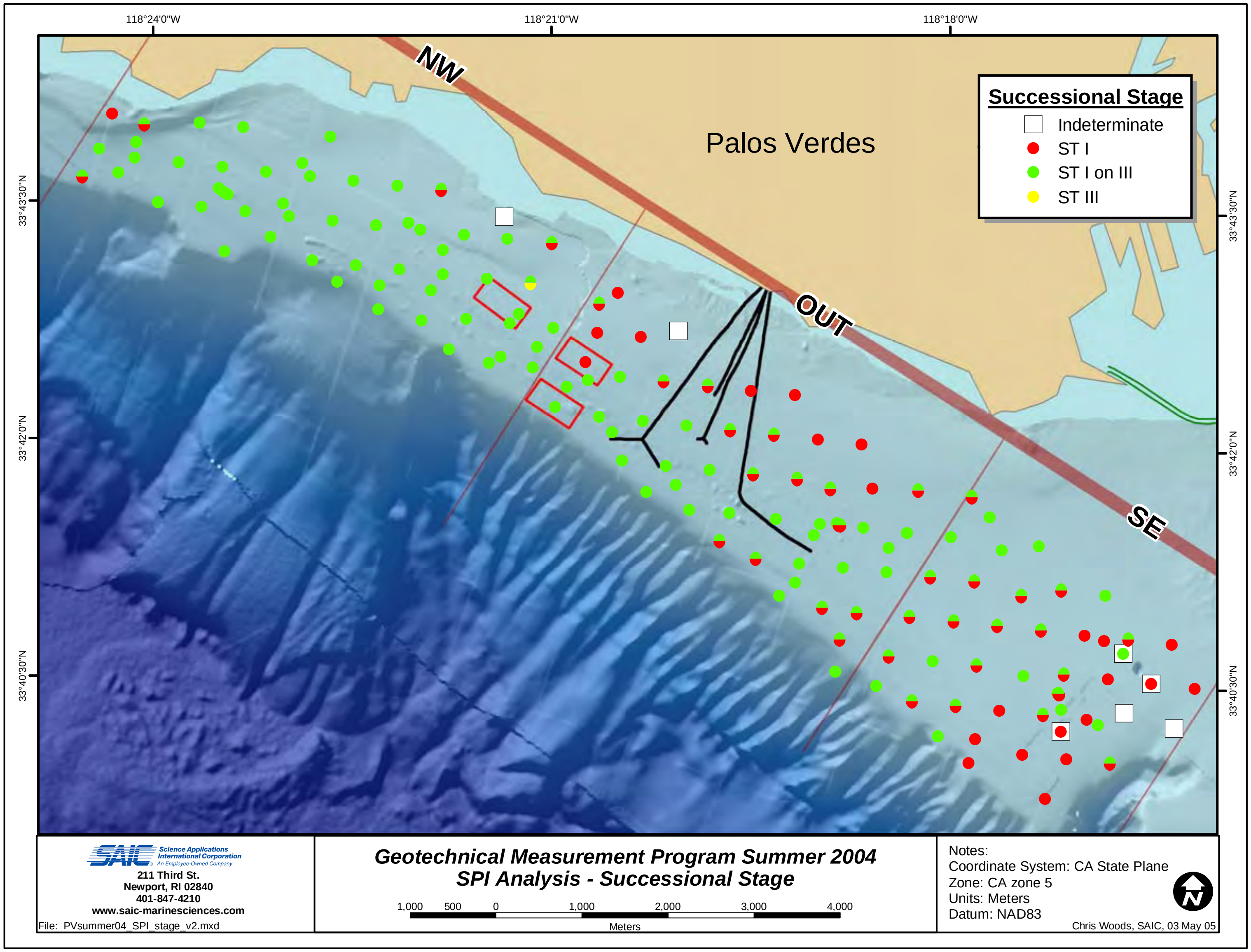


Figure 3.2-9. Map of successional stage status for the July 2004 SPI stations over the Palos Verdes Shelf.

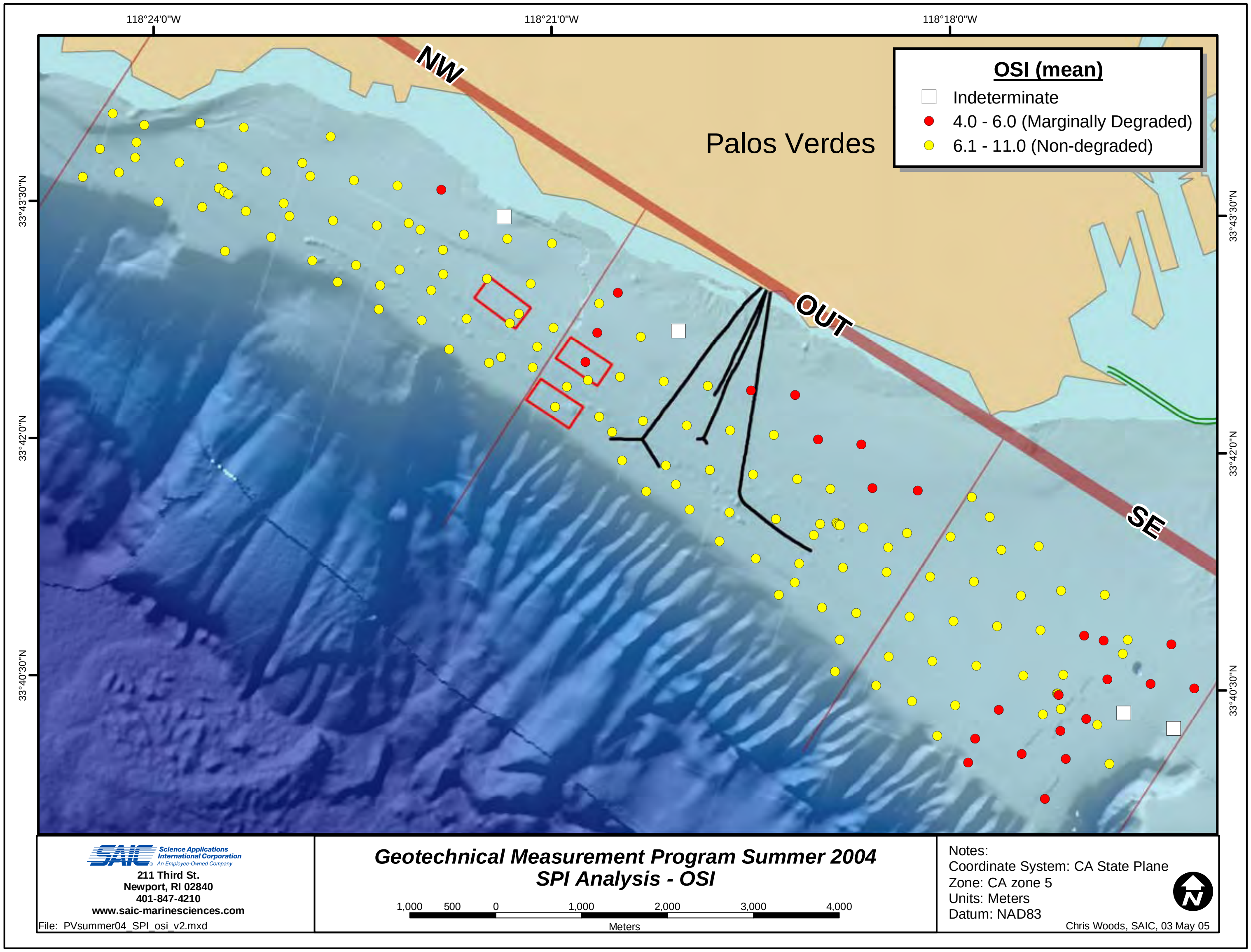


Figure 3.2-10. Map of mean OSI values at the July 2004 SPI stations over the Palos Verdes Shelf.

Stage III activity (Stage I on III successional status) was detected in 96% of the NW stations, 82% of the OUT stations, and 65% of the SE stations. Overall, the presence of Stage III taxa at the majority of stations sampled over the survey area reflected a mature benthic community. Lower occurrences of Stage III infauna at the SE and inshore OUT stations, characterized by coarser grained sediments (sand), was likely attributable to adaptation of Stage I species to the physical instability of the sediment-water interface (i.e., bed-load transport of sand), as well as the lack of organic matter available to infaunal deposit feeders. As a result, the sand limited the establishment of a Stage III community consisting of subsurface-deposit feeders. Alternatively, the NW stations composed of primarily fine-grained, organic-rich sediments were dominated by a Stage I on III successional status.

As discussed in Section 2.2.1, the REMOTS® Organism-Sediment Index (OSI) is a summary parameter used to provide a relative index of benthic habitat quality. The OSI is calculated using values assigned for the apparent RPD depth and successional status, as well as indicators of methane or low oxygen; OSI values may range from −10 (azoic with low sediment-dissolved-oxygen and/or presence of methane gas in the sediment) to +11 (healthy, aerobic environment with deep RPD depths and advanced successional stages). Overall, the high mean OSI values exhibited over much of the study area were reflective of the generally healthy benthic habitat conditions found across the PV Shelf (Figure 3.2-10). Analogous to the successional status results, lower OSI values (+4.0 to +6.0) were generally observed at the SE and inshore OUT sample areas where coarser grains comprised the surface sediments (Figure 3.2-10). Replicate-averaged OSI values for the stations within the NW sample area ranged from +6.0 to +10.5, with an overall average of +8.8 indicative of healthy benthic habitat conditions (Table 3.2-1; Figure 3.2-10). Replicate-averaged OSI values were slightly lower for the OUT and SE stations, with values ranging from +4.0 to +10.5 (Table 3.2-2; Figure 3.2-10). However, the overall mean OSI values for the OUT and SE stations (+7.9 and +7.2, respectively) were still indicative of generally healthy benthic habitat conditions (Table 3.2-2). Four stations (NW-23, OUT-4, SE-32, and SE-40) had an indeterminate OSI value due to low prism penetration in the hard bottom.

The high OSI values observed at many of the stations were the result of moderately deep RPD depths and an advanced benthic recolonization status over the majority of the PV Shelf at the time of the survey (Figure 3.2-8A&B). Conversely, lower OSI values reflected shallower RPD depths and/or the presence of only Stage I organisms and subsequent decrease in evidence of advanced Stage III activity at these stations (Figure 3.2-8C). Overall, the high OSI values observed over the majority of the survey area reflected the widespread presence of an abundant and diverse benthic community comprised of both Stage I and Stage III taxa. Bioturbation of this community has served to irrigate and aerate the surface sediments, resulting in RPD depths generally exceeding 2 cm across the survey area. Though it provides a useful indicator of the relative benthic health of the near-surface sediments across the PV Shelf, the OSI by itself can not be used to make broader inferences about the longer-term sediment contamination concerns that presently exist.

3.2.2 Plan-View Image Results

The plan-view images adequately captured sedimentary and biological conditions at the sediment-water interface over the PV Shelf covering a seafloor surface area of approximately 0.3 m^2. One image per station was analyzed, cataloging sediment type and distinguishing and quantifying physical and biological features.

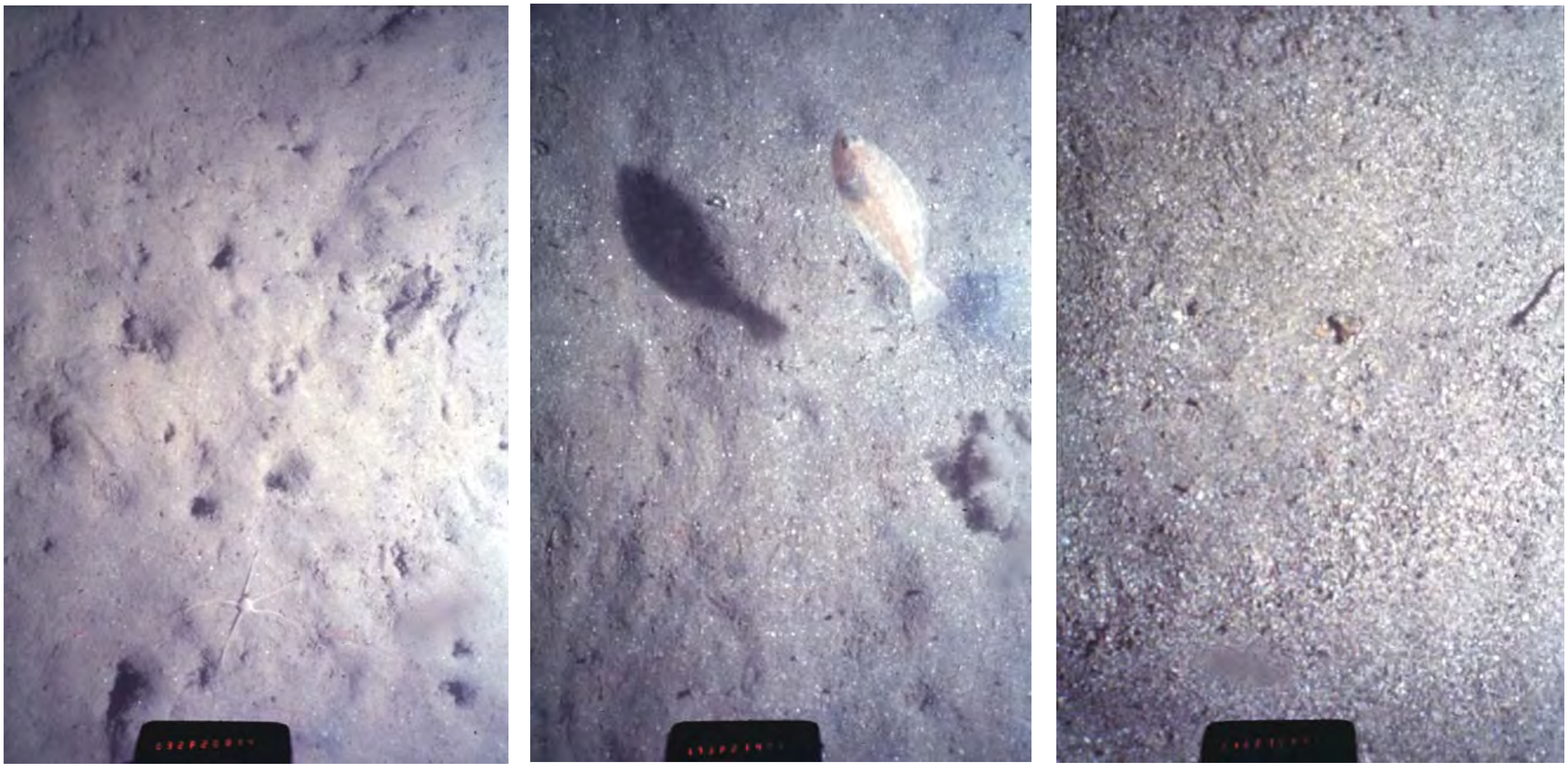
Though it is difficult to accurately assign a specific grain size based on a plan-view image, it is possible to characterize the general sediment type. A variety of sediment types were present over the PV Shelf study region, with both fine-grained (silt/clay) and coarse-grained sediments (medium and coarse sand) observed (Figure 3.2-11). Based on the collective plan-view image results, a large portion of the PV

Shelf was composed of soft, fine-grained sediments consisting of a mixture of silts/clays and fine sand (Figure 3.2-12). However, a greater sand component was observed at many stations, particularly at many of the inshore stations, as well as some of the offshore stations within the SE region (Figure 3.2-6). TheNW sampling stations were predominantly composed of fine-grained sediments, though a few stations located close to the shoreline displayed visibly coarser grain sediments. Stations in the OUT sample area ranged from soft, fine-grained sediments to coarse sand. Hard bottom conditions with hard coral were observed at station OUT-4 (Figures 3.2-6, 3.2-12 and 3.2-13). A small grouping of stations surrounding the termination of the easternmost outfall had a slightly harder bottom composition, consisting of medium to fine sand. Stations within the SE sample area had the highest occurrence of hard sediment types (coarse to medium grained sand and hard coral) however, the predominant sediment type was still fine-grained (silts/clays and fine sand). Hard coral was present at two stations (SE-18 and SE-30) in the SE sample area (Figure 3.2-13). Overall, the PV Shelf is composed of soft, fine-grained sediments, with visibly coarser-grained sediments at a number of stations in close proximity to the shoreline, approximately 500 to 1500 m offshore (Figure 3.2-12).

Changes in surface topography were usually due to physical features, such as shell material or bedforms (sand ripples). In the plan-view images, the majority of the stations sampled on the PV Shelf contained some shell material (e.g., whole shells, sections, or shell hash; Figures 3.2-14 and 3.2-15). The NW sample area had the lowest occurrence of shell material. The majority of the stations within the OUT and SE sample areas contained shell material (Figure 3.2-14). Bedforms (sand ripples) generally occur in high-energy environments and were less prevalent on the PV Shelf (Figure 3.2-15). Only 14 stations displayed visible bedforms; these stations were primarily located in the NW sample area, with only one station in the OUT sample area exhibiting sand ripples (Figure 3.2-14). All of the stations containing bedforms were positioned approximately 1500 m from the shoreline.

Plan-view images typically capture a 0.3 m^2 image of the seafloor. In this small area, a great amount of detail can be gathered about the biological conditions of the seafloor (e.g., infaunal burrows, biogenic mounds, and biological organisms). The majority of the stations over the PV Shelf contained relatively few (1-10) detectable infaunal burrows (Figure 3.2-11A and 3.2-14). The stations with the highest quantity of infaunal burrows were located on the outer margins of the PV Shelf, where softer sediments were detected. Stations closer to shore, characterized by larger-grained sediments, had few or no burrows present. The NW sample area of the shelf displayed the highest number of infaunal burrows at the sediment surface. The quantity of burrows ranged from 0 to 60 burrows (Figure 3.2-14). Stations with a higher number of burrows present (11-20 and 20-60) in the NW sample area were generally located on the outer margins of the PV Shelf in deeper water, while the stations with little burrow activity were located closer to shore. The OUT sample area displayed the most uniform presence of burrows, generally ranging from 1 to 10 burrows present. The SE sample area had the highest occurrence of stations with no biological burrow activity. Throughout the shelf area, stations with no burrows present were located close to shore and were characterized by coarser grained sediments (Figure 3.2-12 and 3.2-14).

In addition to infaunal burrows, plan-view images showed an extensive array of biological assemblages. Both infaunal (i.e., tubicolous polychaetes) and epifaunal organisms (i.e., sea stars) were observed and identified in plan-view images. Tubicolous polychaetes (tube worms) were widespread over the entire sample area (Figure 3.2-16). In addition, sea pens, sea stars, brittle stars, anemones (*Corynactis californica*), urchins, sponges, bryozoans (*Diaperoecia* spp.), both hard and soft coral (*Lophogorgia chilensis*) and fish (e.g., sand dabs) were detected within various sediment types at numerous stations throughout the extent of the sampling area (Figures 3.2-12, 3.2-13, 3.2-16 and 3.2-17).



NW -54 OUT-3 NW -1

Figure 3.2-11. Plan-view images demonstrating the various sediment types observed over the Palos Verdes Shelf. Fine-grained sediments consisting of silt/clay and fine sand (A) composed the majority of sedimentation of the Palos Verdes Shelf, however medium to fine (B) and coarse (C) grained sediments were also observed.

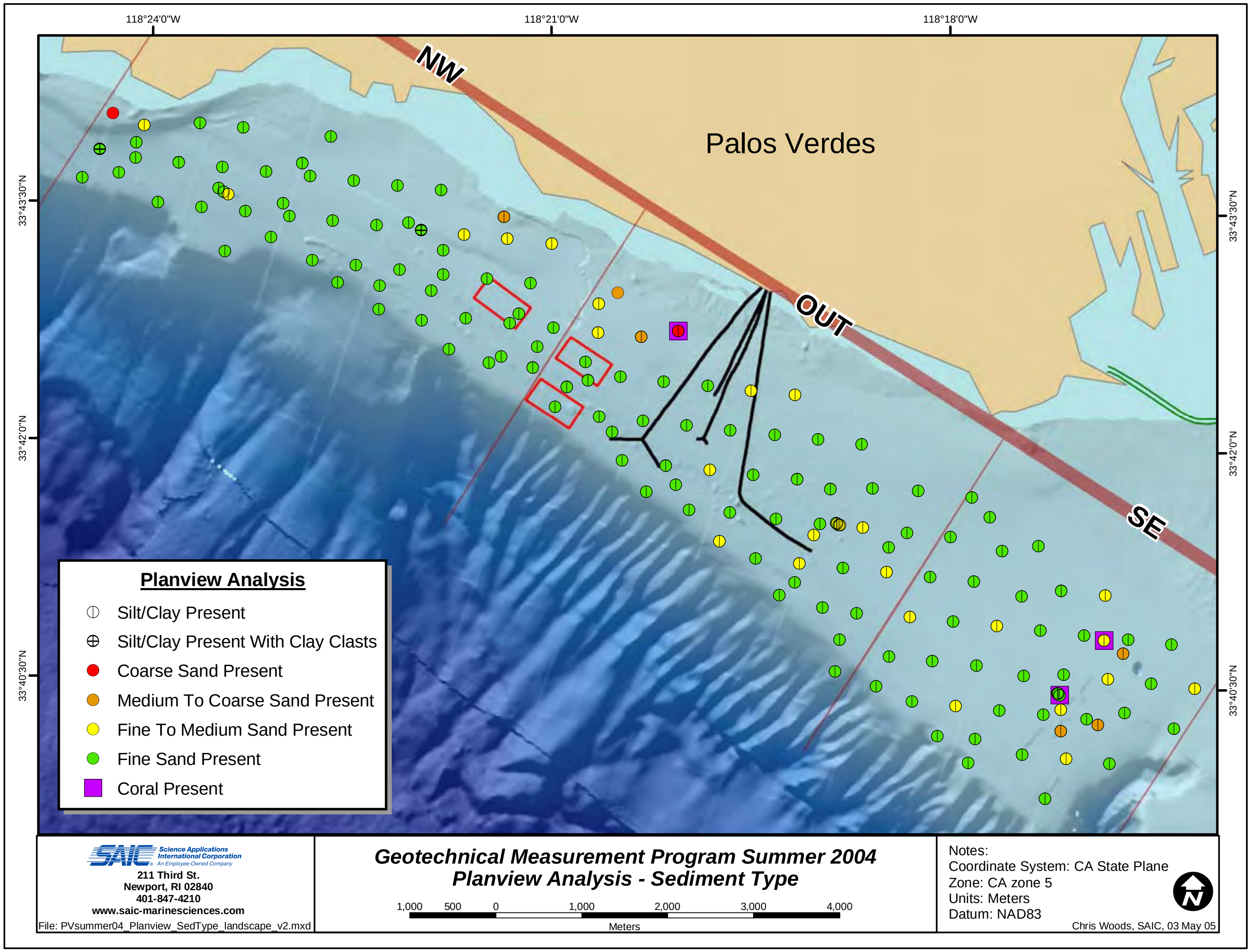
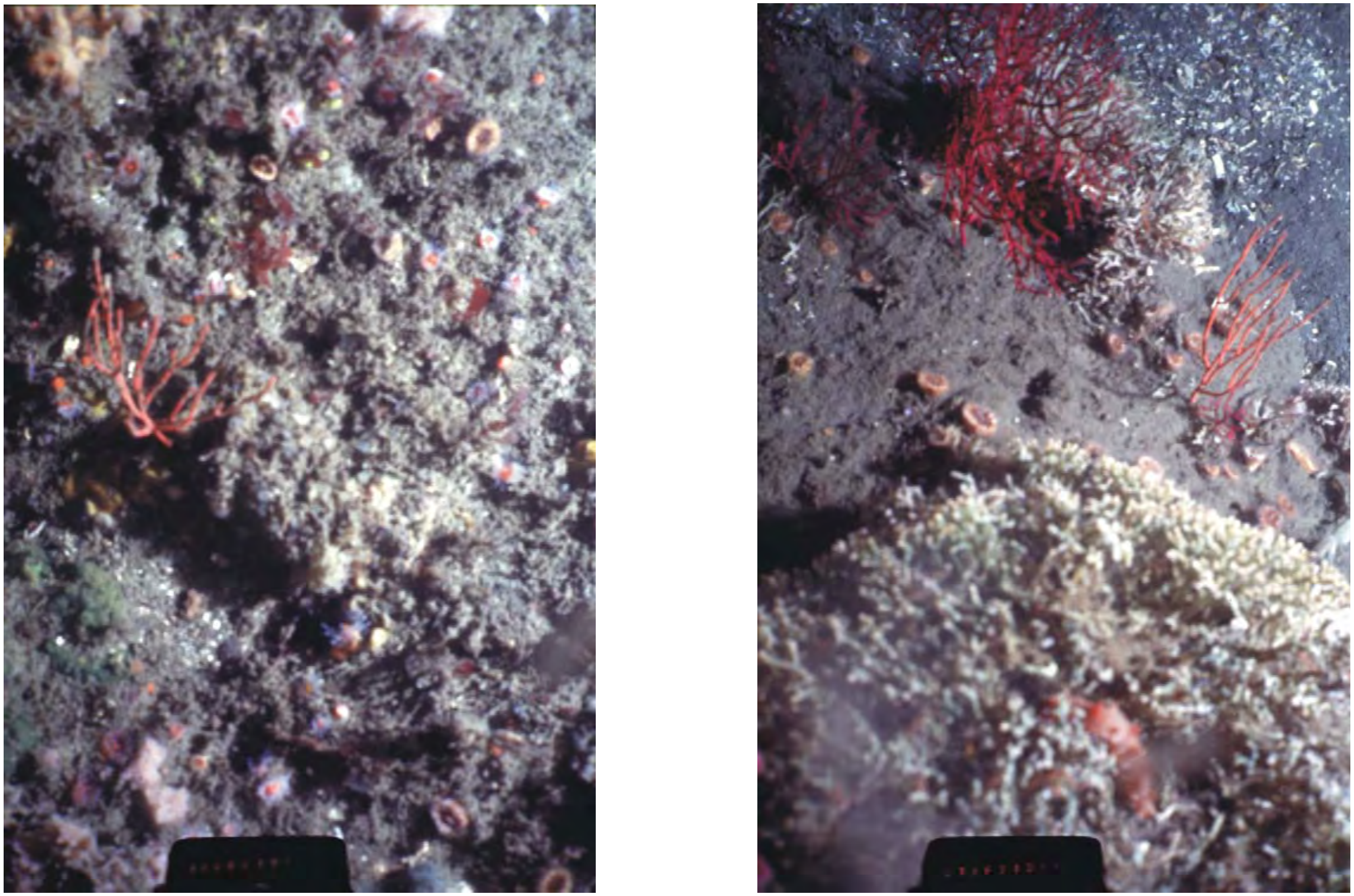


Figure 3.2-12. Map of sediment characteristics at the July 2004 plan-view stations over the Palos Verdes Shelf.



OUT-4 **SE-30**

Figure 3.2-13. Plan-view images illustrating hard bottom conditions (corals) observed over the Palos Verdes Shelf in both the OUT (A) and SE (B) regions.

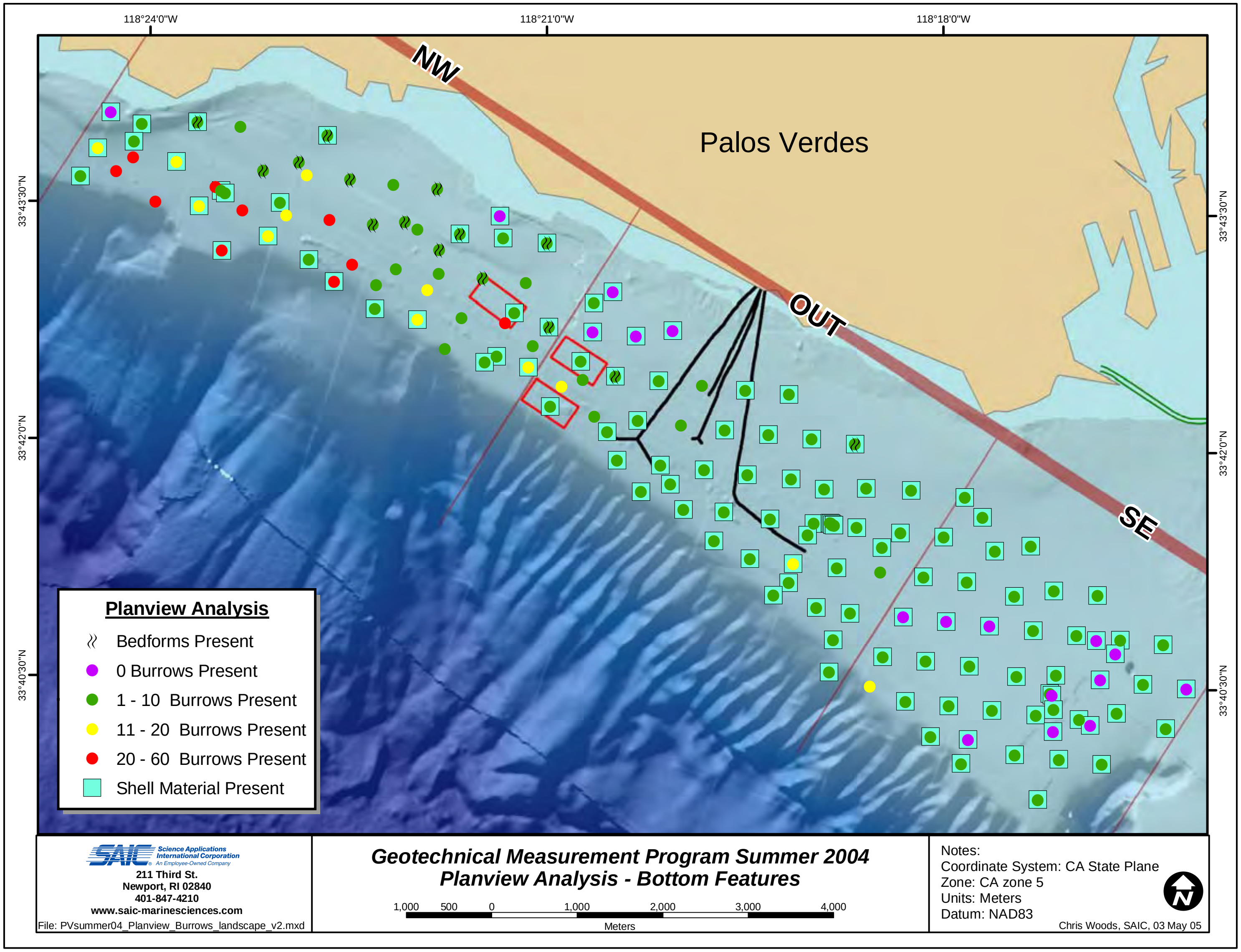


Figure 3.2-14. Map of physical and biological bottom features displayed at the July 2004 plan-view stations over the Palos Verdes Shelf.

NW-16 **SE-41**

Figure 3.2-15. Examples of bedforms (A) and shell hash (B) in plan-view images observed over the Palos Verdes Shelf, resulting in physical changes in surface topography.

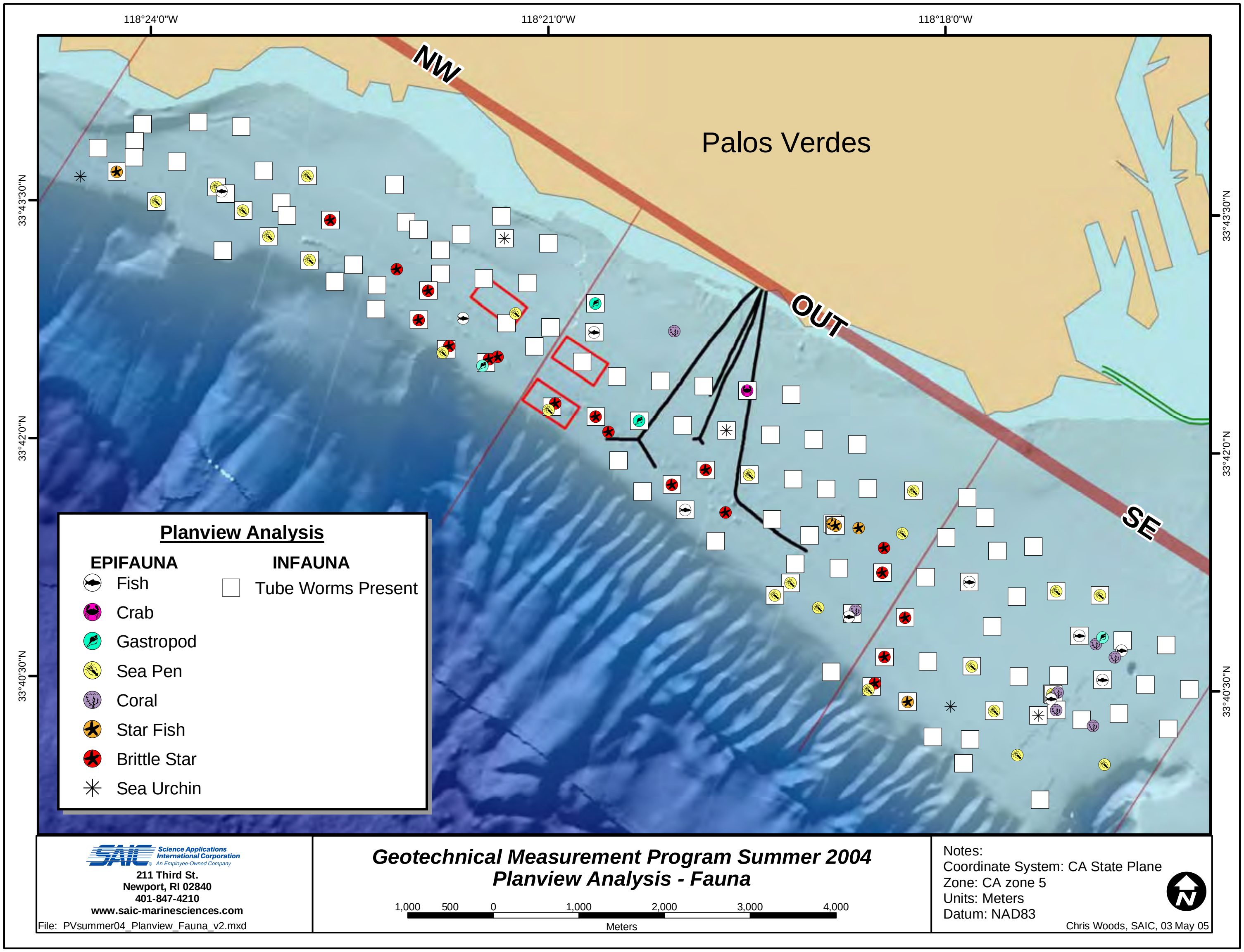


Figure 3.2-16. Map of epifauna and infauna organisms observed at the July 2004 plan-view stations over the Palos Verdes Shelf.

OUT-14 **OUT-49** **SE-35**

Figure 3.2-17. Examples of biological organisms observed in plan-view images over the Palos Verdes Shelf. Brittle stars (A), sea pens and sand dabs (B), as well as urchins were present within the survey area.

3.3 SEDIMENT CORING AND ANALYSIS RESULTS

Over the nine-day sediment coring and analysis program, a total of 15 detailed geotechnical stations were sampled (Figure 2.2-1; Table 2.2-1). Ten of the 15 detailed geotechnical stations were subjected to Gust Chamber, resistivity, and laboratory analyses; three stations were subjected to resisitivity and laboratory analyses; and two stations were subjected to laboratory analyses only. In addition to the 15 detailed geotechnical analysis stations, another 38 stations were subjected to resistivity profiles only (Figure 2.2-1).

Though extensive near-surface biological activity compromised some of the cores collected in the fine-grained sediment areas, the primary problem encountered during the geotechnical coring program was the difficulty in collecting suitable cores over the coarser-grained seafloor areas around the inshore and southeastern portions of the sampling area. Both the side-scan sonar and the imaging data indicated that these areas were comprised of coarser-grained sediments than the mostly fine-grained areas offshore and to the northwest of the outfall pipes. In general, a core was considered suitable for subsequent analysis if it was greater than 20 cm in length, had an even and undisturbed sediment/water interface, and had no significant feeding voids or air pockets visible down the length of the sample (Figure 3.3-1). Though considerable effort was spent trying to collect cores in some of the coarser-grained areas, the cores that were collected in these areas were frequently unsuitable for any of the required analyses. In most cases, the sediment would either wash out of the bottom of the core tube upon retrieval or entrapped air pockets would move up through the sediment column and compromise the sediment/water interface. Because of the difficulty in obtaining adequate cores in these coarser-grained areas, most of the analysis results for this program are focused on stations situated between the 50 to 70 m isobaths on the shelf around and to the northwest of the outfall pipes.

All of the laboratory geotechnical sub-samples were sent to AMS and the analyses for aggregate and disaggregate grain-size, bulk density, water content, and TOC were completed as planned. In addition, sub-samples from these same intervals were also sent to Woods Hole Group for storage and potential chemistry analysis in the future. For each of the cores subjected to a resisitivity profile, a single sediment sub-sample was obtained at the 4-7 cm interval for laboratory analysis of wet-bulk porosity at OSU using the wet-weight/dry-weight technique. The average porosity obtained through this lab analysis in the 4-7 cm depth interval was compared to the average formation factor logged by the resistivity profiler in this same interval. For the Gust Chamber data, the initial processing included the compilation of the time-series turbidity and eroded mass results based on the sampled shear stress values of 0.01 Pa, 0.08 Pa, 0.16 Pa, 0.24 Pa, 0.32 Pa and 0.40 Pa. The eroded mass was divided by the volume of water filtered to provide the average suspended sediment concentration for the time interval during which the water sample was collected. These measured concentrations were then used to calibrate the turbidity measurements and the filtered material was also combusted to determine the organic fraction. The specific results for each of three main analysis techniques are presented below.

(A)

(B)

Figure 3.3-1. Photographs taken aboard the R/V *Vantuna* during the geotechnical coring effort for the Summer 2004 Geotechnical Measurement Program. These photographs depict: a) a recently collected core in the foreground with the OSU gravity corer in the background; and b) a close-up view of a typical intact, undisturbed sediment sample

3.3.1 Gust Chamber Erosion Results

At least two separate Gust Chamber erosion tests were run at ten of the detailed geotechnical stations (Figure 3.3-2). The erosion tests began with a low shear stress (0.01 Pa) to clear out any turbidity in the water above the sediment surface following core retrieval. Following this, steps of 0.08 Pa, 0.16 Pa, 0.24 Pa, 0.32 Pa and 0.40 Pa were used (Figure 3.3-3 and 3.3-4). Each value of shear stress was maintained for a period of 20 minutes. For stresses that exceeded the critical entrainment shear stress for at least some fraction of the sediment at the bed surface, suspended sediment concentration generally rose relatively quickly, peaked, usually within a few minutes, and then decreased in a quasi-exponential fashion. When concentration had declined to near background levels while a constant shear stress was maintained, it was assumed that nearly all of the sediment that could be eroded at that shear stress had been removed from the bed, leaving behind sediment with a higher critical entrainment shear stress. This was the expected pattern for cohesive sediment. The only sample that behaved notably differently was OUT-27A, which responded more like non-cohesive sediment, with relatively constant rates of mass erosion during each stress step. As would typically be expected, the total mass eroded increased with increasing shear stress (Figure 3.3-3).

Using the results from each of the replicate runs, the average total mass eroded and organic mass eroded for each shear stress step were computed in terms of g/cm^2; the red bars indicate the range of measured mass for each case (Figure 3.3-3 and 3.3-4). (Because organic mass was measured by combustion, any combustible material would be included in what has been called the organic mass.) Based on blanks (filters prepared as the others and wetted, but not used to filter sediment), the estimated analytical error for total mass eroded in each step was +0.02 g per filter or 0.02 – 0.07 g ($2\text{-}9\times10^{-4}$ g/cm^2) per step depending on the number of filters used in a step. Larger stresses generally required larger numbers of filters because of the larger amount of mass to filter, so the percent error did not increase with the number of filters. The error was always in the direction of increasing the value of mass eroded.

At this point, no corrections or calibrations have been made to account for potential impacts due to unavoidable external factors such as ship vibration and motion. Though these potential boat-induced impacts were judged to have limited impact on the final erosion results, there were a few instances noted in the field logs where the short-term erosion rates may have been somewhat elevated due to boat motion. During the subsequent data synthesis, an attempt will be made to correlate the continuous time-series turbidity records with the noted periods when boat motion may have impacted the erosion data. If a reasonable correlation can be established, then it may be possible to filter out some of these potential boat-induced impacts.

The estimated analytical error for organic mass eroded in each step was +0.004 g per filter or 0.004 – 0.02 g (0.5-2×10-4 g/cm2) per step, again depending on the number of filters used in a step. On average, the organic mass of eroded sediment was on the order of 10% of the total mass and the percentage generally decreased as shear stress was increased (Figure 3.3-4). Organic mass eroded tended to follow total mass eroded except for the northwestern-most site, where the organic fraction seemed to be higher than the other sites (Figure 3.3-2). The sandier site, OUT-27A, had a lower organic fraction compared to the siltier sites. However, because the mass eroded was lowest at the lower shear stresses, the measurements of organic mass eroded from the bed in these cases may be only marginally significant.

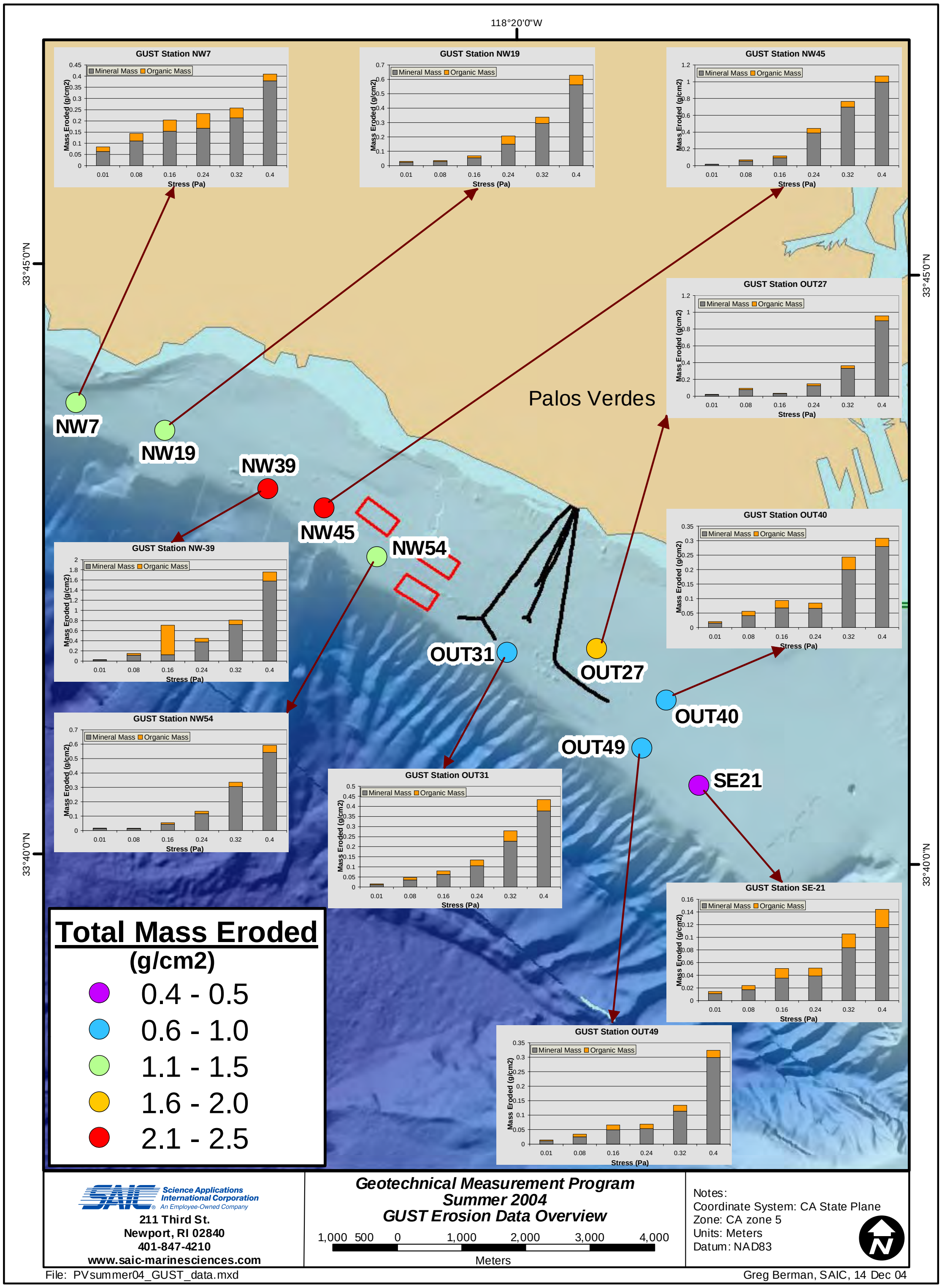


Figure 3.3-2. Summary of the Gust Chamber erosion results at each of the ten sampled stations. The mass eroded values (both total and organic) are based on the computed averages from all of the replicates at each of the stations.

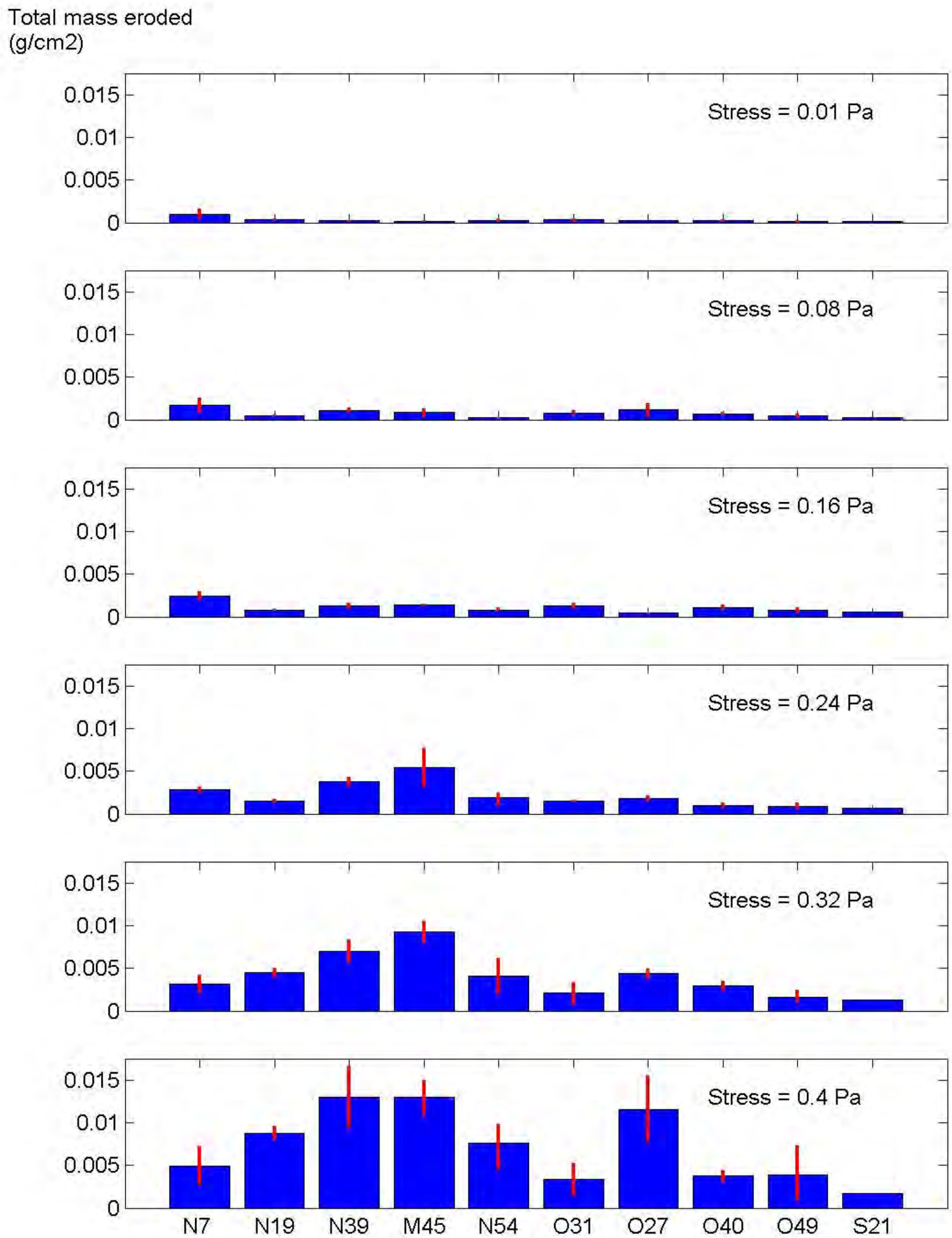


Figure 3.3-3. Summary of the Gust Chamber erosion chamber total mass eroded results (g/cm^2) for each shear stress step and each site. The bar heights are site average values; the red vertical bars indicate the range of values. The sites are ordered from northwest to southeast.

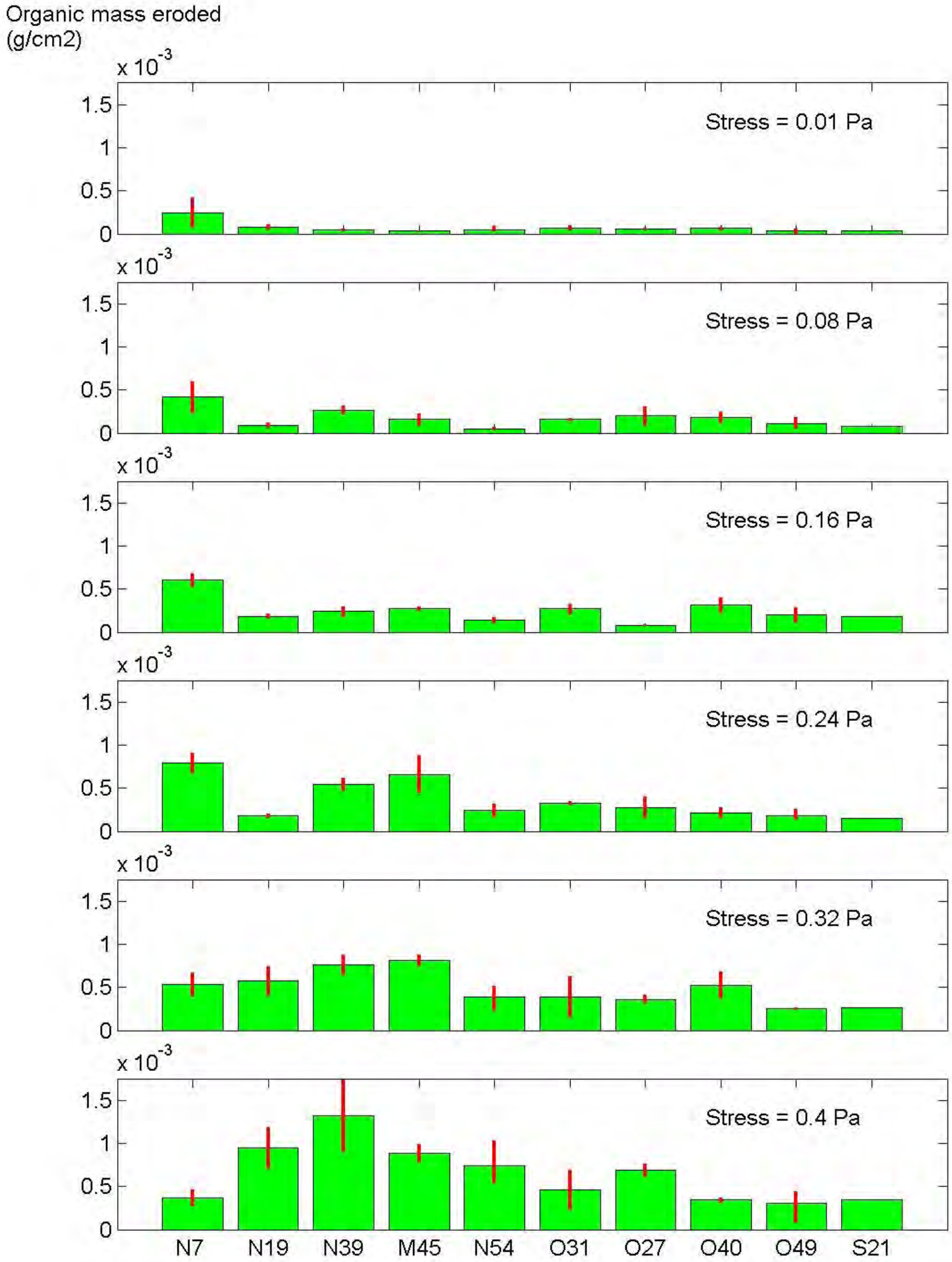


Figure 3.3-4. Summary of the Gust Chamber erosion chamber organic mass eroded results (g/cm^2) for each shear stress step and each site. The bar heights are site average values; the red vertical bars indicate the range of values. The sites are ordered from northwest to southeast.

The highest total mass eroded values (0.030 g/cm^2) were found at stations NW-39 and NW-45, located approximately 4 to 5 km northwest of the northernmost outfall pipe (Figure 3.3-2). Station NW-54, located about 3 km northwest of the pipes, and station OUT-31, located very near one of the pipe discharges, produced significantly lower mass eroded values (0.013 and 0.009 g/cm^2, respectively). Southeast of the outfalls, erosion totals were, on average, lower than any of those to the northwest. An exception to this was the notably sandy, OUT-27, located in relatively shallow water (~40 m, the shallowest site for which erosion tests were run). As mentioned above, the erosion test for this core suggested that the sediment behaved non-cohesively. The second core tested from this site, OUT-27G, showed behavior intermediate between the non-cohesive run and other, cohesive cases. Toward the northwest limit of the sampling area, stations NW-7 and NW-19 produced higher mass eroded values than the southeastern stations, but lower than the northwest stations closer to the outfall pipes.

Using the total mass eroded values computed for each of the Gust sampling stations, an interpolated mass eroded grid surface was generated (Figure 3.3-5). Though this grid was based on a sparse dataset covering a large spatial area, it was useful for helping to visualize the general trends of the erosion results. Because most of the Gust sampling stations were clustered along the 60-m contour, the validity of the interpolated grid results will be higher in those areas around the 60-m contour. Consistent with the higher total mass eroded values associated with stations NW-39 and NW-45, the gridded surface showed the most "erodeable" region of the PV Shelf covering an area roughly 3 to 6 km northwest of the outfall pipes (Figure 3.3-5). The gridded view also illustrated that there was quite a bit of variability in the computed mass eroded values moving from the northwest to the southeast along the 60-m contour of the PV Shelf. Again, it should be emphasized that because of the limited number of Gust stations that were occupied, this mass eroded grid surface is based on a large degree of interpolation. In the future, it should be possible to improve the resolution of the mass eroded grid surface by also considering the results from some of the more densely sampled datasets (e.g., resisitivity, sediment profile images, etc.).

3.3.2 Resistivity Profile Results

In addition to the replicate resistivity cores (up to five) that were collected at 10 of the 15 detailed geotechnical stations, single resistivity cores were collected at an additional 39 stations (Figure 3.3-6). Multiple resistivity profiles (at least 2) were performed on each core. Electrical interference, thought to be caused by the physical proximity between the IRP and the R/V *Vantuna*'s below-deck electrical distribution panel, created noise within a few of the resistivity profiles. This problem had not been encountered during the earlier one-day coring and resisitivity profiling effort that was conducted in advance of the oceanographic mooring deployment, though the survey vessel and equipment set-up were identical. The electrical noise could be effectively filtered out by utilizing resisitivity profile replicates (2 to 12 profiles per station) and bin-averaging the data at 1-mm vertical intervals. However, at a few stations where the electrical interference was particularly strong and only two replicate profiles were collected, the resultant averaged profiles remained quite noisy (e.g., OUT-14). For this reason, all of the figures depicting the porosity results indicate those stations where replicate porosity cores were collected.

Based on the resistivity profiles, the largest change in porosity generally occurred in the top 10 mm of the sediment column (Figure 3.3-7). For this discussion of the porosity results, the surface interval was defined as the top 2 to 10 mm interval of the sediment column and a surface porosity value was computed by averaging all of the individual porosity values within this interval; the 0 to 2 mm interval was not used to exclude the seawater affects on the resistivity measurement.

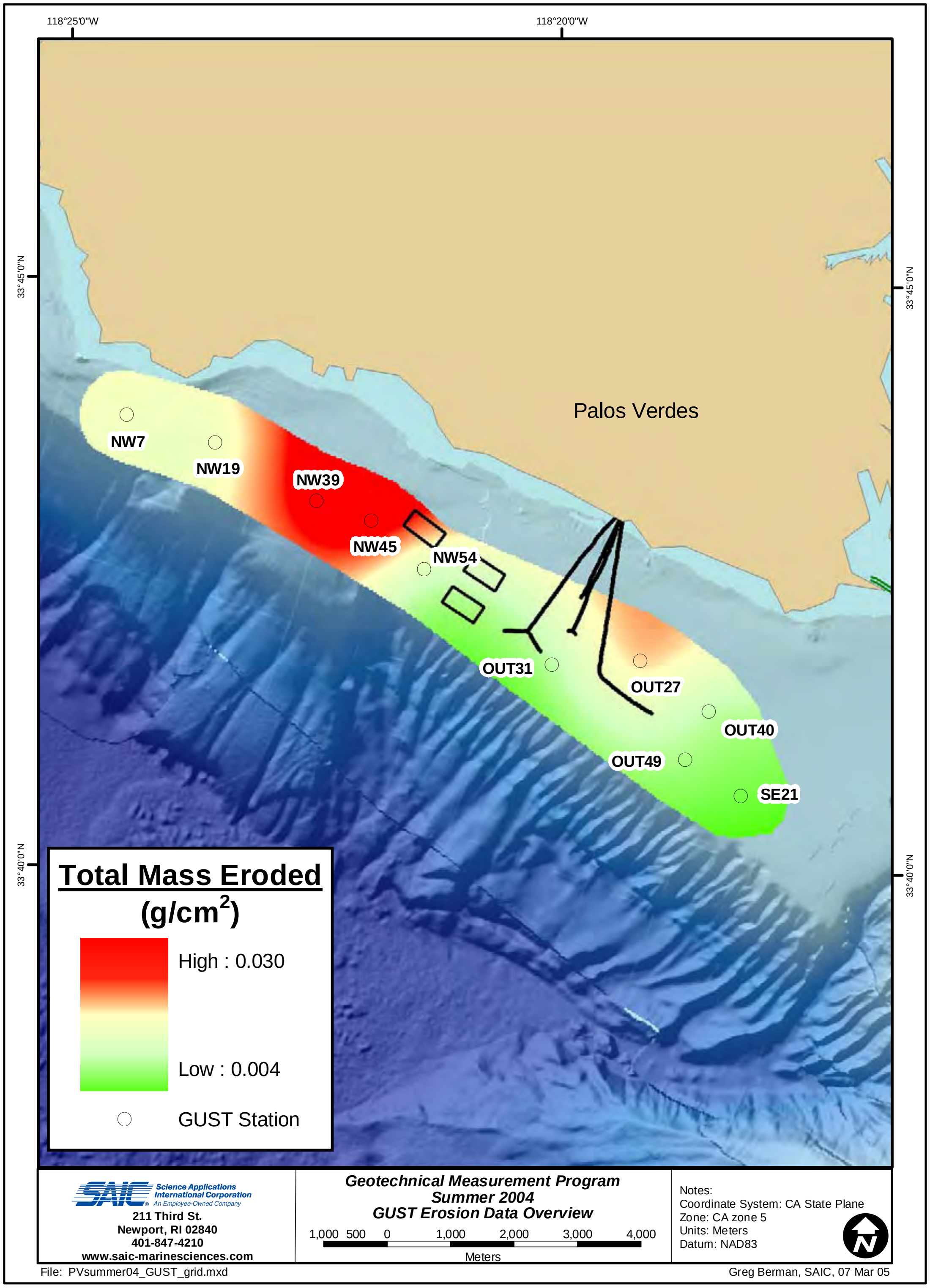


Figure 3.3-5. Gridded total mass eroded data interpolated over the PV Shelf. The mass eroded values (both total and organic) are based on the computed averages from all of the replicates at each of the stations.

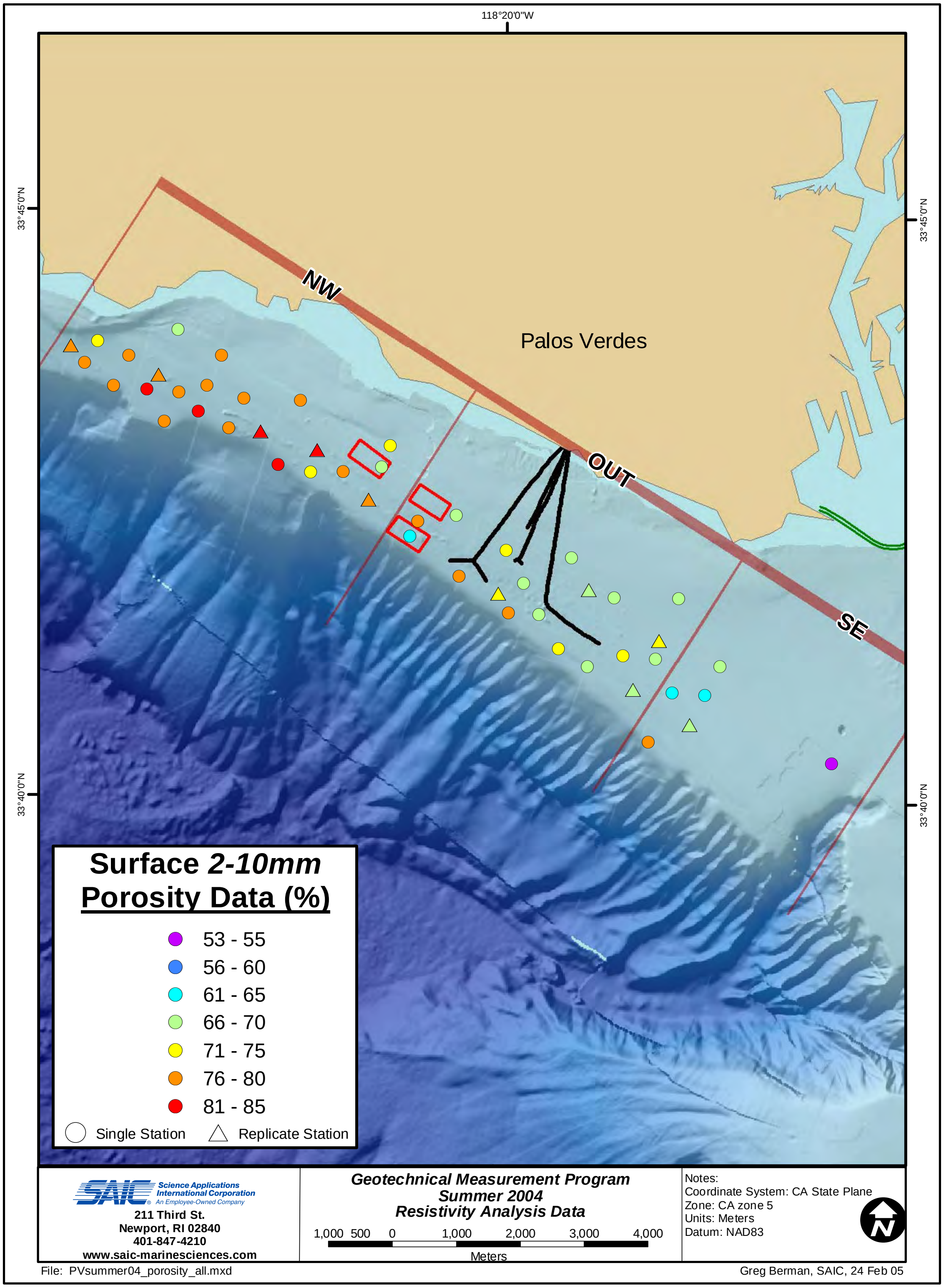


Figure 3.3-6. Summary of the surface porosity results from each sampling station. At single stations, one core was collected and at replicate stations, three to five cores were collected. Two resistivity profiles were conducted on each core that was collected.

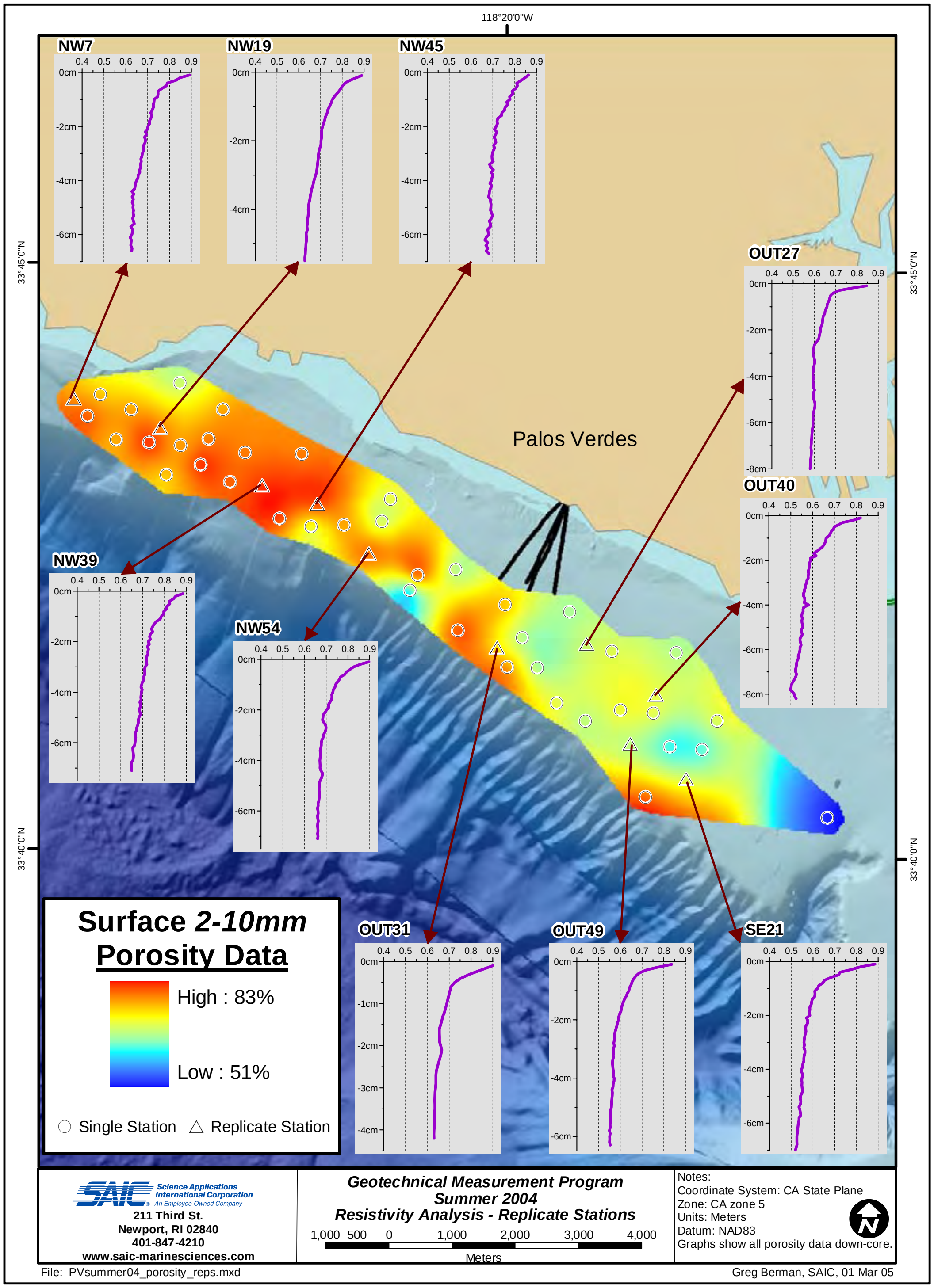


Figure 3.3-7. An interpolated porosity grid surface generated over the PV Shelf based on average surface porosity values for all resistivity stations. The surface porosity values were computed from the top 2 to 10 mm of the resistivity profile and represent the average values computed from all of the replicate profiles obtained at each station. Average resistivity profiles from replicate stations are also shown.

Sediment porosity is a measure of the open space between sediment grains and is defined as the percentage of a volume of sediment that is empty space (volume of the voids divided by the total sediment volume). The development of porosity in marine sediments is highly variable and can be determined by a wide variety of sediment characteristics (e.g., grain shape, sorting, packing, etc.). Irregularly shaped particles (such as clay and organic particles) will tend not to pack as neatly as well-rounded particles, resulting in higher proportions of voidspace (and higher porosities). In addition, clay particles tend to electrostatically repel one-another along the surface of the particles resulting in a larger proportion of voidspace. Sorting is measured as the ratio of the larger to the smaller-sized particles within a sediment matrix. A well-sorted sediment is comprised of primarily a single particle size and will typically have higher porosities than poorly sorted sediments. Poorly sorted sediments have a wider range of sediment grain sizes and the smaller sediment grains can infill sediment pore spaces.

The net effects of these sometimes conflicting porosity factors could be seen in the surface porosity results from the resistivity stations across the PV Shelf (Figure 3.3-6). Though the surface sediments in the SE and OUT regions were reasonably well-sorted relative to the sediments in the NW region, the surface sediments were consistently less porous in these regions. Average surface porosity values for these sampling areas ranged from 71% in the OUT region to 66% in the SE sampling region. All of the stations within these two regions (with the exception of OUT31 adjacent to an outfall discharge) displayed a sand fraction of at least 60% that increased up towards 80% to the southeast. The higher clay content and organic sediments in the NW region exhibited consistently higher porosity values with an average porosity of 77% (Figures 3.3-6 and 3.3-7).

Similar to the mass eroded grid surface generated from the Gust data above, an interpolated porosity grid surface was also generated (Figure 3.3-7). Because there were many more porosity data points than mass eroded data points, the porosity grid surface required less interpolation (resulting in a higher-resolution surface). Consistent with the individual porosity results discussed above, the porosity grid surface generally indicated a more porous northwest region and a less porous area around and to the southeast of the outfalls (Figure 3.3-7). However, there were a few stations (e.g., OUT-14 and SE-33) with computed surface porosity values that were unusually high or low relative to most of the surrounding stations. These outlier stations had a large impact on the gridded surface and account for the low porosity area indicated to the northwest of the outfall pipes and the high porosity area indicated along the southeastern edge of the sampling area (Figure 3.3-7).

As mentioned previously, OUT-14 was a single sample station that was impacted by increased electrical interference that likely affected the computed porosity results. Station SE-33 was another single resistivity station that was located in an area where it was difficult to collect an adequate core sample due to the coarseness of the sediments. Due to uncertainty with the porosity results for these two single stations, the gridded porosity surface was re-generated with the results from OUT-14 and SE-33 not included (top panel of Figure 3.3-8). This re-gridded surface revealed a more consistently porous northwest region, transitioning to a less porous, more compact region to the southeast. These results were similar to the gridded surface that was generated based upon only the replicate resistivity results (bottom panel of Figure 3.3-8). Because there were relatively few replicate resisitivity stations, the large degree of interpolation required for this grid was similar to the level required for the mass eroded grid (discussed in Section 3.3-1). As stated at the end of that section, it should be possible to improve the resolution of these highly interpolated grid surfaces by also considering the results from the other more densely sampled datasets.

3.3.3 Laboratory Geotechnical Results

Laboratory geotechnical analyses were conducted by Applied Marine Sciences, Inc. (AMS) at all 15 of the detailed geotechnical analyses stations (Figure 2.2-1). As discussed in section 2.3, all but one of the

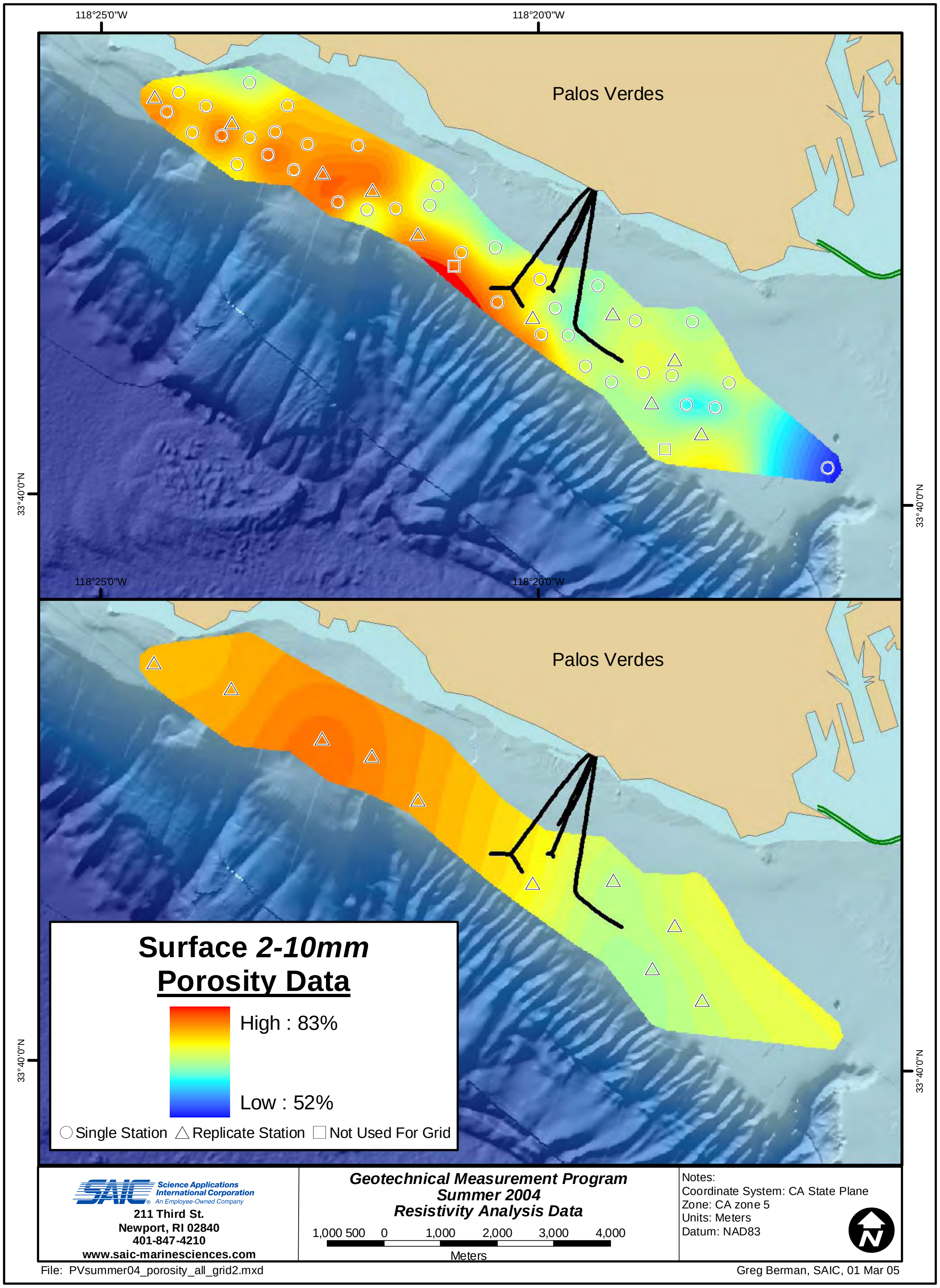


Figure 3.3-8. Two representations of an interpolated porosity grid surface generated over the PV Shelf. The top panel is based on all resistivity stations except for two questionable single sample stations, while the bottom portion is based on the replicate stations only.

geotechnical cores were sub-sampled into five 4-cm intervals from the surface down to 20 cm; a deeper core collected within pilot cap cell LU (Station NW-46) was sub-sampled in 4-cm intervals for its full 60-cm length. Ultimately, all of the sediment sub-samples were sent to AMS for laboratory geotechnical analyses of aggregate and disaggregate grain-size, bulk density, water content, and total organic carbon (TOC). The laboratory analysis procedures were consistent with the Standard Operating Procedures (SOPs) that were outlined in the IWP (SAIC 2004b). After the laboratory analyses were completed, pre-formatted spreadsheet files were generated by AMS that provided a summary of all of the analysis results at each of the stations (Appendix C). In addition, AMS prepared a separate report (Applied Marine Sciences 2004) that presented the results of their analyses, as well as the supporting replicate analysis and quality assurance documentation.

Because much of the complementary geotechnical analyses (e.g., Gust and resistivity analysis) were focused on the near-surface sediments, an initial view of the laboratory geotechnical results was focused on the top (0-4 cm) sediment interval (Figure 3.3-9). Figure 3.3-9 provides a view of the grain-size, bulk density, and TOC results for this surface interval at each of the geotechnical stations. Consistent with the results from many of the other complimentary datasets, the laboratory geotechnical analyses showed that the finer-grained, less dense, and higher TOC surface sediments generally fell to the northwest of the outfall pipes, primarily in the deeper waters (e.g., greater than 50 m) of the PV Shelf. To the south and east of the outfalls, the surface sediments were consistently coarser-grained, denser, and had lower TOC values.

Typically, sands (silicate and carbonate) do not promote the binding of organic carbon, whereas the fine-grained sediments (e.g. silts and clays) bind more readily with organic carbon. Therefore, higher TOC values are generally present in fine-grained sediments. A series of graphs (Figures 3.3-10 through 3.3.12) were generated showing the relationship between grain size and TOC at various sample intervals for all of the PV Shelf sampling stations. A best-fit trend line was computed at each sample interval that helped to illustrate how well the data points correlated with one another. Both the grain size and TOC values showed little deviation around the trend line in both the 0-4 and 4-8 cm intervals (Figure 3.3-10A, B). Both of these intervals revealed finer-grained sediments and higher TOC values within the NW sample area and coarser-grained sediments and lower TOC values to the south and east of the outfalls (sample areas OUT and SE). Station OUT-31, located just to the southeast of a outfall discharge area, was comprised of a higher percentage of silt/clay and displayed relatively higher TOC values than other stations in the OUT sample area. As expected, stations with coarser-grained sediments (e.g., sands) within the OUT and SE sample areas generally displayed lower TOC than stations composed of a higher percentage of silts/clays (NW sample area). There was slightly more variability associated with the 4-8 cm sample interval with respect to grain size and TOC, with some data points falling farther from the trend line.

Geotechnical results for the 8-12 and 12-16 cm intervals showed a similar trend as the near-surface intervals, with an somewhat increasing level of variability among the station results (Figure 3.3-11A, B). Most striking was the noticeably elevated TOC values (> 6%) associated with Station OUT-31 at both of these intervals. Because the TOC associated with OUT-31 was so much higher than the other stations, this station was excluded when computing the trend line for these intervals. With OUT-31 excluded, the best-fit trend lines for these intervals were similar to the trend lines for the surface intervals, with somewhat increasing variability. Because of the close proximity of OUT-31 to the mouth of an outfall pipe, the higher TOC values at the deeper depth intervals may represent the effects of historic effluent fluxes containing a higher organic content. Based on regulatory changes, the Joint Water Pollution Control Plant (JWPCP) switched from advanced primary to full secondary treatment in 2002 that helped to reduce the organic content of the discharged effluent. The consistently lower TOC values associated with top two sampling intervals (0-8 cm) were likely representative of lower organic loading due to the recent changes in the effluent treatment.

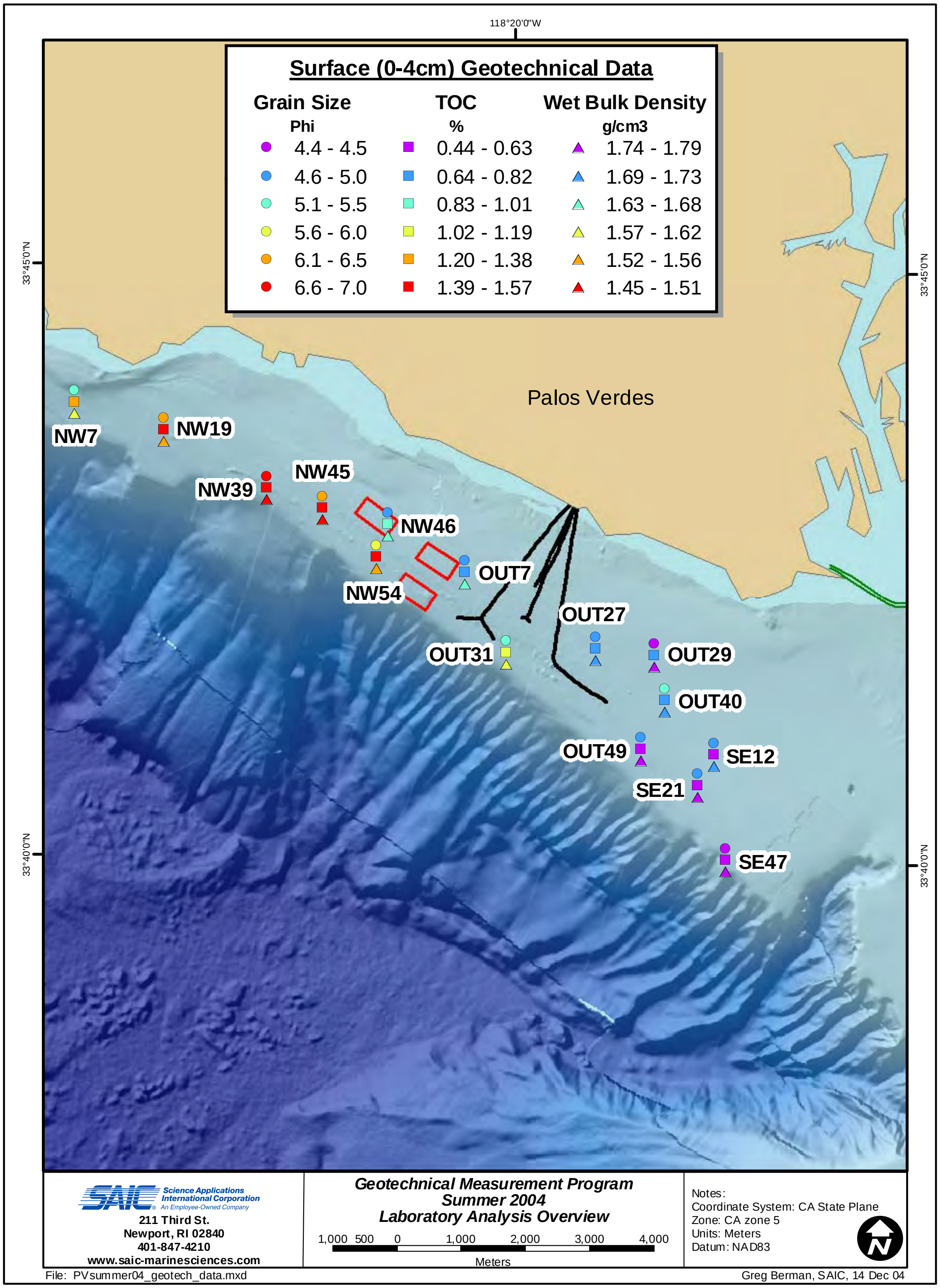


Figure 3.3-9. Overview of the laboratory geotechnical results within the surface interval (0 to 4 cm) at each of the detailed geotechnical station.

Grain Size and Total Organic Carbon

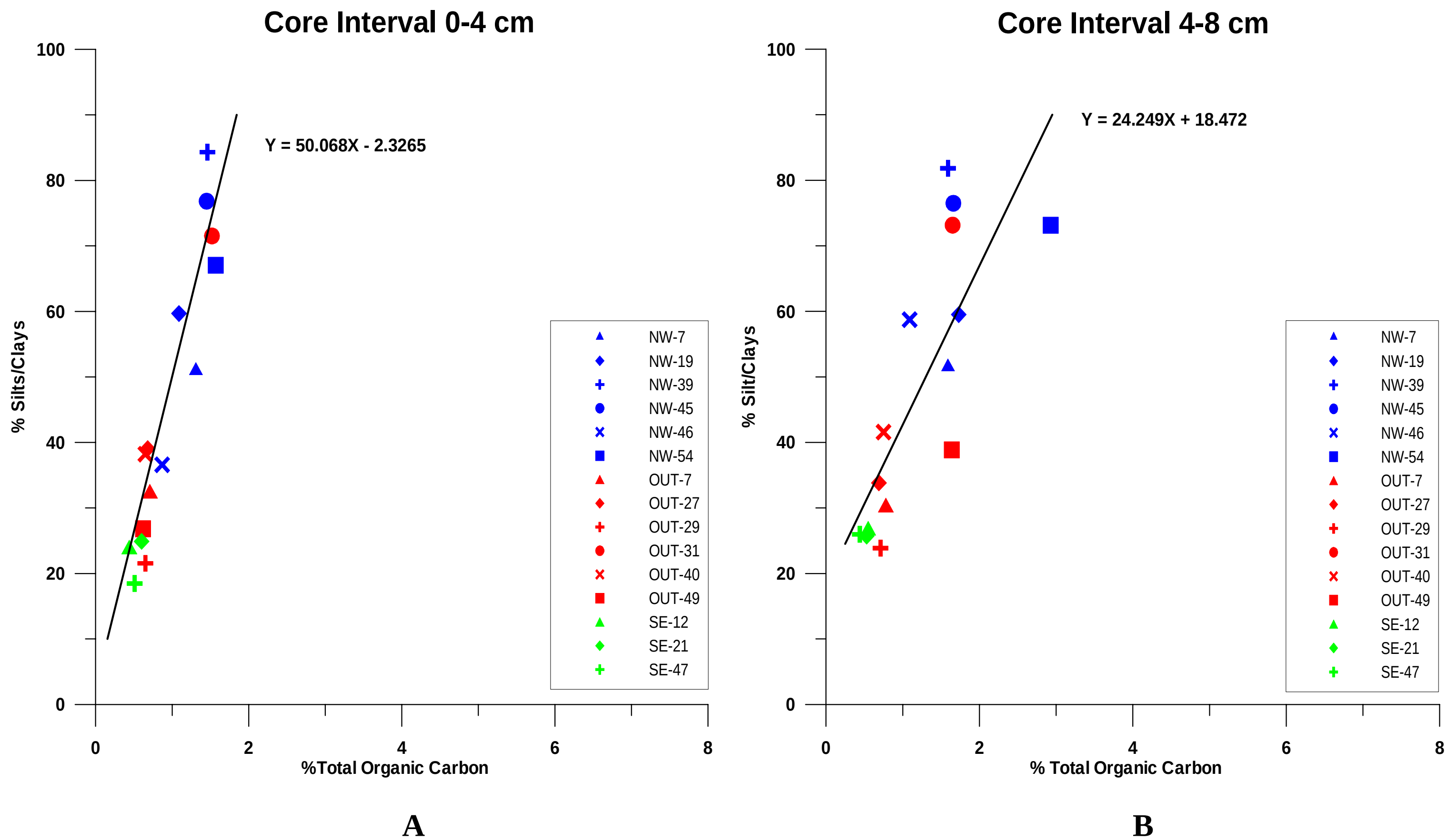


Figure 3.3-10. Graph illustrating the relationaship of grain size (% silts/clays) to percent Total Organic Carbon at varying sampled depth intervals. Graph A depicts the 0-4 cm interval and graph B shows values within the 4-8 cm interval, where values cluster around the trendlines in both graphs.

Grain Size and Total Organic Carbon

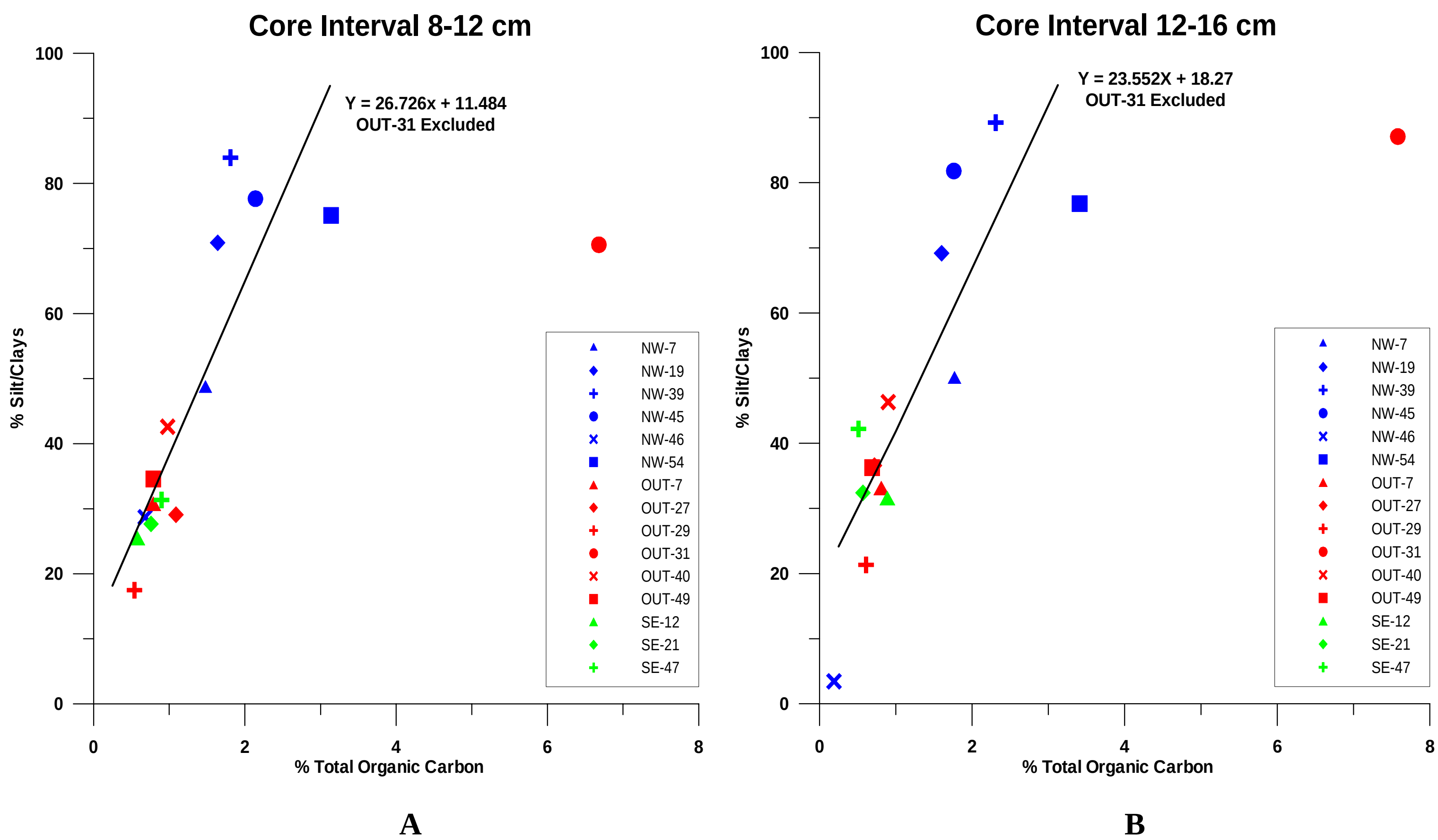


Figure 3.3-11. Graph illustrating the relationship of grain size (% silts/clays) to percent Total Organic Carbon atthe 8-12 cm (A) and 12-16 cm (B) depth intervals. In both graphs, the data points from OUT-31 were excluded to calculate the trendline.

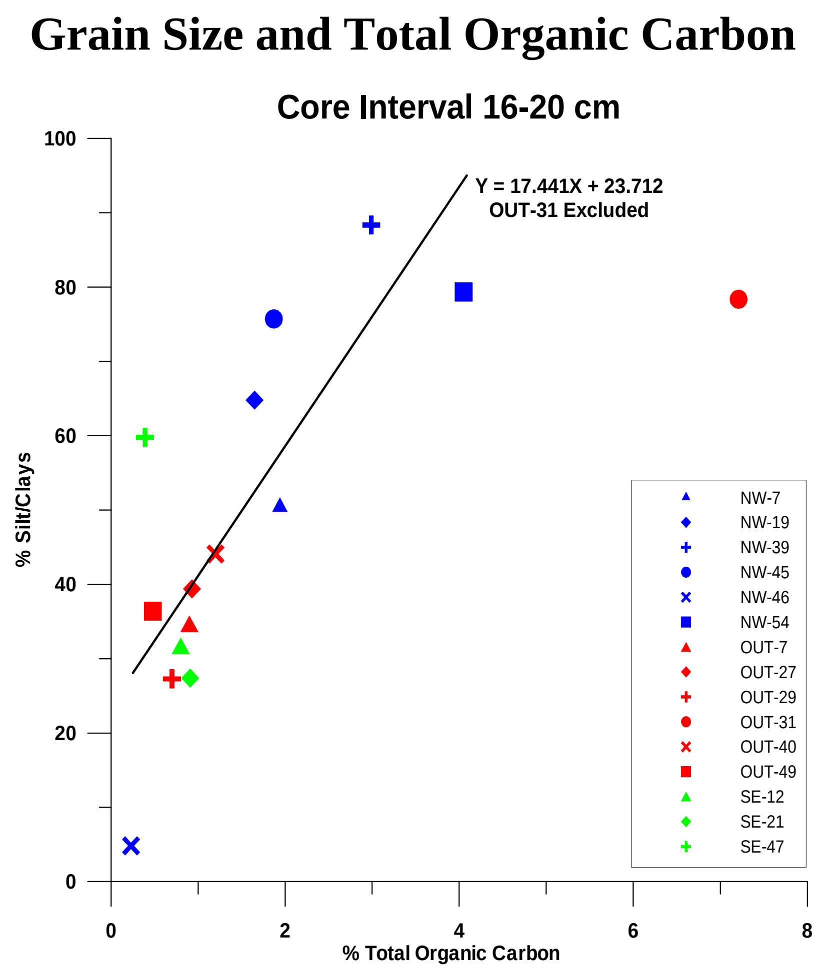


Figure 3.3-12. Graph illustrating the relationship of grain size (% silts/clays) to percent Total Organic Carbon at the 16-20 cm depth interval. Data points from OUT-31 were excluded when calculating the trendline.

Station NW-46, located within Pilot Capping Cell LD, provided another interesting anomaly within both the 8-12 and 12-16 cm intervals. Based on the high sand content at NW-46 for both of these intervals (>70% at 8-12 cm and >90% at 12-16cm), it was likely that most of these sediments represented sand cap material originally deposited in summer 2000. At the 12-16 cm interval, NW-46 displayed much coarser-grained sediments than any of the surrounding stations, with a small silt/clay fraction (< 10%) and very low TOC content. The sediments in the 0-8 cm interval that overlaid the distinct sand cap layer were comprised of a much higher silt/clay fraction (40 - 60%) and likely represented the localized reworking of ambient, cap, and depositional material.

Geotechnical results for the deepest sample interval (16-20 cm) revealed similar results to the 12-16 cm sample interval, with lower TOC values at stations exhibiting coarser-grained sediment (OUT and SE stations) and higher TOC values in the finer-grained sediment (NW stations; Figure 3.3-12). Similarly to the 8-12 and 12-16 sample intervals, Station OUT-31 was excluded from the trend line generation. Slightly more variability existed with respect to grain size and TOC, with data points deviating more from the trend line. Station NW-46 again displayed a very low percentage of silt/clay (<10 %) and near-zero TOC, indicating the continued presence of the coarser sand cap material discussed above.

In order to depict the collective results of the various analyses that were conducted at each of the detailed analysis stations, a composite GIS figure was generated for each of these stations (Figures 3.3-13 thru 3.3-27). All composite GIS figures contain a graphic showing relative location of the station on the PV Shelf, along with side-scan sonar and multibeam backscatter imagery in the immediate vicinity of the sampling station. Plan-view and annotated SPI images are included, as well as a summary of the SPI parameters. Geotechnical results (grain size, TOC, and water content) are graphed and separated by 4 cm sampling intervals. In some composite figures, graphs are shown relative to the core image. As discussed previously, not all of the detailed analysis stations were subjected to the identical suite of analyses. This was mainly true in the coarser-grained areas to the southeast where it was difficult to obtain an adequate core for either Gust Chamber or resistivity profile analyses (Figure 2.2-1). At the sampling stations where Gust Chamber and resistivity profiles could be collected, composite GIS figures contain Gust Chamber result graphs as well as porosity profiles to varying depth intervals.

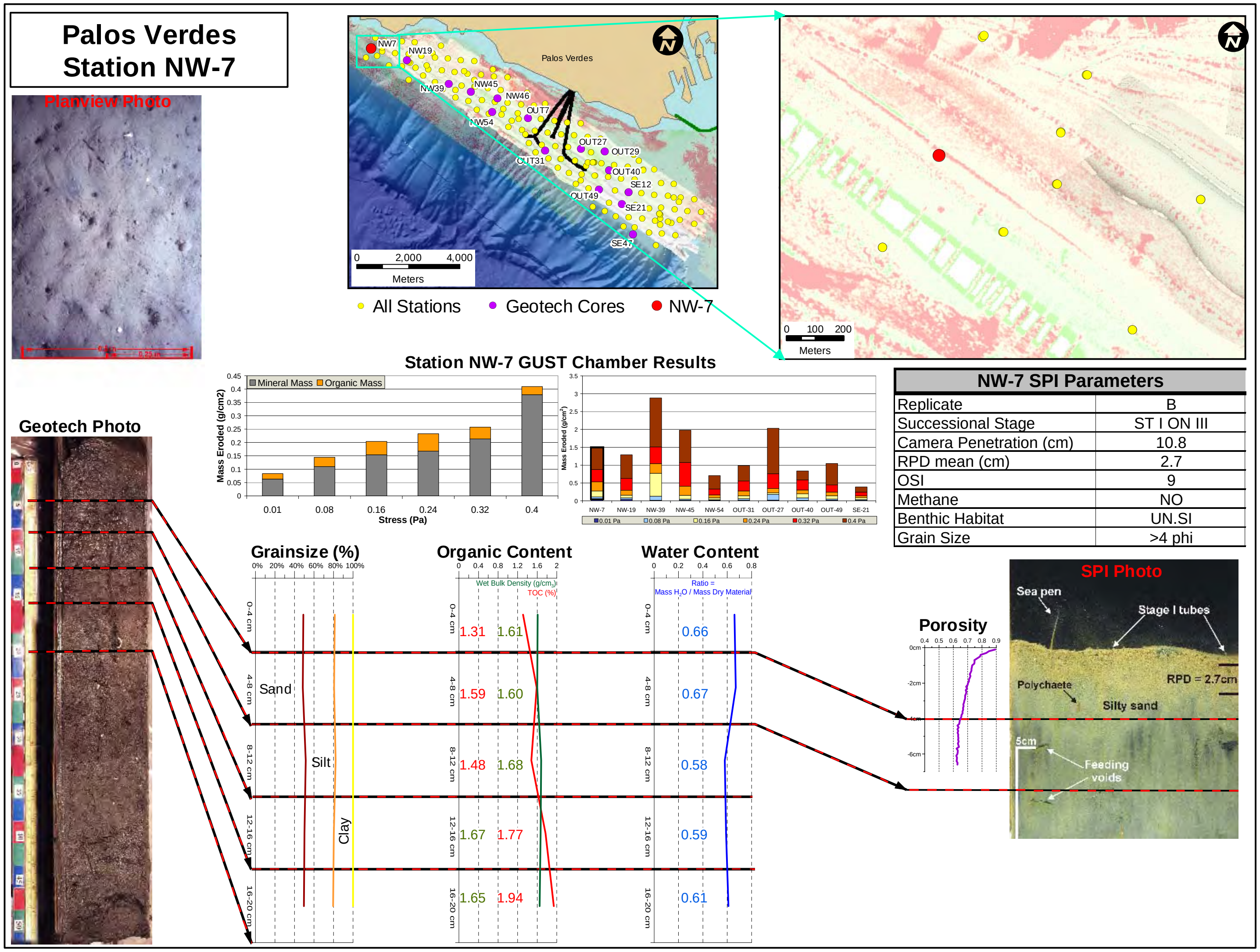


Figure 3.3-13. Composite overview of the analysis results for Station NW-7. The relative location of this sampling station is indicated on the overview graphic at the top of this figure. The graphic in the upper right-hand corner shows the side-scan sonar and multibeam backscatter imagery in the immediate vicinity of this station.

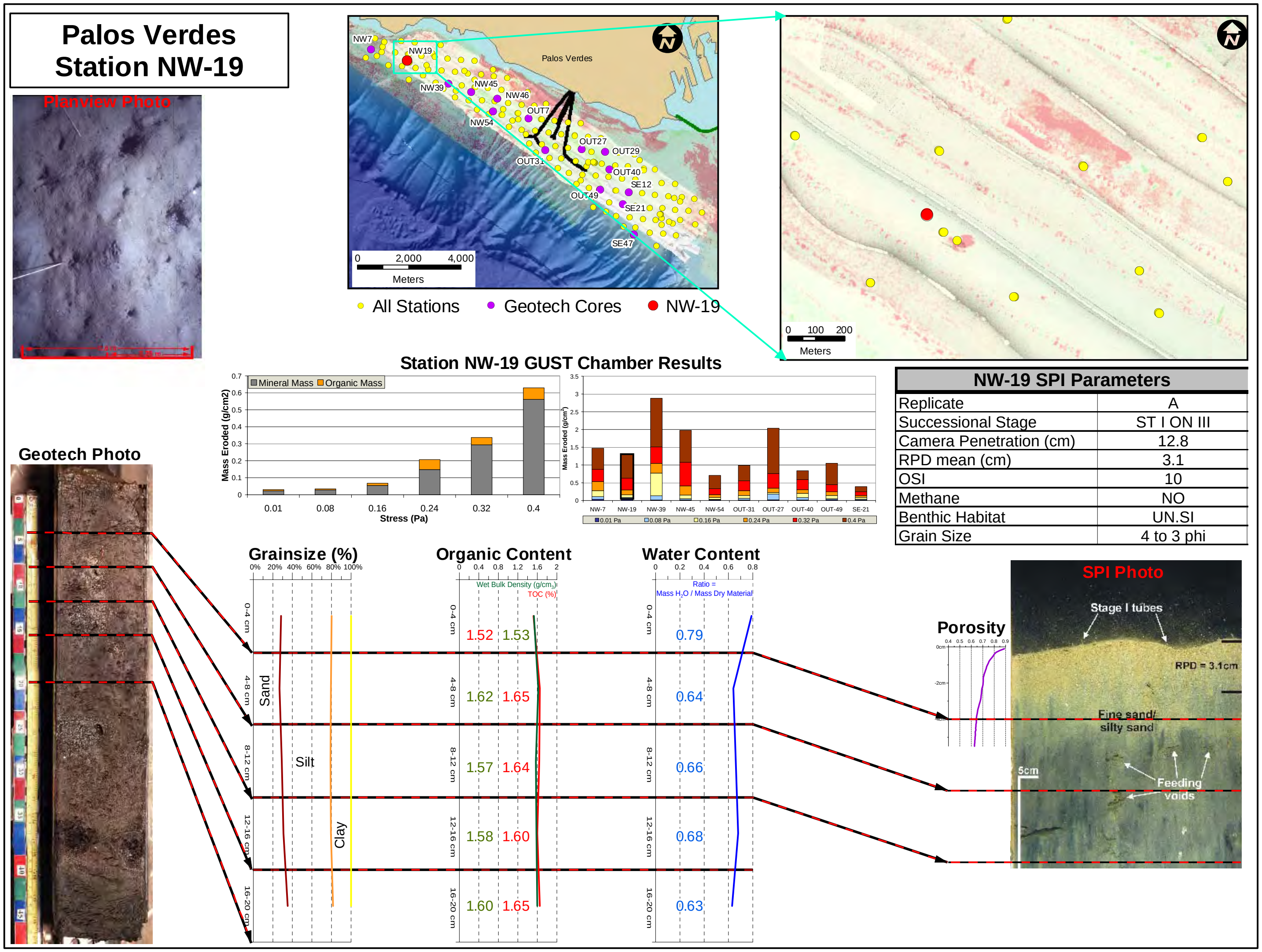


Figure 3.3-14. Composite overview of the analysis results for Station NW-19. The relative location of this sampling station is indicated on the overview graphic at the top of this figure. The graphic in the upper right-hand corner shows the side-scan sonar and multibeam backscatter imagery in the immediate vicinity of this station.

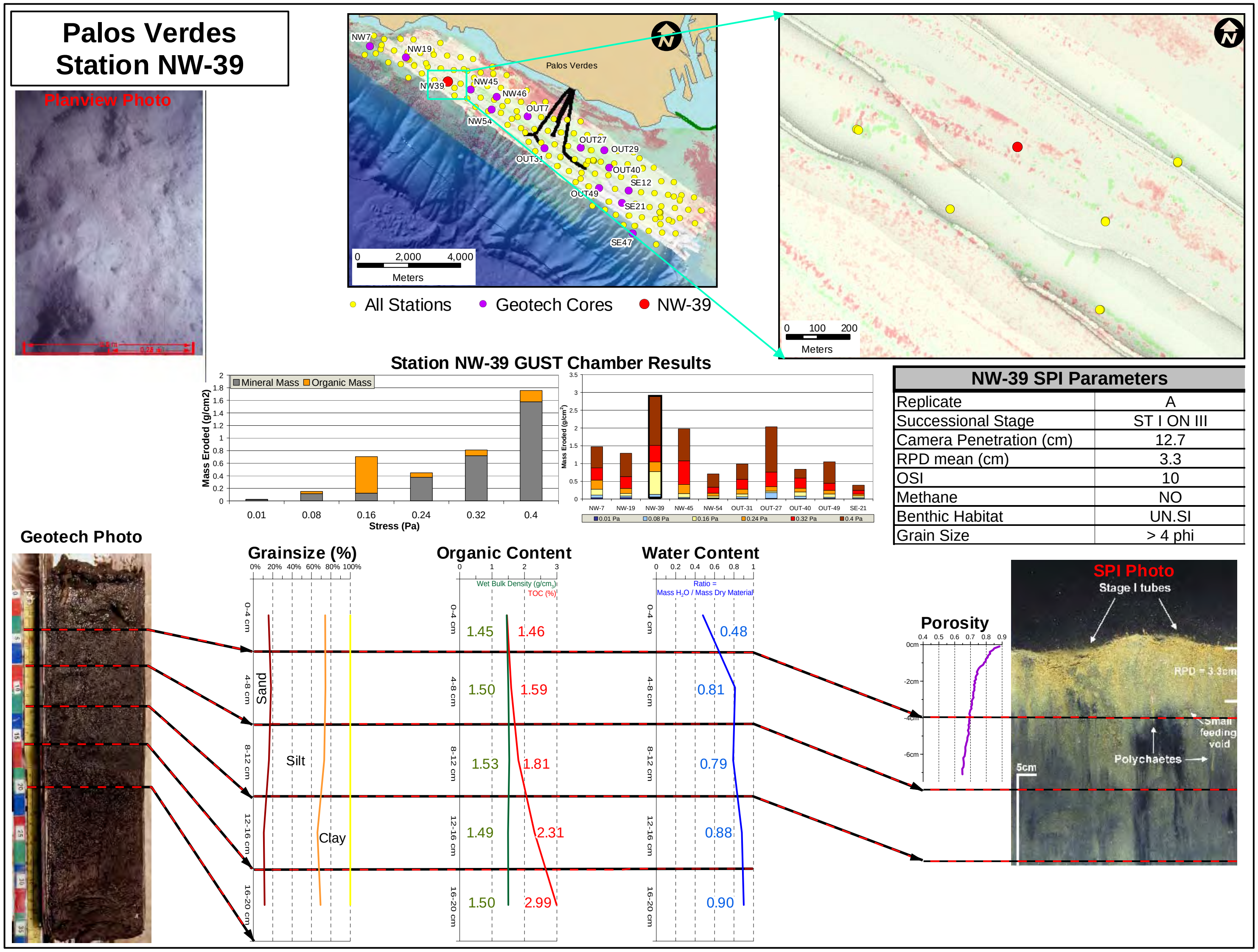


Figure 3.3-15. Composite overview of the analysis results for Station NW-39. The relative location of this sampling station is indicated on the overview graphic at the top of this figure. The graphic in the upper right-hand corner shows the side-scan sonar and multibeam backscatter imagery in the immediate vicinity of this station

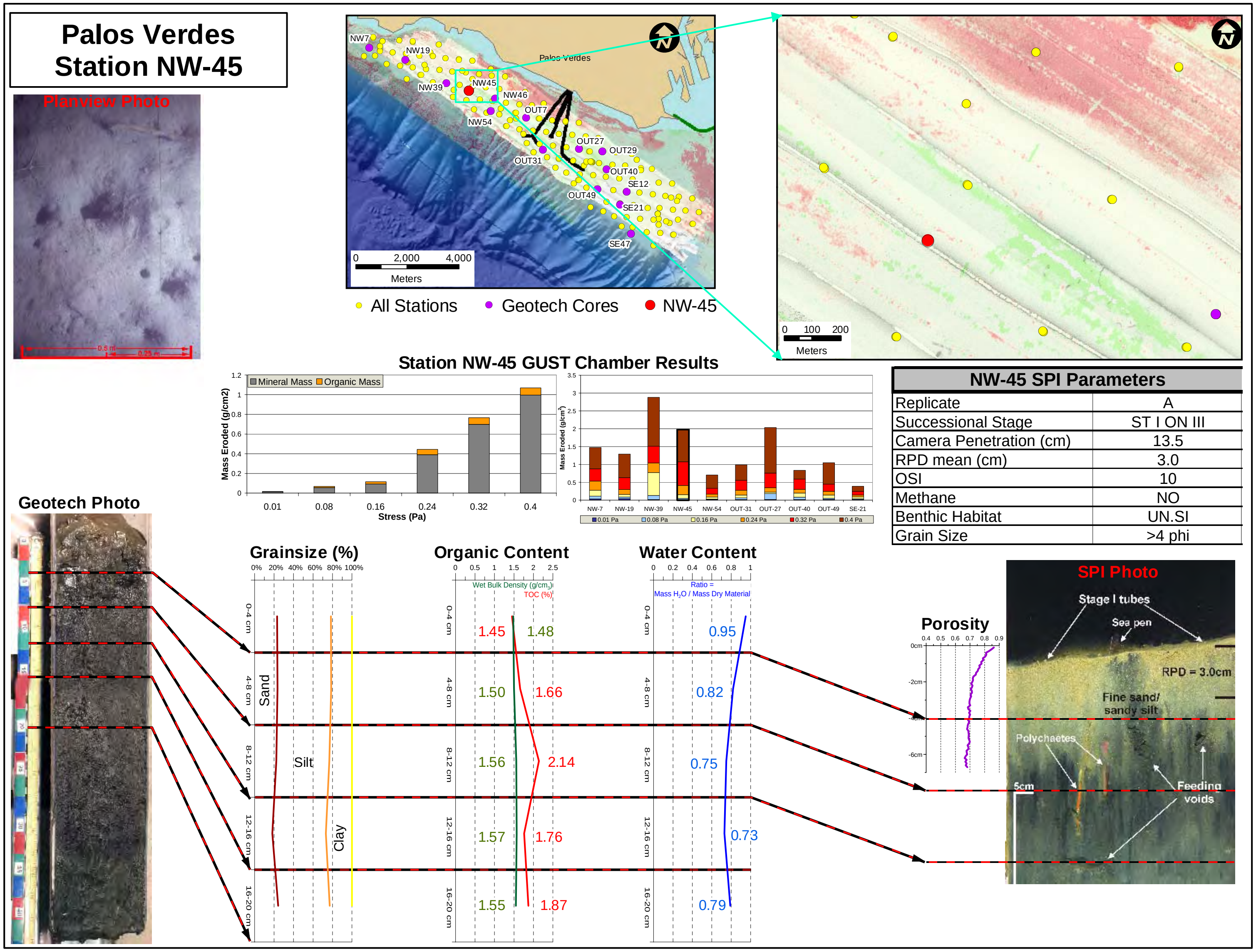


Figure 3.3-16. Composite overview of the analysis results for Station NW-45. The relative location of this sampling station is indicated on the overview graphic at the top of this figure. The graphic in the upper right-hand corner shows the side-scan sonar and multibeam backscatter imagery in the immediate vicinity of this station.

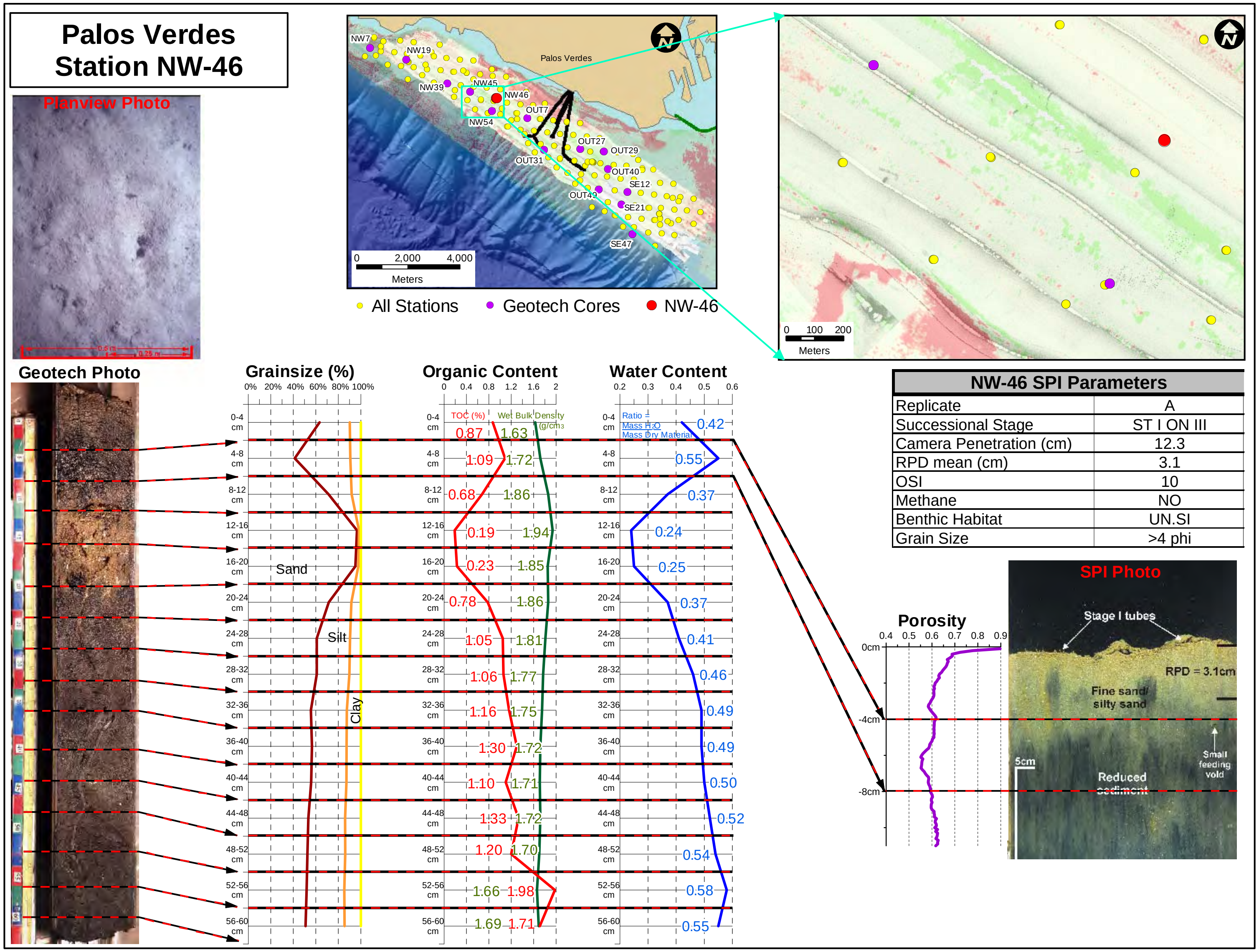


Figure 3.3-17. Composite overview of the analysis results for Station NW-46. Because this station was within one of the pilot cap cells, (LD), it was sub-sampled for its entire length. The relative location of this sampling station is indicated on the overview graphic at the top of this figure. The graphic in the upper right-hand corner shows the side-scan sonar and multibeam backscatter imagery in the immediate vicinity of this station.

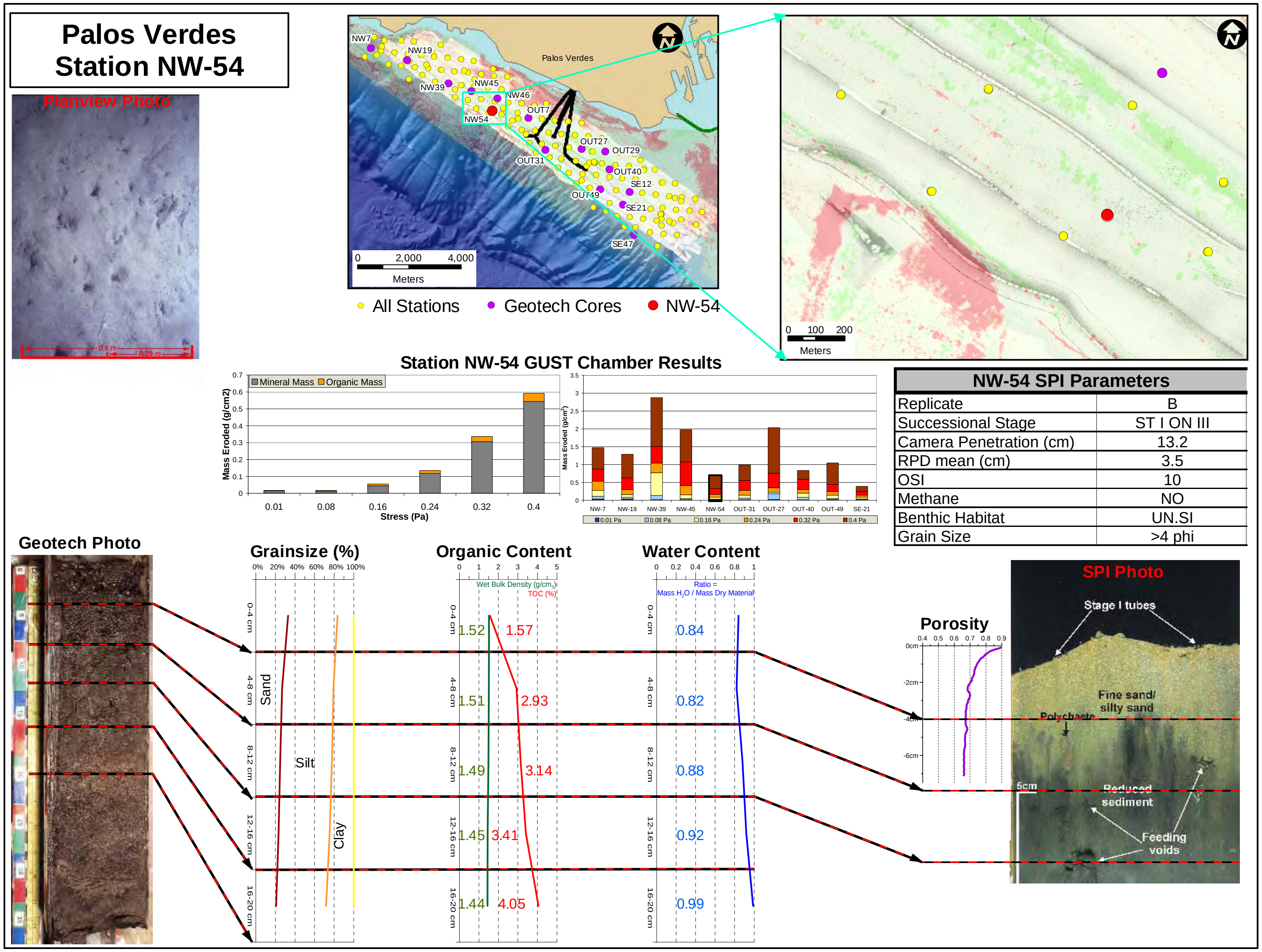
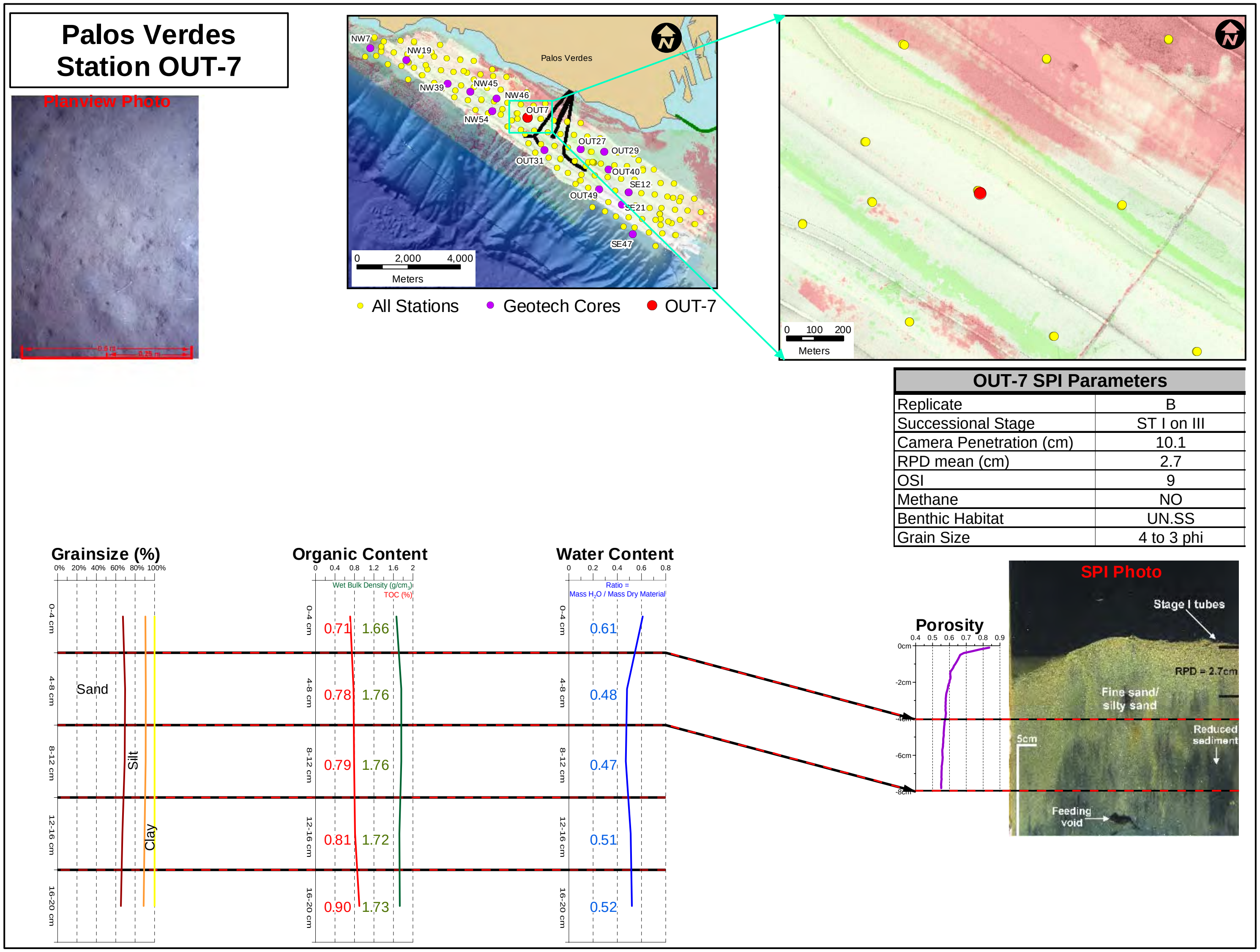


Figure 3.3-18. Composite overview of the anlysis results for Station NW-54. The relative location of this sampling station is indicated on the overview graphic at the top of this figure. The graphic in the upper right-hand corner shows the side-scan sonar and multibeam backscatter imagery in the immediate vicinity of this station.



OUT-7 SPI Parameters	
Replicate	B
Successional Stage	ST I on III
Camera Penetration (cm)	10.1
RPD mean (cm)	2.7
OSI	9
Methane	NO
Benthic Habitat	UN.SS
Grain Size	4 to 3 phi

Figure 3.3-19. Composite overview of the analysis results for Station OUT-7. The relative location of this sampling station is indicated on the overview graphic at the top of this figure. The graphic in the upper right-hand corner shows the side-scan sonar and multibeam backscatter imagery in the immediate vicinity of this station.

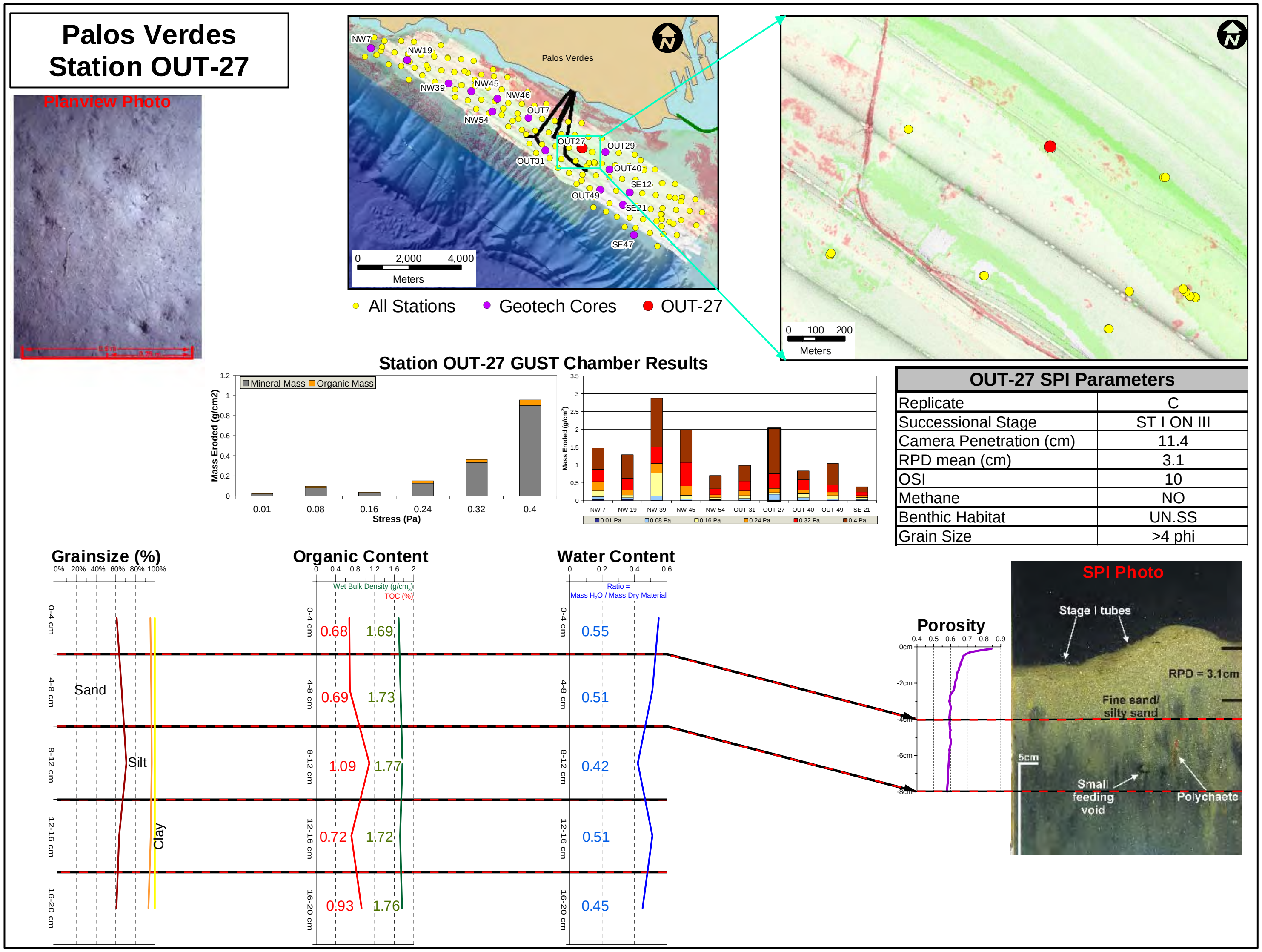
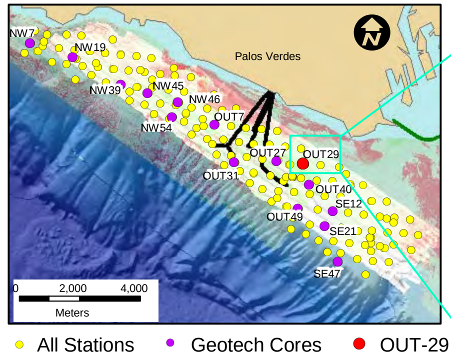
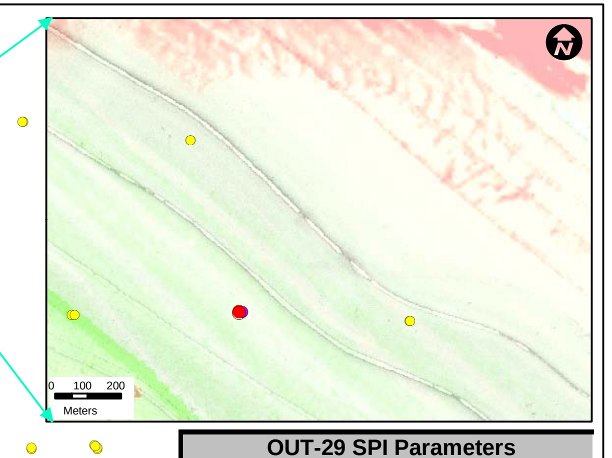


Figure 3.3-20. Composite overview of the analysis results for Station OUT-27. The relative location of this sampling station is indicated on the overview graphic at the top of this figure. The graphic in the upper right-hand corner shows the side-scan and multibeam backscatter imagery in the immediate vicinity of this station.

Palos Verdes
Station OUT-29





OUT-29 SPI Parameters	
Replicate	B
Successional Stage	ST I
Camera Penetration (cm)	8.9
RPD mean (cm)	2.1
OSI	4
Methane	NO
Benthic Habitat	UN.SS
Grain Size	4 to 3 phi

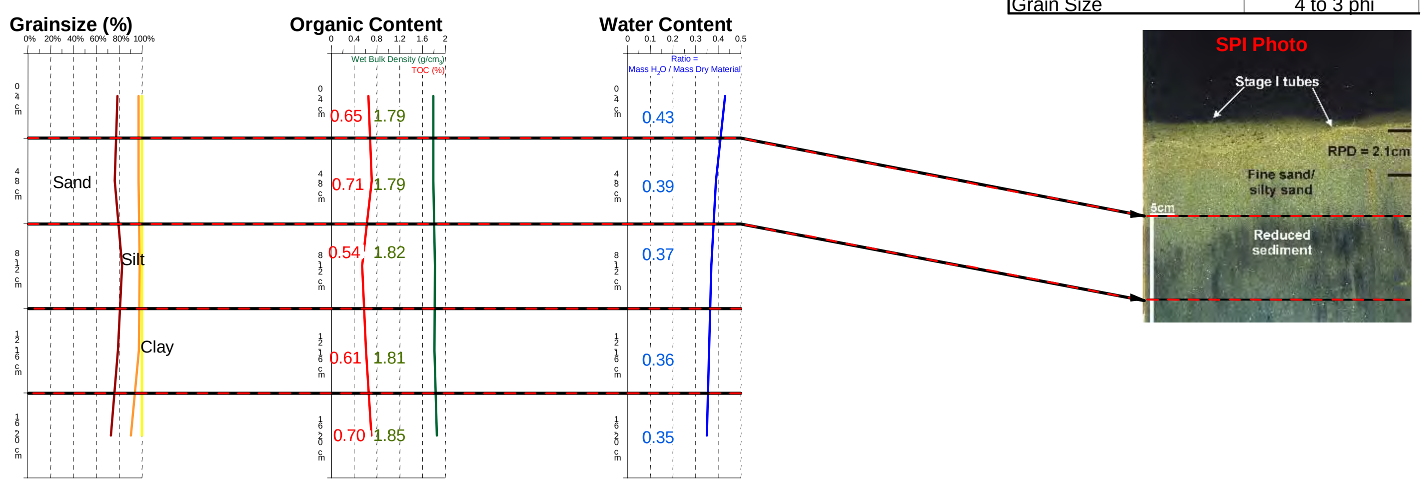
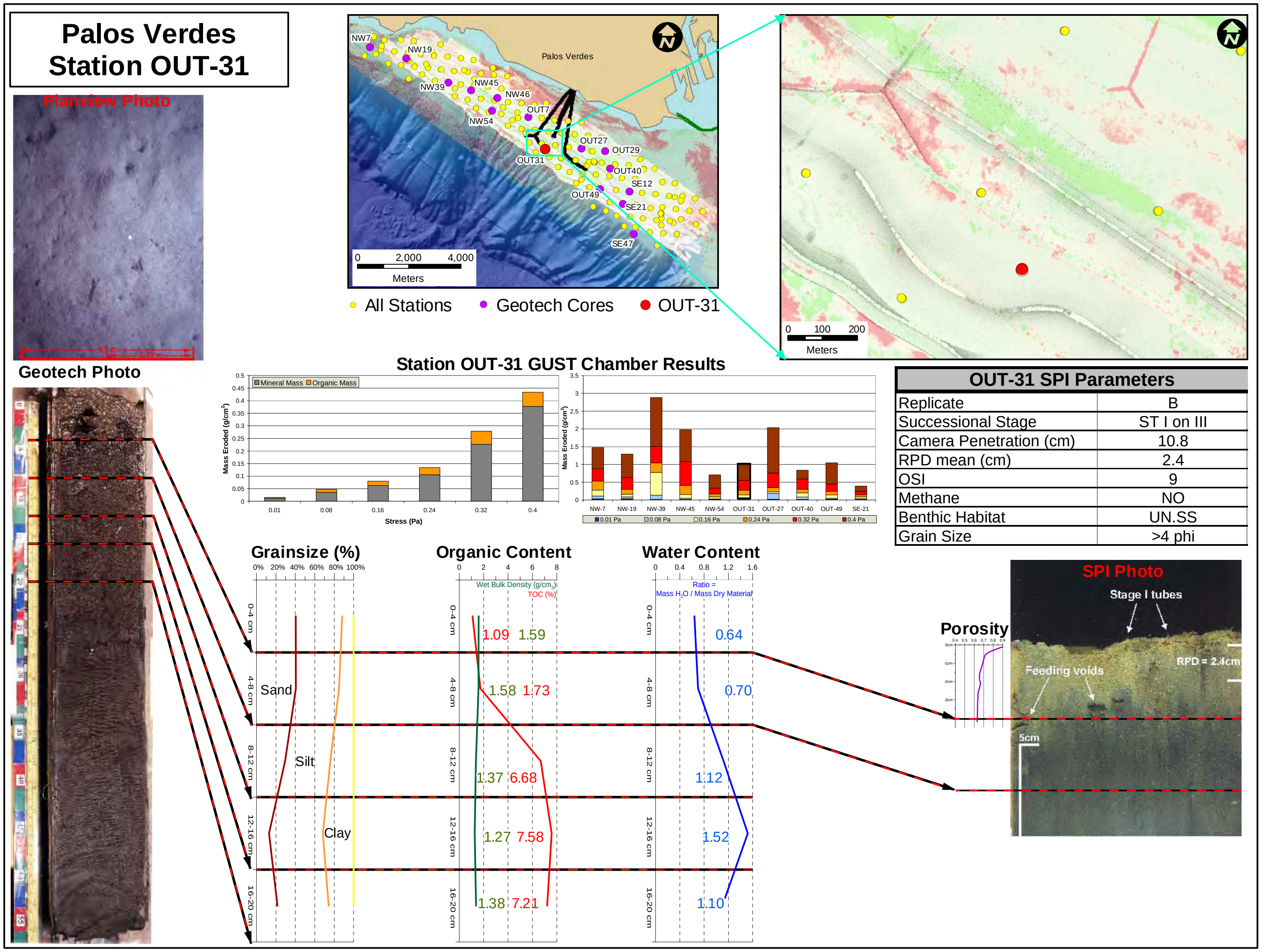
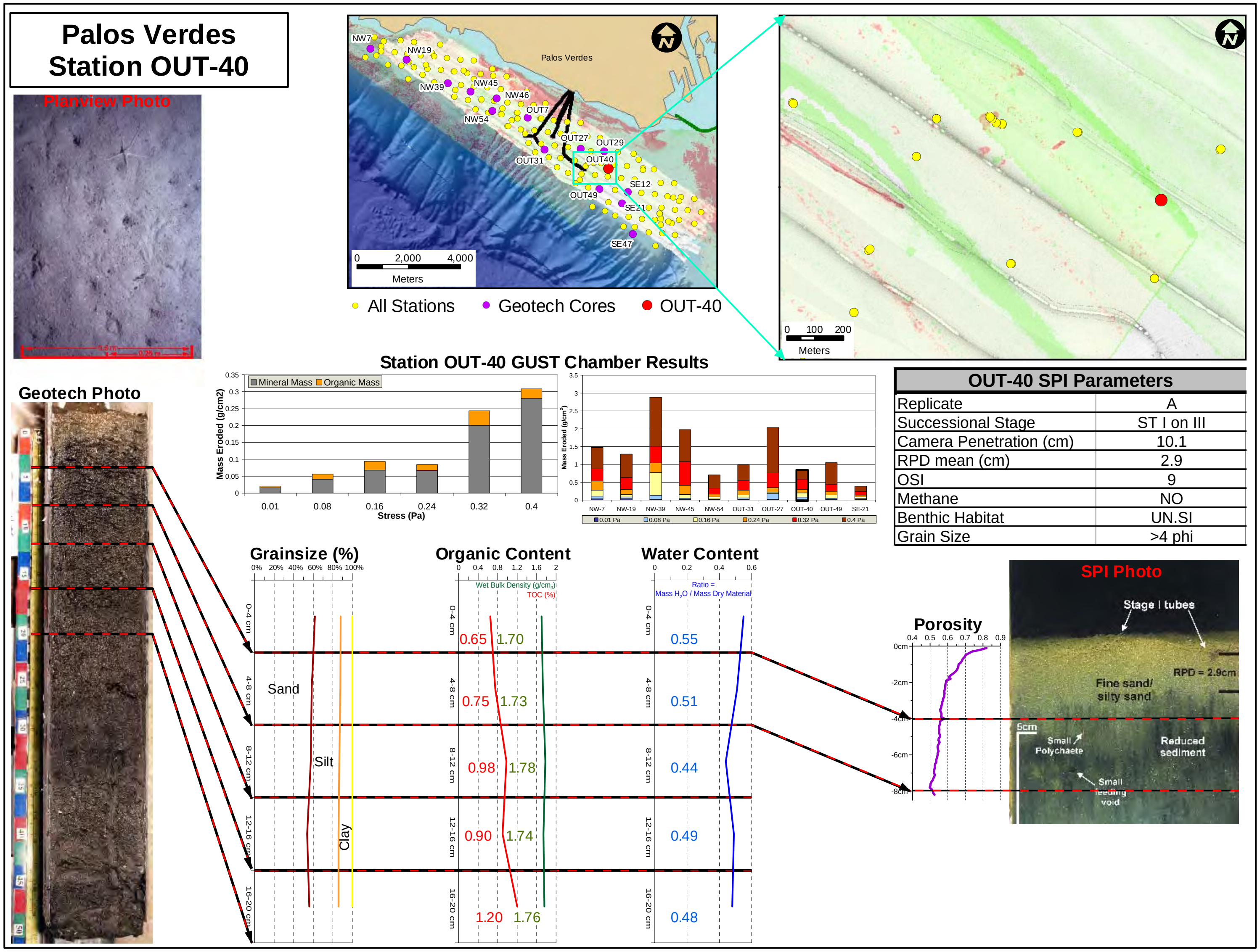


Figure 3.3-21. Composite overview of the anlysis results for Station OUT-29. The relative location of this sampling station is indicated on the overview graphic at the top of this figure. The graphic in the upper right-hand corner shows the side-scan sonar and mutlibeam backscatter imagery in the immediate vicinity of this station.



OUT-31 SPI Parameters	
Replicate	B
Successional Stage	ST I on III
Camera Penetration (cm)	10.8
RPD mean (cm)	2.4
OSI	9
Methane	NO
Benthic Habitat	UN.SS
Grain Size	>4 phi

Figure 3.3-22. Composite overview of the analysis results for Station OUT-31. The relative location of this sampling station is indicated on the overview graphic at the top of this figure. The graphic in the upper right-hand corner shows the side-scan sonar and multibeam backscatter imager in the immediate vicinity of this station.



OUT-40 SPI Parameters	
Replicate	A
Successional Stage	ST I on III
Camera Penetration (cm)	10.1
RPD mean (cm)	2.9
OSI	9
Methane	NO
Benthic Habitat	UN.SI
Grain Size	>4 phi

Figure 3.3-23. Composite overview of the analysis results for Station OUT-40. The relative location of this sampling station is indicated on the overview graphic at the top of this figure. The graphic in the upper right-hand corner shows the side-scan sonar and multibeam backscatter imagery in the immediate vicinity of this station.

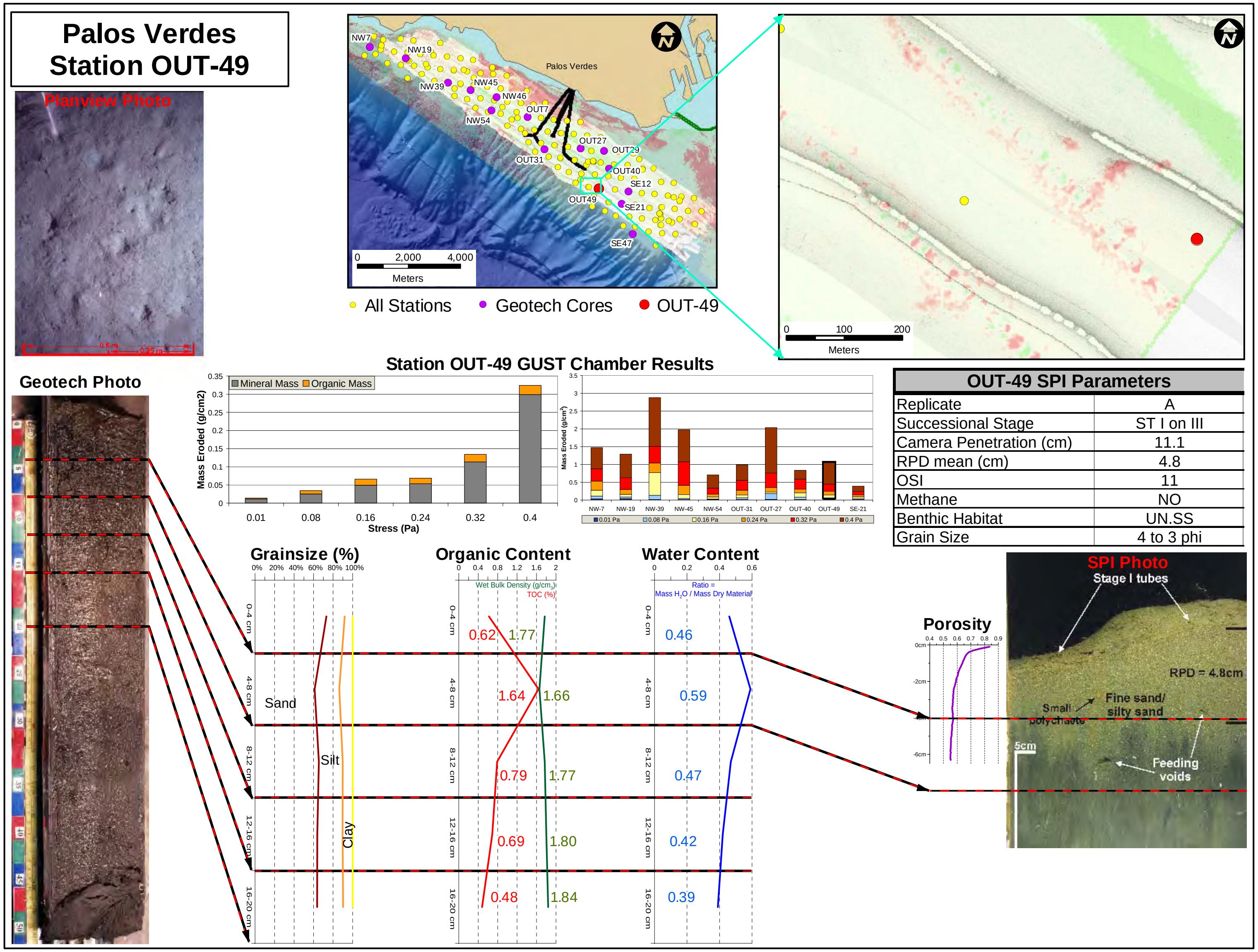
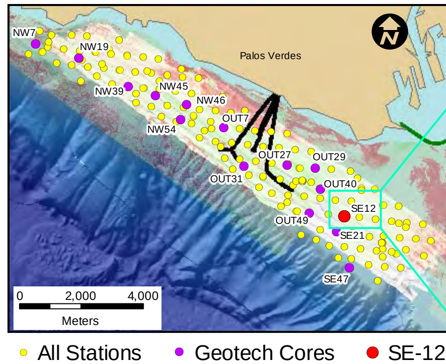
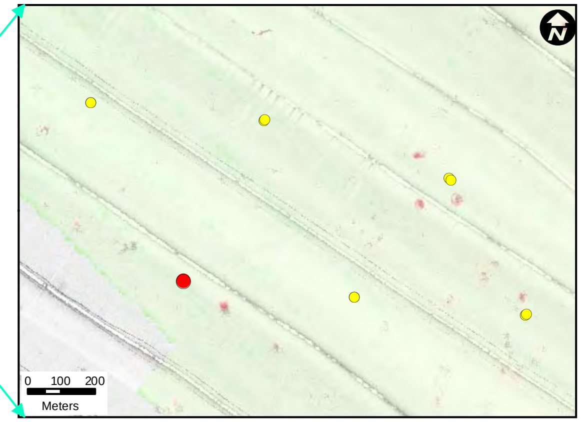


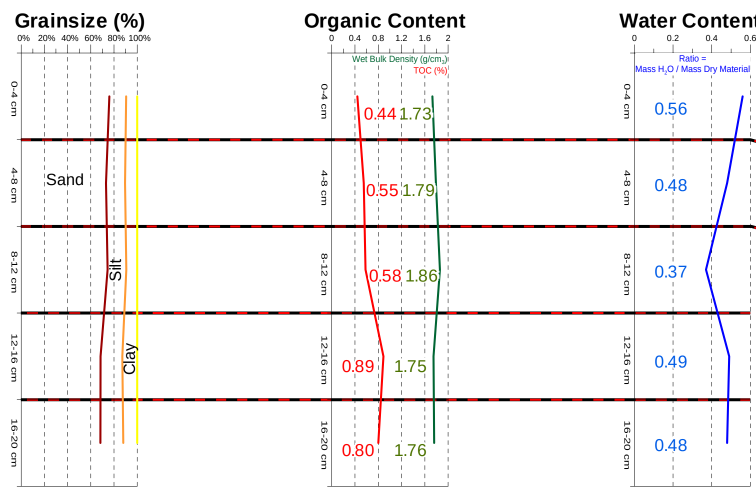
Figure 3.3-24. Composite overview of the anlysis results for Station OUT-49. The relative location of this sampling station is indicated on the overview graphic at the top of this figure. The graphic in the upper right-hand corner shows the side-scan sonar and multibeam backscatter imagery in the immediate vicinity of this station.

Palos Verdes Station SE-12





SE-12 SPI Parameters	
Replicate	B
Successional Stage	ST I
Camera Penetration (cm)	9.6
RPD mean (cm)	3.2
OSI	6
Methane	NO
Benthic Habitat	UN.SS
Grain Size	4 to 3 phi



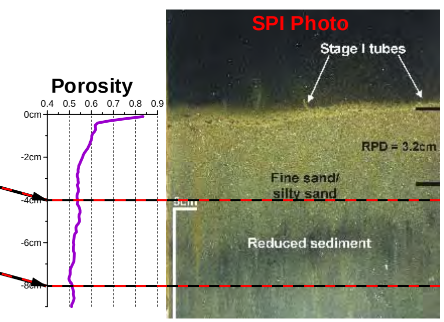


Figure 3.3-25. Composite overview of the anlysis results for Station SE-12. The relative location of this sampling station is indicated on the overview graphic at the top of this figure. The graphic in the upper right-hand corner shows the side-scan sonar and multibeam backscatter imagery in the immediate vicinity of this location.

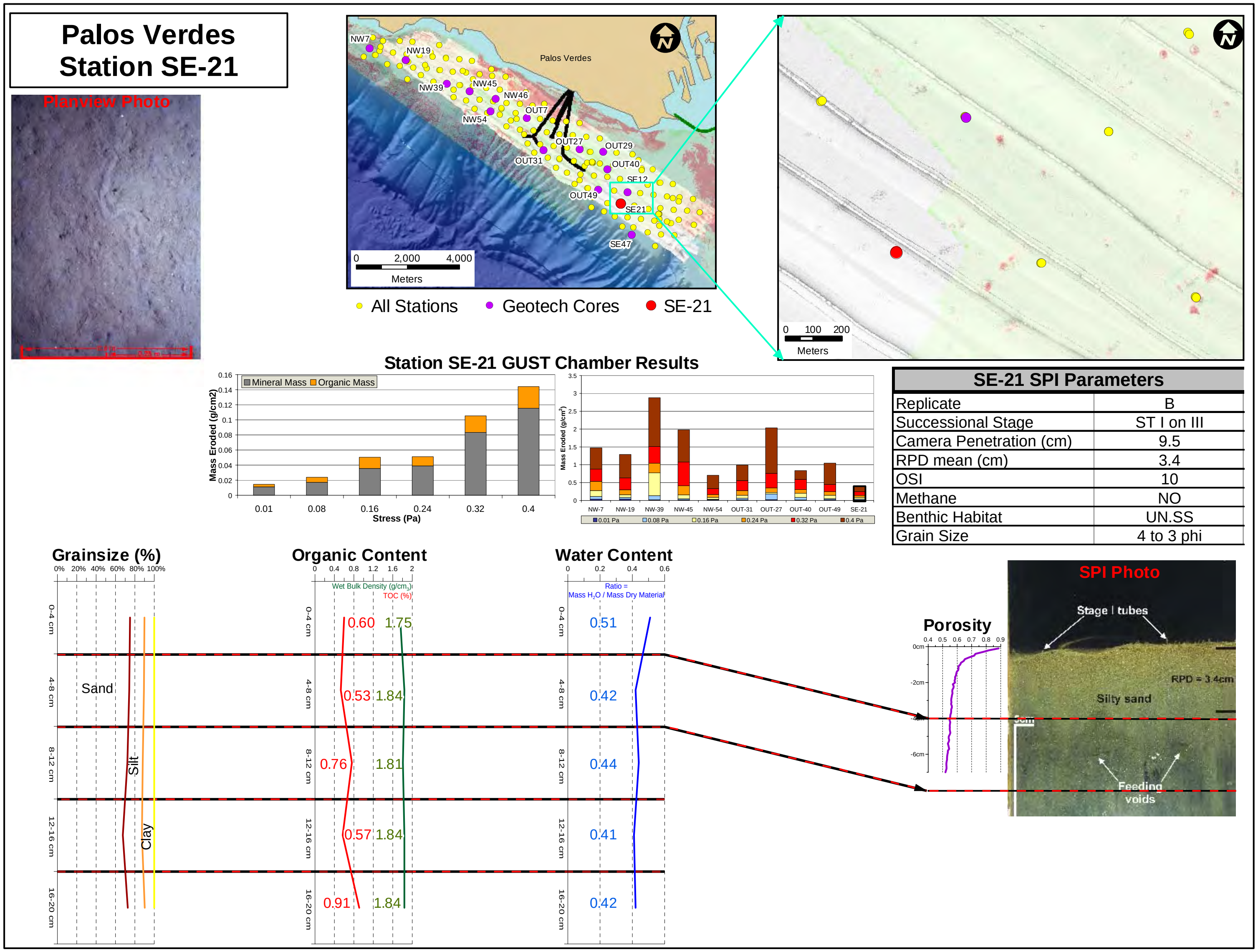
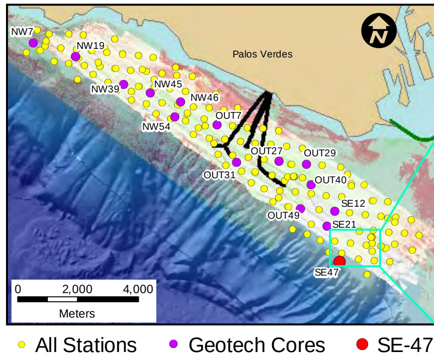
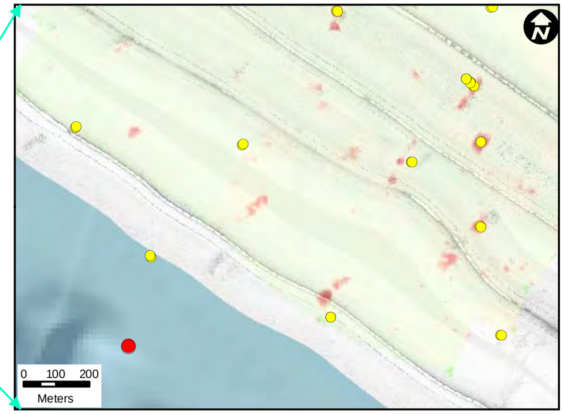


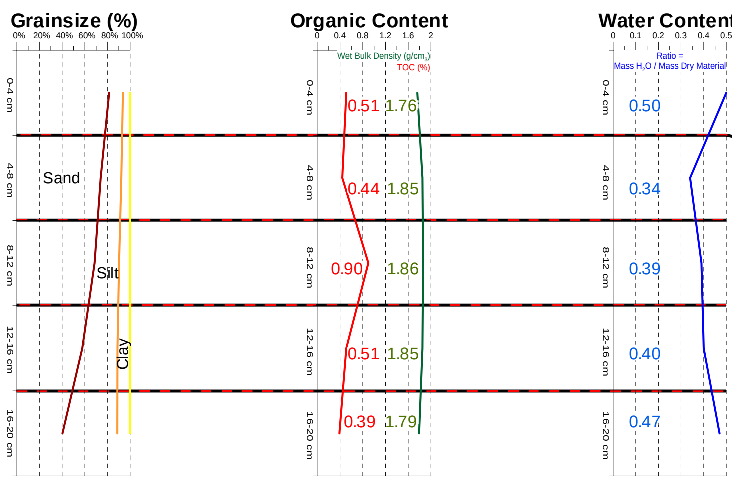
Figure 3.3-26. Composite overview of the anlysis results for Station SE-21. The relative location of this sampling station is indicated on the overview graphic at the top of this figure. The graphic in the upper right-hand corner shows the side-scan sonar and multibeam backscatter imagery in the immediate vicinity of this station.

Palos Verdes
Station SE-47





SE-47 SPI Parameters	
Replicate	C
Successional Stage	ST I
Camera Penetration (cm)	7.0
RPD mean (cm)	3.6
OSI	6
Methane	NO
Benthic Habitat	UN.SS
Grain Size	4 to 3 phi



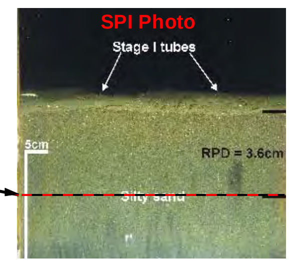


Figure 3.3-27. Composite overview of the anlysis results for Station SE-47. The relative location of this station is indicated on the overview graphic at the top of this figure. The graphic in the upper right-hand corner shows the side-scan sonar and multibeam backscatter imagery in the immediate vicinity of this location.

4.0 SUMMARY

The extensive geotechnical data that were acquired during the 2004 measurement effort have provided additional coverage and detail to more completely and accurately map the geotechnical properties of the near-surface sediments across the Palos Verdes (PV) Shelf, specifically within the region that will later be modeled for predictions of erosion and transport of ambient sediments and cap material. The initial broad-scale side-scan sonar data helped to delineate those regions of the shelf with somewhat differing sediment or surface roughness characteristics. The interpretation of the broad-scale acoustic data was greatly enhanced by the extensive number of high-resolution sediment-profile and plan-view images that were collected across the different regions of the shelf. Not only did these images help to confirm the broad-scale acoustic interpretation, but they also provided valuable quantitative and qualitative data on the physical and biological characteristics across the shelf area. In addition, the follow-on coring program and subsequent analyses provided the detailed quantitative data (e.g., geotechnical properties, porosity profiles, and shear stress erosion rates) that will ultimately be required within the model formulation effort. Finally, the Sedflume analyses, conducted by ERDC as a separate and complementary element of the Geotechnical program, will provide additional quantitative data on sediment erodibility at greater shear stress levels and deeper sediment depths (relative to the Gust Chamber results).

The detailed geotechnical and erosion shear stress analyses that are of primary interest for the modeling effort were conducted on cores collected at only a dozen or so stations across the entire shelf. Because of the relative sparseness of these data, it will be important to critically assess the quality and validity of each of these data points before they are relied on during the subsequent data synthesis. Based on the interpolated grid surfaces that were generated from some of the quantitative geotechnical datasets (e.g., total mass eroded and porosity), it appeared that these data revealed a generally consistent picture of the PV Shelf sediments. However, there were some individual station values that appeared contradictory to some of the general trends observed along the Shelf. When developing the final critical shear stress parameters, it will also be important to closely evaluate the agreement between the Gust and Sedflume erosion results. In addition, the differences in the “surface” interval between the various analysis techniques will also need to be considered during the subsequent analysis.

In addition to the dozen detailed geotechnical and erosion stations, porosity profiles were obtained at about 50 stations, high-resolution sediment-profile and plan-view images were collected at about 175 stations, and a broad-scale acoustic image mosaic was created covering most of the shelf area. Though a complete analysis of the correlation between the various datasets was well outside the scope of this basic data reporting effort, the initial review of these data have shown generally consistent and logical agreement between the various datasets. Detailed visual comparisons were made between the side-scan sonar acoustic imagery and the numerous sediment-profile and plan-view photographs, primarily to assist with the interpretation and analysis of the side-scan sonar data. As illustrated in many of the figures presented in this report, there was strong and consistent agreement between the acoustic and photographic imagery data.

Numerical and statistical analysis techniques will be required to more completely assess the correlation between the various quantitative data results (including numerical values derived from sediment-profile image analysis and side-scan sonar reflectivity or backscatter intensity). Based on the extent of the correlation between the datasets, it may be possible to iteratively and numerically link these datasets. Based on multivariate or co-Kriging analyses between the relatively sparse erosion shear stress data and the other datasets (e.g., discrete porosity profiles, discrete sediment-profile data, continuous acoustic imagery data) of increasing density and coverage, it may be possible to reliably infer the desired erosion shear stress results across the shelf to a denser level of spatial resolution.

As stated in the Introduction, the Geotechnical Measurement Program was designed to address the following key questions originally developed by the technical review committee and set forth in the IWP:

1) ***What is the small-scale variability in the erodibility (and other geotechnical properties) of the near-surface sediments across the PV Shelf?***
2) ***How well can existing rapid sampling techniques be used to measure or predict the erodibility of the near-surface sediments?***
3) ***What is the extent of the seasonal differences in the geotechnical properties of the near-surface sediments (if a second field study is conducted in the alternate season)?***

Though a complete discussion on the answers to these questions will not be possible until after the subsequent data analyses and synthesis have been completed, it is possible to evaluate how well the recently acquired geotechnical data may enable these questions to be addressed. Based on the quantitative results obtained through the analytical elements of the coring program, it appears that the first IWP question has been adequately addressed. A review of the mass eroded values obtained through the Gust Chamber analyses indicated that there was statistically significant variability in the computed erosion values moving from the northwest to the southeast along the 60-m contour of the PV Shelf. Likewise, the laboratory geotechnical results (e.g., grain size, bulk density, water content, porosity, etc.) also showed considerable variability across different areas of the Shelf. It is expected that the Sedflume results will provide another dataset that will help to evaluate and better define the variability of the geotechnical properties of the PV Shelf sediments.

The second IWP question addresses the ability to use the more rapidly sampled datasets (e.g., side-scan sonar imagery, sediment-profile images, resistivity profiles) to measure or predict erodibility of the near-surface sediments. Though the required data to assess this question was acquired during the recent measurement program, the analyses required to answer this question will be a primary focus of the subsequent data synthesis effort. As addressed earlier in this section, numerical and statistical analysis techniques will be required to more completely assess the correlation between the various quantitative data results and to determine if it is possible to reliably infer the desired erosion shear stress results across the shelf to a greater level of spatial resolution based on the more densely sampled datasets. Though a complete analysis of the correlation between the various datasets was well outside the scope of this basic data reporting effort, the initial review of these data have shown generally consistent and logical agreement between the various datasets.

Because this measurement program was conducted over just a single time period that would be representative of summer conditions, it is not possible to definitively answer the third IWP question with these data alone. Though it is unlikely that a comparable geotechnical dataset has been previously collected along the Shelf during a past winter season, there may be historical geotechnical data available that would enable some analysis of possible seasonal differences in sediment properties. At a minimum, the results from the sediment cores and related geotechnical and porosity analyses that were conducted at each of the six oceanographic mooring locations in the late winter 2004 (prior to initial mooring deployment) could be used to make some initial comparisons between the winter and summer geotechnical characteristics of the near-surface sediments. Based on a cursory review of these data, there appeared to be limited seasonal differences in the near-surface geotechnical properties at the overlapping stations.

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Appendix A
Sediment Profile Image Tables
A-1 – SE
A-2 – OUT
A-3 – NW

Appendix A-1. REMOTS® Sediment-Profile Imaging Data from the Palos Verdes July 2004 Survey (SE Stations).

Station	Replicate	Date	Time	Successional Stage	Grain Size (phi) Min	Grain Size (phi) Max	Grain Size (phi) Maj Mode	Benthic Habitat	Mud Clasts Present	Camera Penetration (cm) Min	Camera Penetration (cm) Max	Camera Penetration (cm) Range	Camera Penetration (cm) Mean	Dredged Material Thickness (cm) Min	Dredged Material Thickness (cm) Max	Dredged Material Thickness (cm) Mean	Redox Rebound Thickness (cm) Min	Redox Rebound Thickness (cm) Max	Redox Rebound Thickness (cm) Mean	Apparent RPD Thickness (cm) Min	Apparent RPD Thickness (cm) Max	Apparent RPD Thickness (cm) Mean	Methane Count	OSI	Surface Roughness	Low DO	Comments
SE1	B	7/12/2004	08:46:00	ST I	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	8.48	9.87	1.39	9.17	0	0	0	0	0	0	0.26	4.01	2.63	0	5	Physical	NO	Tan silty sand/tan & blk sandy silt, red sed @z, shell frag-surd, polychaetes @z, iron oxide, tubes, biogenic mound-far
SE1	C	7/12/2004	08:47:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	8.45	9.16	0.71	8.81	0	0	0	0	0	0	0.70	3.09	2.08	0	8	Physical	NO	Tan fine/tan & blk silty sand, bedforms-sand ripple?,red sed @z, sm tubes, polychaetes @z sm voids, biogenic mound-far
SE10	B	7/11/2004	14:56:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	8.24	10.57	2.33	9.4	0	0	0	0	0	0	1.14	4.45	3.27	0	10	Physical	NO	Tan fine sand/tan & blk silty sand, red sed @ z, tubes, sm polychaete @z, iron oxide streaks
SE10	C	7/11/2004	14:56:00	ST I	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	9.47	10.8	1.33	10.14	0	0	0	0	0	0	0.66	4.75	3.14	0	6	Physical	NO	Tan fine sand/tan & blk silty sand, red sed band @z, sm polychaetes @z, sm tubes, iron
SE11	A	7/11/2004	14:15:00	ST I	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	8.78	9.63	0.85	9.2	0	0	0	0	0	0	0.48	4.82	3.72	0	6	Physical	NO	Tan/tan & blk silty sand, red sed @z, shell material @z, sm tubes, sm polychaetes @z, sm
SE11	C	7/11/2004	14:17:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SI	TRUE	10.58	11.09	0.51	10.84	0	0	0	0	0	0	0.55	3.64	2.80	0	9	Physical	NO	Tan/tan & blk silty sand, red sed band, void, tubes, polychaetes @z, ox clasts
SE12	B	7/11/2004	14:06:00	ST I	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	8.92	10.28	1.36	9.6	0	0	0	0	0	0	0.63	4.19	3.17	0	6	Physical	NO	Tan fine sand/tan & blk silty sand, tubes, polychaete-far; iron oxide streak, relic RPD?, red sed band
SE12	C	7/11/2004	14:07:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	9.02	9.87	0.85	9.44	0	0	0	0	0	0	0.18	4.82	3.30	0	10	Physical	NO	Tan fine sand/tan & blk silty sand, red sed @z, tubes, void, shell bits, iron oxide streak
SE13	B	7/11/2004	13:58:00	ST I	> 4 phi	2 phi	4 to 3 phi	UN.SI	FALSE	9.68	10.61	0.93	10.15	0	0	0	0	0	0	0.63	4.34	3.56	0	6	Physical	NO	Tan silty sand/tan & blk sandy silt, red sed @z, sm tubes, sm polychaete @z, iron oxide
SE13	C	7/11/2004	13:59:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	8.45	9.16	0.71	8.81	0	0	0	0	0	0	0.55	3.49	2.55	0	9	Biogenic	NO	Tan/tan & gry silty sand, shell frags, sm void, tubes, biogenic mound, m clumps-far?, sm polychaete @z
SE14	A	7/11/2004	13:50:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	7.69	8.12	0.43	7.9	0	0	0	0	0	0	0.33	3.97	2.69	0	9	Physical	NO	Tan/tan &gry silty sand, red sed @z, voids, tubes
SE14	B	7/11/2004	13:51:00	ST I	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	7.62	9.28	1.66	8.45	0	0	0	0	0	0	0.33	4.34	2.71	0	5	Physical	NO	Tan/tan & blk silty sand, red sed @z, iron oxide, sm tubes, fecal casts-far?, sm polychaete
SE15	A	7/11/2004	13:42:00	ST I	> 4 phi	2 phi	4 to 3 phi	UN.SI	FALSE	3.7	5.41	1.71	4.55	0	0	0	0	0	0	0.37	3.38	2.32	0	5	Physical	NO	Tan/gry silty sand, underpen, shell bits, tubes, fecal casts @ surf
SE15	B	7/11/2004	13:43:00	ST I	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	4.01	4.65	0.64	4.33	0	0	0	0	0	0	0.26	3.09	2.44	0	5	Physical	NO	Tan/gry silty sand, underpen, sm tubes
SE16	B	7/11/2004	13:21:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	4.92	5.65	0.73	5.28	0	0	0	0	0	0	0.44	4.05	2.73	0	9	Physical	NO	Tan/gry silty sand, low pen, iron oxide, polychaete @z, fecal casts @ surf, tubes, burrow or
SE16	C	7/11/2004	13:21:00	ST I	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	3.51	4.68	1.17	4.09	0	0	0	0	0	0	0.40	3.79	1.82	0	4	Physical	NO	Tan/gry silty sand, low pen, shell frags, tubes, org near surf?, biogenic mound?
SE17	B	7/11/2004	13:12:00	ST I	4 phi	2 phi	3 to 2 phi	SA.F	FALSE	0.05	3.42	3.37	1.74	0	0	0	0	0	0	0.11	3.49	2.44	0	5	Physical	NO	Tan fine sand, low pen, shell frags @ surf, anemone-far?, sand ripple?
SE17	C	7/11/2004	13:13:00	ST I	4 phi	2 phi	3 to 2 phi	SA.F	FALSE	2.66	5.2	2.54	3.93	0	0	0	0	0	0	0.74	5.04	3.92	0	7	Physical	NO	Tan fine sand, bedforms-sand ripple, sm tubes, sm polychaete @z
SE18	A	7/11/2004	13:35:00	ST I	4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	6.79	7.64	0.85	7.22	0	0	0	0	0	0	0.04	5.04	2.75	0	5	Physical	NO	Tan/gry silty sand, iron oxide, shell bits, sm tubes
SE18	B	7/11/2004	13:36:00	ST I	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	4.27	5.13	0.86	4.7	0	0	0	0	0	0	0.18	3.64	2.57	0	5	Physical	NO	Tan/gry silty sand, shell bits, iron oxide, sm void?, hydroid @ surf, organic detritus @ surf
SE19	A	7/11/2004	13:28:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	4.77	5.53	0.76	5.15	0	0	0	0	0	0	0.81	3.94	2.77	0	9	Physical	NO	Tan/gry silty sand, shell frags, tubes, sm voids, polychaete @z, org detritus @ surf, fecal
SE19	C	7/11/2004	13:29:00	INDET	N/A	N/A	N/A	SH.SA	FALSE	.	1.07	1.07	0.54	0	0	0	0	0	0	-99.00	-99.00	-99.00	0	99	Indeterminate	NO	Hard bottom, underpen, shell bed, bryozoans, macroalgae
SE2	A	7/12/2004	08:38:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	9.14	10.11	0.97	9.62	0	0	0	0	0	0	0.33	3.61	2.71	0	9	Physical	NO	Tan/tan & gry silty sand, red sed patches @z, lg polychaete @z, v sm voids, tubes, combfis (Zaniolepis)? @ surf, biogenic mounds-far
SE2	C	7/12/2004	08:39:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	8.83	9.59	0.76	9.21	0	0	0	0	0	0	0.70	3.83	2.93	0	9	Physical	NO	Tan/tan & gry silty sand, red sed patches @z, shell frags @ surf, polychaete @z, void, sm
SE20	A	7/10/2004	10:35:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SI	FALSE	9.62	10.42	0.8	10.02	0	0	0	0	0	0	0.63	3.68	2.75	0	9	Physical	NO	Tan/tan &blk silty sand, shell material @z, tubes, voids, red sed @z, sm polychaetes @z
SE20	B	7/10/2004	10:36:00	ST I	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	9.63	11.25	1.62	10.44	0	0	0	0	0	0	0.70	3.90	3.03	0	6	Biogenic	NO	Tan silty sand/tan & blk sandy silt, shell material or wht clay @z, red sed band, tubes, biogenic mounds, fecal lyr
SE21	A	7/11/2004	11:42:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	7.86	8.86	1	8.36	0	0	0	0	0	0	0.96	3.94	3.15	0	10	Physical	NO	Tan/gry muddy fine sand, tubes, shell frags, indistinct voids @z?, polychaete near surf, sm
SE21	B	7/11/2004	11:43:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	8.97	9.97	1	9.47	0	0	0	0	0	0	0.55	4.75	3.38	0	10	Physical	NO	Tan & gry muddy fine sand, tubes, voids, shell frags, red sed @z
SE22	A	7/11/2004	12:21:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	8.59	10.04	1.45	9.32	0	0	0	0	0	0	0.29	3.46	2.42	0	9	Physical	NO	Tan/tan & gry silty sand, wht clay @z, tubes, red sed @z, polychaetes @z, voids, burrow, biogenic mound-far
SE22	B	7/11/2004	12:21:00	ST I	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	9.16	10.09	0.93	9.62	0	0	0	0	0	0	0.59	3.53	2.46	0	5	Physical	NO	Tan/tan & gry silty sand, red sed band, shell material, sm polychaete @z, tubes, biogenic mound-far
SE23	B	7/11/2004	12:30:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	7.86	8.54	0.68	8.2	0	0	0	0	0	0	0.37	3.83	2.77	0	9	Physical	NO	Tan & gry silty sand, dense surf tubes, voids
SE23	C	7/11/2004	12:31:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	6.58	7.31	0.73	6.94	0	0	0	0	0	0	0.18	3.20	2.52	0	9	Physical	NO	Tan & gry silty sand, lg voids, tubes, shell bits
SE24	A	7/11/2004	12:37:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	9.38	10.09	0.71	9.74	0	0	0	0	0	0	0.18	3.24	2.33	0	9	Physical	NO	Tan & gry silty sand, bedforms-sand ripple?, sm tubes, void
SE24	C	7/11/2004	12:38:00	ST I	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	9.4	9.76	0.36	9.58	0	0	0	0	0	0	0.07	3.35	2.09	0	4	Physical	NO	Tan & gry silty sand, dense surf tubes, sm polychaete @z
SE25	B	7/11/2004	12:45:00	ST I	4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	2.8	4.16	1.36	3.48	0	0	0	0	0	0	0.55	3.20	2.12	0	4	Physical	NO	Tan & gry silty sand, low pen, shell frags, sm polychaetes @z, sm tubes, fecal casts
SE25	C	7/11/2004	12:46:00	ST I	4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	2.45	3.07	0.62	2.76	0	0	0	0	0	0	0.40	3.09	2.19	0	4	Physical	NO	Tan/gry silty sand, low pen, sm tubes, shell frags-surf
SE26	A	7/11/2004	12:52:00	ST I	4 phi	2 phi	3 to 2 phi	SA.F	FALSE	1.07	4.22	3.15	2.64	0	0	0	0	0	0	0.48	3.68	2.34	0	5	Physical	NO	Tan/gry sand, low pen, iron oxide, lg tubes, polychaetes @z, sand ripple?
SE26	B	7/11/2004	12:53:00	INDET	4 phi	2 phi	3 to 2 phi	SA.F	FALSE	1.5	2.88	1.38	2.19	0	0	0	0	0	0	0.33	2.98	2.05	0	99	Physical	NO	Tan fine sand, underpen, shell frags, sand ripple
SE27	B	7/11/2004	13:00:00	ST I	4 phi	1 phi	3 to 2 phi	SA.F	FALSE	1.64	3.26	1.62	2.45	0	0	0	0	0	0	0.15	2.91	1.89	0	4	Physical	NO	Tan fine sand, low pen, sand ripple, red sed @z, tubes, shell frags-far
SE27	C	7/11/2004	13:00:00	ST I	4 phi	1 phi	3 to 2 phi	SA.F	FALSE	1.69	3.32	1.63	2.51	0	0	0	0	0	0	0.74	3.46	2.33	0	5	Physical	NO	Tan fine sand, low pen, sand ripple, shell frags @ surf, sm tubes, org detriturs-far
SE28	A	7/11/2004	10:29:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SS	TRUE	7.59	8.78	1.19	8.18	0	0	0	0	0	0	0.40	4.78	3.49	0	10	Biogenic	NO	Tan/gry silty sand, voids, tubes, ox clasts, biogenic mounds, burrow opening?
SE28	B	7/11/2004	10:30:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	6.6	8.02	1.42	7.31	0	0	0	0	0	0	0.52	3.61	2.37	0	9	Biogenic	NO	Tan/gry silty sand, red sed @z, irreg topo, lg tubes, burrow openings, void, biogenic
SE29	A	7/11/2004	10:26:00	ST I	4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	3.99	4.3	0.31	4.14	0	0	0	0	0	0	0.63	3.31	2.69	0	5	Physical	NO	Tan/gry silty sand, shell frags, fecal casts @ surf, sm voids?
SE29	B	7/11/2004	10:26:00	ST I on III	4 phi	1 phi	3 to 2 phi	SA.F	FALSE	8.64	11.42	2.78	10.03	0	0	0	0	0	0	0.77	5.08	4.04	0	11	Physical	NO	Tan & gry fine sand, sand ripple, tubes, void, burrow, shell frags
SE3	B	7/11/2004	15:20:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SI	TRUE	10.06	10.96	0.9	10.51	0	0	0	0	0	0	0.52	3.53	2.71	0	9	Physical	NO	Tan silty sand/tan & gry sandy silt, voids, tubes, ox clasts, org @ surf=?
SE3	C	7/11/2004	15:21:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SI	FALSE	10.63	11.3	0.67	10.97	0	0	0	0	0	0	0.96	4.86	2.89	0	9	Physical	NO	Tan silty sand/tan & gry sandy silt, red sed @z, voids, burrows, polychaetes @z, sm tubes
SE30	A	7/11/2004	10:23:00	ST I	4 phi	2 phi	4 to 3 phi	UN.SS	TRUE	3.46	4.18	0.72	3.82	0	0	0	0	0	0	0.26	3.90	2.39	0	5	Physical	NO	Tan/gry silty sand, low pen, ox clast, shell frag, sm polychaete @z, sm tubes
SE30	C	7/11/2004	10:24:00	ST I	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	4.51	5.3	0.79	4.91	0	0	0	0	0	0	0.66	3.72	2.91	0	5	Physical	NO	Tan/gry silty sand, shell frags, iron oxide, tubes, biogenic mounds-far, sm polychaetes @z
SE31	A	7/11/2004	10:16:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SI	FALSE	4.65	5.46	0.81	5.06	0	0	0	0	0	0	0.29	3.64	2.72	0	9	Biogenic	NO	Tan/gry silty sand, shell frags, red sed @z, biogenic mound-far?, void, tubes
SE31	C	7/11/2004	10:18:00	ST I on III	> 4 phi	1 phi	4 to 3 phi	UN.SS	FALSE	6.58	8.76	2.18	7.67	0	0	0	0	0	0	0.70	4.23	3.43	0	10	Biogenic	NO	Tan & gry silty sand, shell frags, lg voids, tubes, biogenic mound, burrow opening? org
SE32	A	7/11/2004	09:45:00	INDET	4 phi	2 phi	3 to 2 phi	SA.F	FALSE	1.02	2.21	1.19	1.62	0	0	0	0	0	0	-99.00	-99.00	-99.00	0	99	Physical	NO	Tan fine sand, underpen, shell frags, burrow opening, tube
SE32	B	7/11/2004	09:46:00	INDET	4 phi	2 phi	3 to 2 phi	SA.F	FALSE	1.93	2.54	0.61	2.23	0	0	0	0	0	0	>1.93	>2.54	>2.23	0	99	Physical	NO	Tan fine sand, underpen, sm tubes, RPD >pen
SE33	A	7/11/2004	11:31:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	10.63	11.15	0.52	10.89	0	0	0	0	0	0	0.52	2.98	2.28	0	9	Physical	NO	Tan silty sand/tan & gry sandy silt, shell bits, tubes, red sed @z, sm voids.
SE33	C	7/11/2004	11:33:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	8.92	9.47	0.55	9.19	0	0	0	0	0	0	0.92	3.49	2.51	0	9	Physical	NO	Tan silty sand/tan & gry sandy silt, red sed @z, sm void, tubes, polychaete @z, fecal mound

Appendix A-1., continued.

Station	Replicate	Date	Time	Successional Stage	Grain Size (phi) Min	Grain Size (phi) Max	Grain Size (phi) Maj Mode	Benthic Habitat	Mud Clasts Present	Camera Penetration (cm) Min	Camera Penetration (cm) Max	Camera Penetration (cm) Range	Camera Penetration (cm) Mean	Dredged Material Thickness (cm) Min	Dredged Material Thickness (cm) Max	Dredged Material Thickness (cm) Mean	Redox Rebound Thickness (cm) Min	Redox Rebound Thickness (cm) Max	Redox Rebound Thickness (cm) Mean	Apparent RPD Thickness (cm) Min	Apparent RPD Thickness (cm) Max	Apparent RPD Thickness (cm) Mean	Methane Count	OSI	Surface Roughness	Low DO	Comments
SE34	B	7/11/2004	11:04:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	6.63	7.72	1.09	7.18	0	0	0	0	0	0	0.70	3.79	2.89	0	9	Physical	NO	Tan & gry silty sand, red sed @z, shell frags, void, tubes, sand ripples?, polychaete @z, org-far=starfish (likely Astropecten).
SE34	C	7/11/2004	11:05:00	ST I	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	5.17	6.06	0.89	5.61	0	0	0	0	0	0	0.33	4.01	3.04	0	6	Physical	NO	Tan & gry silty sand, sm tubes, biogenic mound?
SE35	A	7/11/2004	10:54:00	ST I	> 4 phi	1 phi	4 to 3 phi	UN.SS	FALSE	5.82	6.17	0.35	5.99	0	0	0	0	0	0	1.69	5.33	3.91	0	7	Physical	NO	Tan & gry silty sand, shell frags, red sed @z, bedforms or lg biogenic mound-far?
SE35	B	7/11/2004	10:55:00	ST I on III	4 phi	2 phi	3 to 2 phi	UN.SS	FALSE	5.65	6.64	0.99	6.14	0	0	0	0	0	0	0.74	3.97	2.92	0	9	Physical	NO	Tan & gry silty sand, shallow void, tubes, shell frags, sm polychaete @z
SE36	A	7/11/2004	10:45:00	ST I	4 phi	1 phi	4 to 3 phi	UN.SS	FALSE	5.74	6.74	1	6.24	0	0	0	0	0	0	0.63	3.61	2.72	0	5	Physical	NO	Tan & gry silty sand, shell frags, iron oxide, tubes, polychaete @z
SE36	B	7/11/2004	10:46:00	ST I	> 4 phi	1 phi	4 to 3 phi	UN.SS	FALSE	2.94	8.26	5.32	5.6	0	0	0	0	0	0	0.04	4.12	2.09	0	4	Physical	NO	Tan & gry silty sand, sloping topo, shell frags, tubes, fecal casts @ surf, red sed patch @z
SE37	B	7/11/2004	10:37:00	ST I on III	4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	3.87	5.17	1.3	4.52	0	0	0	0	0	0	0.18	3.13	2.30	0	9	Physical	NO	Tan/gry silty sand, shell frags, void, iron oxide, sm tubes
SE37	C	7/11/2004	10:38:00	ST I	4 phi	2 phi	3 to 2 phi	SA.F	FALSE	3.7	6.31	2.61	5.01	0	0	0	0	0	0	1.32	4.41	3.27	0	6	Physical	NO	Tan fine sand, bedforms-sand ripple, tubes
SE38	A	7/11/2004	10:02:00	ST I	4 phi	1 phi	3 to 2 phi	SA.F	FALSE	4.16	4.56	0.4	4.36	0	0	0	0	0	0	0.11	3.64	2.72	0	5	Physical	NO	Tan & gry fine sand, shell frags, iron oxide, sm tubes
SE38	B	7/11/2004	10:02:00	ST I	4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	3.73	4.37	0.64	4.05	0	0	0	0	0	0	0.44	3.16	2.42	0	5	Physical	NO	Tan silty sand, low pen, shell frags, tubes, dead soft coral w/ piece of kelp covered w/an egg
SE39	A	7/11/2004	09:53:00	ST I on III	4 phi	1 phi	4 to 3 phi	UN.SS	FALSE	3.35	6.03	2.68	4.69	0	0	0	0	0	0	0.88	3.83	2.57	0	9	Biogenic	NO	Tan & gry silty sand w/shell hash, lg burrow opening, voids, tubes
SE39	B	7/11/2004	09:54:00	ST I on III	4 phi	1 phi	4 to 3 phi	UN.SS	FALSE	3.59	4.2	0.61	3.89	0	0	0	0	0	0	0.74	3.57	2.86	0	9	Physical	NO	Tan & gry silty sand w/shell hash, void, sm tubes
SE4	A	7/11/2004	15:38:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	6.93	11.39	4.46	9.16	0	0	0	0	0	0	1.25	5.78	3.99	0	11	Physical	NO	Tan silty sand/tan & blk sulfidic sandy silt, red sed @z, sloping topo, sand ripple, lg polychaetes @z, sm tubes, v sm void
SE4	C	7/11/2004	15:40:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	9.38	10.49	1.11	9.93	0	0	0	0	0	0	0.59	3.64	3.05	0	10	Physical	NO	Tan silty sand/tan & blk sulfidic sandy silt, red sed @z, dense surf tubes, v sm void
SE40	A	7/11/2004	09:37:00	INDET	4 phi	1 phi	3 to 2 phi	SA.F	FALSE	1.94	3.4	1.46	2.67	0	0	0	0	0	0	1.21	3.72	2.71	0	99	Physical	NO	Tan fine sand, underpen, sand ripple, tubes
SE40	B	7/11/2004	09:37:00	INDET	4 phi	1 phi	3 to 2 phi	SA.F	FALSE	1.31	1.71	0.4	1.51	0	0	0	0	0	0	>1.31	>1.71	>1.51	0	99	Physical	NO	Tan & gry fine sand, underpen, sea urchin (Lytechinus), RPD>pen
SE41	A	7/11/2004	10:09:00	INDET	N/A	N/A	N/A	HR	FALSE	.	0.05	0.05	0.03	0	0	0	0	0	0	0.00	0.00	0.00	0	99	Indeterminate	NO	Hard bottom, underpen, soft coral (Lophogorgia)
SE41	C	7/11/2004	10:11:00	ST I	4 phi	1 phi	4 to 3 phi	UN.SS	FALSE	4.2	4.96	0.76	4.58	0	0	0	0	0	0	0.92	3.49	2.38	0	5	Physical	NO	Tan & gry silty sand, shell frags, tubes
SE42	A	7/11/2004	08:56:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	7.24	8.45	1.21	7.84	0	0	0	0	0	0	0.33	3.64	2.69	0	9	Physical	NO	Tan & gry silty sand, wht clay @z?, shell frags, tubes, v sm void, sm polychaetes @z, red sed patches @z
SE42	B	7/11/2004	08:57:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SS	TRUE	8.78	9.07	0.29	8.92	0	0	0	0	0	0	0.70	4.12	2.66	0	9	Physical	NO	Tan & gry silty sand, shell frags, red sed @z, void, polychaetes @z, tubes, ox clasts, iron
SE43	A	7/11/2004	09:04:00	ST I	> 4 phi	2 phi	4 to 3 phi	SA.F	FALSE	4.51	5.44	0.93	4.98	0	0	0	0	0	0	0.85	3.46	2.54	0	5	Physical	NO	Tan & gry fine sand, low pen, shell frags, sm tubes, iron oxide
SE43	B	7/11/2004	09:05:00	ST I	> 4 phi	2 phi	4 to 3 phi	SA.F	FALSE	4.77	5.77	1	5.27	0	0	0	0	0	0	0.74	3.75	2.63	0	5	Physical	NO	Tan & gry fine sand, low pen, shell frags, bedforms-sand ripple, sm tubes
SE44	A	7/11/2004	09:13:00	ST I	4 phi	1 phi	3 to 2 phi	SA.F	FALSE	3.89	4.46	0.57	4.18	0	0	0	0	0	0	0.22	3.90	2.81	0	5	Physical	NO	Tan & gry fine sand, shell frags, tubes
SE44	C	7/11/2004	09:14:00	ST I	4 phi	1 phi	3 to 2 phi	SA.F	FALSE	3.94	4.77	0.83	4.36	0	0	0	0	0	0	0.88	3.42	2.63	0	5	Physical	NO	Tan & gry fine sand, shell frags, sm tubes, sand ripples
SE45	B	7/11/2004	09:22:00	ST I	4 phi	1 phi	3 to 2 phi	SA.F	FALSE	2.89	3.51	0.62	3.2	0	0	0	0	0	0	0.44	3.49	2.42	0	5	Physical	NO	Tan & gry fine sand, shell frags, tubes
SE45	C	7/11/2004	09:22:00	ST I	4 phi	1 phi	3 to 2 phi	SA.F	FALSE	3.11	3.63	0.52	3.37	0	0	0	0	0	0	0.55	3.46	2.71	0	5	Physical	NO	Tan & gry fine sand, shell frags, sm tubes, iron oxide
SE46	A	7/11/2004	09:28:00	ST I on III	4 phi	1 phi	3 to 2 phi	UN.SS	FALSE	4.46	5.11	0.65	4.78	0	0	0	0	0	0	0.44	3.42	2.76	0	9	Physical	NO	Tan & gry fine sand (or silty sand?), shell frags, voids, sm tubes
SE46	C	7/11/2004	09:30:00	ST I	> 4 phi	1 phi	3 to 2 phi	SA.F	FALSE	4.7	5.6	0.9	5.15	0	0	0	0	0	0	0.59	3.94	2.68	0	5	Physical	NO	Tan & gry fine sand, shell frags, sm tubes, iron oxide, sand ripple
SE47	A	7/11/2004	08:45:00	ST I	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	6.06	6.98	0.92	6.52	0	0	0	0	0	0	0.70	4.30	3.49	0	6	Physical	NO	Tan/gry muddy fine sand, tubes, shell frags, polychaete @z
SE47	C	7/11/2004	08:47:00	ST I	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	6.83	7.24	0.41	7.03	0	0	0	0	0	0	1.14	4.52	3.64	0	6	Physical	NO	Tan/gry muddy fine sand, tubes, shell frags, sm polychaetes @z, iron oxide streaks
SE48	A	7/11/2004	08:34:00	ST I	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	4.3	4.7	0.4	4.5	0	0	0	0	0	0	0.33	5.04	3.81	0	7	Physical	NO	Tan & gry silty sand, shell frags, sm tubes, fecal casts-surf, sm polychaetes @z
SE48	B	7/11/2004	08:35:00	ST I	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	4.39	5.06	0.67	4.72	0	0	0	0	0	0	0.22	3.53	2.55	0	5	Physical	NO	Tan & gry silty sand, shell frags, tubes, fecal lyr, sm polychaetes @z
SE5	B	7/11/2004	15:30:00	ST I on III	> 4 phi	1 phi	4 to 3 phi	UN.SS	FALSE	5.87	7.36	1.49	6.61	0	0	0	0	0	0	0.22	5.78	3.25	0	10	Physical	NO	Tan & gry silty sand, sand ripple?, tubes, sm void, fecal/flock lyr?
SE5	C	7/11/2004	15:38:00	ST I on III	> 4 phi	1 phi	4 to 3 phi	UN.SS	FALSE	6.86	7.59	0.73	7.23	0	0	0	0	0	0	0.70	3.94	2.79	0	9	Physical	NO	Tan & gry silty sand, lg void, sm tubes, bivalve-far
SE6	A	7/11/2004	14:41:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	8.38	10.49	2.11	9.43	0	0	0	0	0	0	0.33	4.38	3.11	0	10	Physical	NO	Tan silty sand/tan & blk sandy silt, red sed band, voids, dense surf tubes, polychaetes @z
SE6	B	7/11/2004	14:42:00	ST I	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	9	9.92	0.92	9.46	0	0	0	0	0	0	1.07	5.22	3.56	0	6	Physical	NO	Tan silty sand/tan & blk sandy silt, red sed @z, polychaetes @z, tubes.
SE7	B	7/11/2004	14:49:00	ST I	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	8.92	9.73	0.81	9.32	0	0	0	0	0	0	1.07	4.30	3.06	0	6	Physical	NO	Tan silty sand/blk sandy silt, red sed @z, tubes, polychaete @z
SE7	C	7/11/2004	14:50:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	8.69	9.63	0.94	9.16	0	0	0	0	0	0	0.92	3.35	2.47	0	9	Physical	NO	Tan silty sand/tan & blk sandy silt, red sed @z, tubes, sm voids, polychaetes @z, hydroid-far
SE8	A	7/11/2004	15:03:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	9.87	10.42	0.55	10.15	0	0	0	0	0	0	0.99	3.79	2.92	0	9	Physical	NO	Tan & gry silty sand, red sed @z, sm void, sm tubes
SE8	B	7/11/2004	15:04:00	ST I	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	9.73	10.14	0.41	9.93	0	0	0	0	0	0	1.18	4.38	3.24	0	6	Physical	NO	Tan & gry silty sand, polychaete @z, tubes
SE9	B	7/11/2004	15:11:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	10.01	10.68	0.67	10.35	0	0	0	0	0	0	0.26	4.05	2.34	0	9	Physical	NO	Tan & gry silty sand, lg void, tubes, iron oxide, biogenic mound-far
SE9	C	7/11/2004	15:11:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	10.01	10.77	0.76	10.39	0	0	0	0	0	0	0.81	3.61	2.43	0	9	Physical	NO	Tan & gry silty sand, voids, tubes, surf rework

Appendix A-2. REMOTS® Sediment-Profile Imaging Data from the Palos Verdes July 2004 Survey (OUT Stations).

Station	Replicate	Date	Time	Successional Stage	Grain Size (phi)			Benthic Habitat	Mud Clasts Present	Camera Penetration (cm)				Dredged Material Thickness (cm)			Redox Rebound Thickness (cm)			Apparent RPD Thickness (cm)			Methane Count	OSI	Surface Roughness	Low DO	Comments
					Min	Max	Maj Mode			Min	Max	Range	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean					
OUT1	B	7/10/2004	13:49:00	ST I	> 4 phi	1 phi	3 to 2 phi	SA.F	FALSE	2.85	4.35	1.5	3.6	0	0	0	0	0	0	0.52	4.12	2.34	0	5	Physical	NO	Brn medium sand mixed w/silt and shell hash, shell frags-surf, red sed patch @z, wiper clast
OUT1	C	7/10/2004	13:49:00	ST I	> 4 phi	1 phi	3 to 2 phi	SA.M	FALSE	2.85	4.96	2.11	3.9	0	0	0	0	0	0	>2.85	>4.96	>3.9	0	7	Physical	NO	Brn medium sand w/ shell hash, sand ripple, RPD >pen, low pen, wiper clast.
OUT10	A	7/10/2004	15:11:00	ST I	> 4 phi	1 phi	4 to 3 phi	UN.SS	FALSE	4.11	5.3	1.19	4.7	0	0	0	0	0	0	1.10	4.01	2.59	0	5	Physical	NO	Brn/gry & blk silty sand, shell hash, red sed @z, tubes, hydroids-far?
OUT10	B	7/10/2004	15:12:00	ST I	> 4 phi	1 phi	4 to 3 phi	UN.SS	FALSE	6.22	6.5	0.28	6.36	0	0	0	0	0	0	1.47	4.08	2.86	0	5	Physical	NO	Brn sand mixed w/ blk silt, shell hash, red sed @z, sm tubes
OUT11	B	7/10/2004	15:19:00	ST I	> 4 phi	1 phi	3 to 2 phi	SA.F	FALSE	4.54	4.77	0.23	4.65	0	0	0	0	0	0	0.29	3.46	2.28	0	5	Physical	NO	Brn sand w/silt & shell hash, shell frags -surf, red sed patch @z.
OUT11	C	7/10/2004	15:20:00	ST I	> 4 phi	1 phi	3 to 2 phi	SA.F	FALSE	4.96	5.68	0.72	5.32	0	0	0	0	0	0	0.74	5.19	3.90	0	7	Physical	NO	Brn sand w/ shell hash/blk sulfidic silt, hydroids-far?
OUT12	A	7/10/2004	12:50:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	11.18	11.8	0.62	11.49	0	0	0	0	0	0	0.70	3.72	2.71	0	9	Biogenic	NO	Tan/blk sulfidic silty sand, close to Cell LU, dense surf tubes, void, sm polychaetes @z, org @z
OUT12	B	7/10/2004	12:50:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	9.97	11.44	1.47	10.7	0	0	0	0	0	0	0.92	4.05	2.55	0	9	Physical	NO	Tan silty sand (dep lyr)/ blk sulfidic silt, wht clay (cap material), near Cell LU, tubes, voids, polychaete
OUT13	A	7/10/2004	08:50:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	12.2	12.8	0.6	12.5	0	0	0	0	0	0	0.99	4.38	2.62	0	9	Physical	NO	Tan sand (dep lyr)/blk sulfidic sandy m, v red sed @z, dense surf tubes, voids, burrows, shell frag
OUT13	B	7/10/2004	08:50:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	10.28	11.82	1.54	11.05	0	0	0	0	0	0	0.66	5.04	3.00	0	9	Physical	NO	Tan fine sand/blk sulfidic sandy m, cap material=gry clay @ z? (between cells SU and LU), v red sed @z, dense surf tubes, voids, extensive burrow system, burrow opening, sm poly @z
OUT14	A	7/10/2004	08:58:00	ST I on III	> 4 phi	1 phi	4 to 3 phi	UN.SS	FALSE	9.02	10.38	1.36	9.7	0	0	0	0	0	0	1.62	3.64	2.60	0	9	Physical	NO	Depositional lyr/cap material (in Cell SU), brn sand mixed w/blk sulfidic silt/gry sand & wht clay w/ shell frags, v red sed @z, org @ z, voids, tubes, burrow opening?, burrow, brittlestars @ surf.
OUT14	C	7/10/2004	08:59:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SI	FALSE	10.04	10.66	0.62	10.35	0	0	0	0	0	0	1.10	4.16	3.31	0	10	Physical	NO	Depositional lyr/cap material (Cell SU), brn sand/blk sulfidic silt/gry sand and wht clay w/ shell frags, dense surf tubes, void, Nice sed layering
OUT15	A	7/10/2004	09:05:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	TRUE	12.1	13.15	1.05	12.62	0	0	0	0	0	0	1.10	3.27	2.16	0	8	Physical	NO	Tan silty sand/blk sulfidic sandy silt, ox & red clasts, numerous voids, tubes, burrow
OUT15	C	7/10/2004	09:06:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	TRUE	12.77	13.37	0.6	13.07	0	0	0	0	0	0	0.52	3.20	2.57	0	9	Physical	NO	Tan fine sand/blk sulfidic sandy silt, ox clasts, numerous voids, tubes, sm polychaetes
OUT16	A	7/10/2004	12:00:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	9.62	11.53	1.91	10.57	0	0	0	0	0	0	0.52	3.42	2.24	0	8	Biogenic	NO	Tan silty sand/blk sulfidic sandy silt, burrow opening, sm voids, tubes, v anoxic sed @z
OUT16	B	7/10/2004	12:01:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	10.68	11.75	1.07	11.22	0	0	0	0	0	0	0.37	4.12	2.85	0	9	Biogenic	NO	Tan silty sand/blk sulfidic sandy silt, dense surf tubes, voids, sm polychaetes @z
OUT17	A	7/10/2004	14:49:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	11.09	12.32	1.23	11.7	0	0	0	0	0	0	0.15	3.38	2.26	0	9	Physical	NO	Tan/blk silty sand, v red sed @z, voids, tubes, burrow opening
OUT17	B	7/10/2004	14:49:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	10.76	11.91	1.15	11.34	0	0	0	0	0	0	0.92	3.38	2.38	0	9	Physical	NO	Tan silty sand/blk sulfidic sandy silt, dense surf tubes, sand ripples?, voids, well-defined RPD
OUT18	B	7/10/2004	15:06:00	ST I	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	9.68	10.49	0.81	10.09	0	0	0	0	0	0	0.59	3.90	3.09	0	6	Physical	NO	Tan silty sand/tan & blk sandy silt, v red sed @z, sm tubes, polychaetes @z, iron oxide
OUT18	C	7/10/2004	15:06:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	9.9	10.77	0.87	10.34	0	0	0	0	0	0	0.59	3.38	2.56	0	9	Physical	NO	Tan silty sand/tan & blk suldfidic sandy silt, v red sed @z, void, polychaete @z, tubes, burrow
OUT19	A	7/10/2004	15:26:00	ST I	> 4 phi	2 phi	4 to 3 phi	UN.SI	FALSE	8.54	9	0.46	8.77	0	0	0	0	0	0	0.66	4.82	3.21	0	6	Physical	NO	Tan silty sand/tan & blk sulfidic silty sand, sm polychaete @z, hydroid, sm tubes
OUT19	C	7/10/2004	15:27:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	8.71	9.05	0.34	8.88	0	0	0	0	0	0	0.29	3.13	2.14	0	8	Physical	NO	Tan silty sand/tan & blk sulfidic sandy silt, v red sed @z, void, sm tubes, polychaetes @z
OUT2	B	7/10/2004	13:57:00	ST I	> 4 phi	1 phi	3 to 2 phi	UN.SS	FALSE	8.02	9.78	1.76	8.9	0	0	0	0	0	0	0.55	6.77	4.82	0	7	Physical	NO	Brn sand & shell hash/blk sulfidic silty sand, bedform-sand ripple, sm tubes
OUT2	C	7/10/2004	13:58:00	ST I on III	> 4 phi	1 phi	4 to 3 phi	UN.SS	FALSE	6.06	7.29	1.23	6.68	0	0	0	0	0	0	0.63	5.08	3.16	0	10	Physical	NO	Brn sand & shell hash, red sed patch, voids, tubes, polychaete @z
OUT20	A	7/10/2004	15:58:00	ST I	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	9.38	9.95	0.57	9.66	0	0	0	0	0	0	0.96	4.41	3.77	0	7	Physical	NO	Tan fine sand/tan & blk sulfidic silty sand, sm tubes, red sed @z, red clasts-far
OUT20	B	7/10/2004	15:58:00	ST I	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	7.17	7.55	0.38	7.36	0	0	0	0	0	0	0.15	3.57	2.19	0	4	Physical	NO	Tan/tan & blk sulfidic silty sand, red sed patches @z, void?, sm tubes
OUT21	A	7/11/2004	07:55:00	ST I	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	5.84	7.12	1.28	6.48	0	0	0	0	0	0	0.22	3.46	2.75	0	5	Physical	NO	Tan & gry silty sand, red sed patches @z, sand ripples, sm tubes, polychaete @z
OUT21	C	7/11/2004	07:57:00	ST I	> 4 phi	2 phi	4 to 3 phi	UN.SI	FALSE	4.51	6.44	1.93	5.48	0	0	0	0	0	0	0.37	3.05	2.28	0	5	Physical	NO	Tan/gry silty sand, red sed patches @z, tubes
OUT22	A	7/10/2004	09:11:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	12.67	13.62	0.95	13.15	0	0	0	0	0	0	0.66	3.35	2.34	0	9	Physical	NO	Tan silty sand/blk sulfidic sandy silt (near outfall), v red sed, sm tubes, voids-active, burrow, polychaetes @z, biogenic mound?
OUT22	B	7/10/2004	09:12:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	13.13	14.17	1.04	13.65	0	0	0	0	0	0	0.37	4.45	3.03	0	10	Physical	NO	Tan silty sand/blk sulfidic sandy silt, sm tubes, voids, sm polychaete @z, fecal mound
OUT23	A	7/10/2004	09:18:00	ST I on III	> 4 phi	1 phi	> 4 phi	UN.SI	FALSE	14.6	16.02	1.42	15.31	0	0	0	0	0	0	0.81	6.81	5.51	0	11	Physical	NO	Tan silty sand/blk sulfidic sandy silt, bedforms-sand ripples, sm voids, shell frags, sm tubes, sm polychaetes @z, deep RPD
OUT23	B	7/10/2004	09:19:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	12.58	13.29	0.71	12.93	0	0	0	0	0	0	0.85	3.75	2.78	0	9	Physical	NO	Tan silty sand/blk sulfidic sandy silt, voids, shell frags, tubes, v red sed @z
OUT24	A	7/10/2004	11:51:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	11.8	12.86	1.06	12.33	0	0	0	0	0	0	0.33	3.49	2.52	0	9	Biogenic	NO	Tan silty sand/blk sulfidic sandy silt, dense surf tubes, burrow opening, void, lg burrowing polychaete
OUT24	B	7/10/2004	11:51:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	TRUE	11.11	12.34	1.23	11.73	0	0	0	0	0	0	0.40	3.49	2.24	0	8	Physical	NO	Tan silty sand/blk sulfidic sandy silt, lg red clasts, tubes, void, sm polychaetes@z
OUT25	B	7/10/2004	14:57:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	10.44	11.01	0.57	10.73	0	0	0	0	0	0	0.33	3.57	2.65	0	9	Physical	NO	Tan silty sand/blk sulfidic sandy silt, sm tubes, brittle stars @ surf, voids, org @ z?, sm polychaetes
OUT25	C	7/10/2004	14:58:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	9.52	10.35	0.83	9.94	0	0	0	0	0	0	0.48	3.72	2.78	0	9	Physical	NO	Tan silty sand/blk sulfidic sandy silt, brittle stars @ surf, voids, sm tubes, sm polychaetes @z, iron
OUT26	A	7/10/2004	15:33:00	ST I	> 4 phi	2 phi	4 to 3 phi	UN.SI	FALSE	9.62	10.52	0.9	10.07	0	0	0	0	0	0	1.14	3.90	2.82	0	5	Physical	NO	Tan/tan & blk silty sand, red sed band, sm tubes, org @ z, sm polychaetes @z
OUT26	B	7/10/2004	15:34:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SI	FALSE	9.57	10.01	0.44	9.79	0	0	0	0	0	0	0.44	4.30	2.94	0	9	Physical	NO	Tan/tan & blk silty sand, voids, tubes, org in water column?
OUT27	A	7/10/2004	15:41:00	ST I	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	10.28	10.99	0.71	10.64	0	0	0	0	0	0	0.66	4.01	3.05	0	6	Physical	NO	Tan fine sand (dep lyr)/blk sulfidic silty sand, tubes, v red sed @z, org @z
OUT27	C	7/10/2004	15:42:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SS	FALSE	10.01	12.8	2.79	11.41	0	0	0	0	0	0	1.07	4.45	3.09	0	10	Physical	NO	Tan fine sand (dep lyr)/blk sulfidic silty sand, sand ripple?, v red sed @z, sm tubes, polychaete @z, sm voids
OUT28	A	7/10/2004	15:48:00	ST I	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	9.81	11.44	1.63	10.62	0	0	0	0	0	0	0.29	2.17	1.28	0	3	Physical	NO	Tan fine sand/tan & blk sulfidic silty sand, subsurface red sed band=?, sand dragged down?, v red sed @z, lg poly @z, tubes, shell frags
OUT28	C	7/10/2004	15:50:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SS	FALSE	9.47	10.16	0.69	9.82	0	0	0	0	0	0	0.33	4.34	3.51	0	10	Physical	NO	Tan fine sand (dep lyr)/tan & blk sulfidic sandy m, tubes, void, lg poly @z, iron oxide, red sed band @z
OUT29	A	7/11/2004	08:03:00	ST I	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	9.57	10.06	0.49	9.82	0	0	0	0	0	0	0.44	3.42	2.26	0	5	Physical	NO	Tan/blk muddy fine sand, sm tubes, v red sed @ z, sm void @ bottom?, sm polychaetes @z
OUT29	B	7/11/2004	08:04:00	ST I	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	8.31	9.52	1.21	8.92	0	0	0	0	0	0	0.59	3.02	2.07	0	4	Physical	NO	Tan fine sand (dep lyr)/tan & blk silty sand, v red sed @z, tubes, v sm void?, ox burrow, bedforms?
OUT3	A	7/10/2004	14:03:00	ST I	> 4 phi	1 phi	4 to 3 phi	UN.SS	FALSE	8.57	9.33	0.76	8.95	0	0	0	0	0	0	1.21	3.57	2.43	0	5	Physical	NO	Brn sand mixed w/silt, red sed patch @z, shell hash, sm tubes, hydroid-far
OUT3	B	7/10/2004	14:03:00	ST I	> 4 phi	1 phi	4 to 3 phi	UN.SS	FALSE	8.95	9.62	0.67	9.28	0	0	0	0	0	0	0.18	2.91	1.99	0	4	Physical	NO	Brn & gry sand mixed w/ silt, red sed patch @z, tubes, shell hash, biogenic mound-far?
OUT30	A	7/11/2004	08:11:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	5.79	7.43	1.64	6.61	0	0	0	0	0	0	0.07	3.83	2.19	0	8	Physical	NO	Tan & gry silty sand, sm tubes, void or burrow - occupied
OUT30	C	7/11/2004	08:13:00	ST I	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	5.55	6.44	0.89	5.99	0	0	0	0	0	0	0.66	3.31	2.22	0	4	Physical	NO	Tan & gry silty sand, sand ripples?, red sed @z, sm tubes
OUT31	A	7/10/2004	11:42:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SS	TRUE	11.01	12.58	1.57	11.8	0	0	0	0	0	0	0.77	4.05	3.00	0	9	Physical	NO	Tan sand (dep lyr)/blk sulfidic silty sand, v red sed @z, sm tubes, red clasts, voids (at RPD boundary), polychaete @z
OUT31	B	7/10/2004	11:43:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SS	FALSE	10.35	11.23	0.88	10.79	0	0	0	0	0	0	0.44	3.83	2.42	0	9	Physical	NO	Depositional lyr>pen=sand?, tan/gry sandy m, tubes, voids, grainsize mm borderline 4 to 3?, burrow opening
OUT32	A	7/10/2004	09:26:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	14.9	16.12	1.22	15.51	0	0	0	0	0	0	0.04	3.02	1.94	0	8	Biogenic	NO	Tan silty sand/blk sulfidic sandy silt, tubes, voids, polychaetes @z, fecal lyr, burrow opening?, v red sed @z
OUT32	B	7/10/2004	09:26:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	TRUE	14.52	17.09	2.57	15.81	0	0	0	0	0	0	0.37	4.01	2.33	0	9	Physical	NO	Tan silty sand/blk sulfidic sandy silt, red clasts, tubes, voids, shell material @z, polychaetes @z
OUT33	B	7/10/2004	09:34:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	TRUE	10.99	13.48	2.49	12.23	0	0	0	0	0	0	0.04	3.64	2.56	0	9	Biogenic	NO	Tan silty sand/blk sulfidic sandy silt, burrow opening, void, tubes, ox clasts, polychaete @z, shell material
OUT33	C	7/10/2004	09:35:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	9.85	12.46	2.61	11.16	0	0	0	0	0	0	0.52	4.27	2.44	0	9	Physical	NO	Tan silty sand/blk sulfidic sandy silt, tubes, voids, shell material, lg polychaete @z
OUT34	A	7/10/2004	11:31:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	10.63	11.66	1.03	11.15	0	0	0	0	0	0	1.29	3.38	2.66	0	9	Physical	NO	Tan silty sand/blk sandy silt, tubes, voids, red sed @z, shell material, polychaete @z
OUT34	C	7/10/2004	11:32:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	10.77	11.44	0.67	11.1	0	0	0	0	0	0	0.15	3.24	2.01	0	8	Physical	NO	Tan silty sand/tan & blk sandy silt, red sed @z, tubes, sm voids, iron oxide, org @ surf?
OUT35	A	7/10/2004	11:22:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SI	FALSE	9.44	9.97	0.53	9.7	0	0	0	0	0	0	0.40	3.42	2.52	0	9	Physical	NO	Tan silty sand/tan & blk sandy silt, v red sed patch @z, voids, tubes
OUT35	B	7/10/2004	11:23:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	9.87	10.49	0.62	10.18	0	0	0	0	0	0	0.40	4.08	2.91	0	9	Physical	NO	Tan/tan & blk silty sand, tubes, voids, sm polychaetes @z
OUT36	A	7/10/2004	11:14:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	9.26	9.78	0.52	9.52	0	0	0	0	0	0	0.37	3.86	2.94	0	9	Physical	NO	Tan silty sand/tan & blk sandy silt, red sed band, dense surf tubes, sm voids, lg polychaete @z
OUT36	B	7/10/2004	11:14:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	9.3	10.23	0.93	9.76	0	0	0	0	0	0	1.62	4.27	2.87	0	9	Physical	NO	Tan silty sand/tan & blk sandy silt, red sed band, dense surf tubes, voids
OUT37	B	7/11/2004	16:02:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	9.63	10.61	0.98	10.12	0	0	0	0	0	0	0.77	4.45	3.37	0	10	Physical	NO	Tan silty sand/tan & gry sandy silt, red sed @z, voids, tubes, sand ripple?
OUT37	C	7/11/2004	16:03:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	8.78	9.78	1	9.28	0	0	0	0	0	0	0.37	3.31	2.52	0	9	Physical	NO	Tan silty sand/tan & blk sandy silt, red sed band, polychaete @z, void, tubes, starfish (Astropecten) @ surf
OUT38	A	7/11/2004	15:46:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	9.71	10.16	0.45	9.93	0	0	0	0	0	0	0.52	3.57	2.71	0	9	Physical	NO	Tan silty sand/tan & blk sulfidic sandy silt, dense surf tubes, voids, burrow-opening
OUT38	C	7/11/2004	15:47:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	8.76	9.49	0.73	9.12	0	0	0	0	0	0	0.88	3.79	2.74	0	9	Physical	NO	Tan silty sand/tan & blk sandy silt, v red sed @z, lg void, dense surf tubes, sm polychaete @z, sm burrow-opening
OUT39	A	7/10/2004	11:08:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	10.57	11.09	0.52	10.83	0	0	0	0	0	0	1.84	4.75	3.73	0	10	Physical	NO	Tan sand (dep lyr)/blk sulfidic silty sand, tubes, voids, iron oxide streaks
OUT39	B	7/10/2004	11:09:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	9.4	10.42	1.02	9.91	0	0	0	0	0	0	0.99	4.27	3.24	0	10	Biogenic	NO	Tan sand (dep lyr)/tan & blk sulfidic sandy m, v red sed band @z, dense surf tubes, voids

Appendix A-2., continued.

Station	Replicate	Date	Time	Successional Stage	Grain Size (phi) Min	Grain Size (phi) Max	Grain Size (phi) Maj Mode	Benthic Habitat	Mud Clasts Present	Camera Penetration (cm) Min	Camera Penetration (cm) Max	Camera Penetration (cm) Range	Camera Penetration (cm) Mean	Dredged Material Thickness (cm) Min	Dredged Material Thickness (cm) Max	Dredged Material Thickness (cm) Mean	Redox Rebound Thickness (cm) Min	Redox Rebound Thickness (cm) Max	Redox Rebound Thickness (cm) Mean	Apparent RPD Thickness (cm) Min	Apparent RPD Thickness (cm) Max	Apparent RPD Thickness (cm) Mean	Methane Count	OSI	Surface Roughness	Low DO	Comments
OUT4	A	7/10/2004	14:23:00	INDET	N/A	N/A	N/A	HR	FALSE	0	0	0	0	0	0	0	0	0	0	-99.00	-99.00	-99.00	0	99	Indeterminate	NO	Hard bottom, underpen, sponge, gorgonian (Lophogorgia)
OUT4	B	7/10/2004	14:24:00	INDET	N/A	N/A	N/A	HR	FALSE	0	0	0	0	0	0	0	0	0	0	-99.00	-99.00	-99.00	0	99	Indeterminate	NO	Hard bottom, underpen, coral, bryozoans (Diaperoecia), anemone (Corynactis)
OUT40	A	7/11/2004	15:54:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	9.57	10.71	1.14	10.14	0	0	0	0	0	0	0.81	3.38	2.93	0	9	Physical	NO	Tan fine sand (dep lyr)/tan & blk sulfidic silty sand, v red sed @z, dense surf tubes, sm anoxic void?, polychaete @z, bedforms?
OUT40	B	7/11/2004	15:54:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	9.35	10.3	0.95	9.83	0	0	0	0	0	0	0.48	3.53	2.26	0	9	Biogenic	NO	Tan fine sand (dep lyr)/tan & blk sulfidic silty sand, v red sed @z, dense surf tubes, burrows, filled ox voids?, sm polychaetes @z, shell frag
OUT41	A	7/10/2004	09:41:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	13.75	15.26	1.51	14.51	0	0	0	0	0	0	0.92	3.79	2.24	0	8	Physical	NO	Tan silty sand/tan & blk sandy silt, bedforms-sand ripple?, red sed patch @z, shell material, sm void, tubes, org @z
OUT41	C	7/10/2004	09:42:00	ST I	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	12.04	13.01	0.97	12.52	0	0	0	0	0	0	0.07	3.61	2.31	0	5	Physical	NO	Tan silty sand/tan & blk sandy silt, red sed band, tubes, polychaete @z, sm void?
OUT42	A	7/10/2004	09:49:00	ST I	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	11.85	12.91	1.06	12.38	0	0	0	0	0	0	0.77	4.27	2.97	0	5	Physical	NO	Tan silty sand/tan & blk sandy silt, red sed @z, shell material, tubes, sm void?, sm polychaete @z, fecal lyr?
OUT42	C	7/10/2004	09:50:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	TRUE	10.99	13.19	2.2	12.09	0	0	0	0	0	0	0.59	4.49	2.86	0	9	Physical	NO	Tan silty sand/tan & blk sandy silt, red sed patch @z, ox clasts, tubes, voids, shell material, polychaetes @z
OUT43	A	7/10/2004	11:00:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	10.61	11.75	1.14	11.18	0	0	0	0	0	0	0.99	3.57	2.93	0	9	Physical	NO	Tan silty sand/tan & blk sandy silt, red sed @z, tubes, sm voids, burrow, shell material
OUT43	C	7/10/2004	11:01:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	9.78	10.92	1.14	10.35	0	0	0	0	0	0	0.44	3.64	2.64	0	9	Physical	NO	Tan silty sand/tan & blk sandy silt, red sed @z, tubes, voids, sm polychaetes @z
OUT44	B	7/11/2004	14:27:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	9.44	11.09	1.65	10.26	0	0	0	0	0	0	0.33	4.23	3.31	0	10	Physical	NO	Tan silty sand/tan & blk sandy silt, red sed band, tubes, polychaete @z, iron oxide
OUT44	C	7/11/2004	14:27:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	10.8	11.32	0.52	11.06	0	0	0	0	0	0	0.99	4.67	3.71	0	10	Physical	NO	Tan silty sand/tan & blk sandy silt, red sed band, biogenic mound-far?, tubes, void
OUT45	B	7/11/2004	14:35:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SI	FALSE	9.63	10.14	0.51	9.89	0	0	0	0	0	0	0.66	3.64	3.11	0	10	Physical	NO	Tan silty sand/tan & blk sandy silt, v red sed @z, tubes, voids, sm polychaete @z, iron oxide
OUT45	C	7/11/2004	14:35:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	9.24	12.15	2.91	10.69	0	0	0	0	0	0	0.70	5.19	2.74	0	9	Biogenic	NO	Tan silty sand/tan & blk sandy silt, v red sed @z, dense surf tubes, voids, polychaete @z, burrow opening?, fecal lyr, shell bits
OUT46	A	7/10/2004	10:54:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	11.13	12.72	1.59	11.93	0	0	0	0	0	0	0.70	5.74	4.05	0	11	Physical	NO	Tan fine sand (dep lyr)/tan & blk silty sand, sand ripple, void, sea pen @ surf, v sm tubes, polychaet @z, burrowing anemone @z?, red sed @z
OUT46	B	7/10/2004	10:55:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	8.14	11.32	3.18	9.73	0	0	0	0	0	0	0.74	4.38	3.03	0	10	Physical	NO	Tan fine sand/tan & blk silty sand, tubes, org @z?, v sm void?, red sed @z.
OUT47	A	7/10/2004	09:57:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	9.81	11.61	1.8	10.71	0	0	0	0	0	0	0.74	3.61	2.54	0	9	Physical	NO	Tan silty sand/tan & gry sandy silt, tubes, voids, shell material, iron oxide, sm polychaete @z
OUT47	B	7/10/2004	09:58:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	11.2	12.51	1.31	11.85	0	0	0	0	0	0	1.25	3.57	2.84	0	9	Physical	NO	Tan silty sand/tan & blk sandy silt, red sed @z, voids, lg polychaete @z, tubes, sm burrow openings, shell material
OUT48	A	7/10/2004	10:06:00	ST I	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	10.25	10.71	0.46	10.48	0	0	0	0	0	0	0.74	4.05	3.48	0	6	Physical	NO	Tan silty sand/tan & blk sandy silt, tubes, shell material
OUT48	C	7/10/2004	10:07:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	8.19	9.71	1.52	8.95	0	0	0	0	0	0	0.04	3.86	2.35	0	9	Biogenic	NO	Tan silty sand/tan & blk sandy silt, sm void, polychaete @z, sea pen-far, tubes, burrow opening, fecal lyr?
OUT49	A	7/10/2004	10:45:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	9.62	12.48	2.86	11.05	0	0	0	0	0	0	3.09	6.22	4.83	0	11	Physical	NO	Tan fin sand/tan & blk silty sand, sand ripple?, dense surf tubes, voids, org @z, red sed @z, shell frags
OUT49	C	7/10/2004	10:46:00	ST I	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	9.44	10.94	1.5	10.19	0	0	0	0	0	0	0.63	3.97	3.26	0	6	Physical	NO	Tan fine sand/tan & blk silty sand, tubes, red sed @z, lg burrowing worm @z (Stage III worm, but no void?).
OUT5	A	7/10/2004	14:17:00	ST I	4 phi	1 phi	2 to 1 phi	SA.M	FALSE	2.47	4.84	2.37	3.66	0	0	0	0	0	0	>2.47	>4.84	>3.66	0	6	Physical	NO	Brn sand & shell hash, underpen, tubes, RPD>pen
OUT5	B	7/10/2004	14:18:00	ST I	> 4 phi	1 phi	3 to 2 phi	SA.M	FALSE	3.42	4.32	0.9	3.87	0	0	0	0	0	0	>3.42	>4.32	>3.87	0	7	Physical	NO	Brn sand w/shell hash, tubes, underpen
OUT50	A	7/10/2004	10:18:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	8.45	9.57	1.12	9.01	0	0	0	0	0	0	1.25	3.75	2.68	0	9	Biogenic	NO	Tan silty sand/tan & blk sandy silt, red sed @z, polychaete @z, void, tubes, sea pen @ surf, burrow opening?
OUT50	B	7/10/2004	10:19:00	ST I	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	10.61	11.32	0.71	10.97	0	0	0	0	0	0	0.66	4.16	3.13	0	6	Biogenic	NO	Tan silty sand/tan & blk sandy silt, shell material, tubes, red sed @z, biogenic mounds, sm polychae @z
OUT51	A	7/10/2004	10:26:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	TRUE	10.57	11.72	1.15	11.15	0	0	0	0	0	0	1.21	3.68	1.93	0	8	Physical	NO	Tan silty sand/tan & gry sandy silt, gry clay @ z?, red clast, void, tubes, fecal lyr
OUT51	B	7/10/2004	10:27:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	TRUE	10.39	10.92	0.53	10.66	0	0	0	0	0	0	0.33	3.13	2.04	0	8	Physical	NO	Tan silty sand/tan & gry sandy silt, red clatst, sm polychaetes @z, sm voids, iron oxide, shell material, red sed @z
OUT6	A	7/10/2004	12:57:00	ST I	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	7.76	8.33	0.57	8.05	0	0	0	0	0	0	0.77	3.46	2.69	0	5	Physical	NO	Depositional lyr/cap material (Cell LU), brn fine sand/blk sulfidic silt and gry clay, v red sed @z, hyrdroids @ surf, sm tubes
OUT6	C	7/10/2004	12:58:00	ST I	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	6.96	8.38	1.42	7.67	0	0	0	0	0	0	0.74	3.46	2.32	0	5	Physical	NO	Depositional lyr/cap material ?(Cell LU), brn fine sand/blk sulfidic silt w/gry clay, shell frags, tubes, v red sed @z, sm polychaete @z
OUT7	A	7/10/2004	14:09:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	8.95	10.8	1.85	9.88	0	0	0	0	0	0	0.92	4.38	3.65	0	10	Physical	NO	Tan fine sand (dep lyr)/tan & blk silty sand, sand ripples, v red sed @z, voids
OUT7	B	7/10/2004	14:10:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	8.62	11.47	2.85	10.05	0	0	0	0	0	0	0.40	3.68	2.66	0	9	Physical	NO	Tan fine sand/tan & blk sulfidic silty sand, sand ripple, v red sed @z, voids, tubes, polychaete @z, iron oxide streaks
OUT8	A	7/10/2004	14:33:00	ST I	> 4 phi	2 phi	4 to 3 phi	UN.SI	FALSE	10.28	11.51	1.23	10.9	0	0	0	0	0	0	1.18	3.72	2.66	0	5	Physical	NO	Tan silty sand/tan & blk sandy silt, red sed @z, tubes, shell bits, org @ z?, hydroids @ surf?
OUT8	B	7/10/2004	14:33:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SI	TRUE	8.81	9.52	0.71	9.17	0	0	0	0	0	0	0.33	3.46	2.49	0	9	Physical	NO	Tan silty sand w/blk sufldiic sandy silt, v red sed patch @z, shell frags, sm tubes, voids, sm polychaetes @z, red clast
OUT9	A	7/10/2004	14:41:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	9.59	10.61	1.02	10.1	0	0	0	0	0	0	0.15	4.08	2.74	0	9	Biogenic	NO	Tan fine sand/tan& gry silty sand, red sed band, lg tube, biogenic mound, polychaete @z, void, shell bits, org floc @ surf?
OUT9	C	7/10/2004	14:42:00	ST I	> 4 phi	1 phi	4 to 3 phi	UN.SS	FALSE	10.42	13.95	3.53	12.18	0	0	0	0	0	0	0.18	4.60	3.62	0	6	Physical	NO	Tan sand/tan & gry silty sand, v red sed @ z, sloping topo-sand ripple, shell bits, tubes, polychaetes @z
OUTA	B	7/12/2004	08:27:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	TRUE	9.92	10.39	0.47	10.16	0	0	0	0	0	0	0.81	3.49	2.92	0	9	Physical	NO	Tan silty sand/blk sulfidic sandy silt, v red sed @z, lg void, tubes, red clast, sm polychaetes @z
OUTA	C	7/12/2004	08:27:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	TRUE	10.09	11.13	1.04	10.61	0	0	0	0	0	0	1.10	3.83	2.79	0	9	Physical	NO	Tan silty sand/tan & blk sulfidic sandy silt, v red sed @ z, shell frags, red clasts, tubes, sm voids, burrow, m clump-far
OUTB	A	7/12/2004	08:21:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	8.5	9.24	0.74	8.87	0	0	0	0	0	0	0.26	3.97	2.89	0	9	Physical	NO	Tan silty sand/tan & blk sulfidic sandy silt, red sed @z, sm voids, sm tubes, starfish (Astropecten)-fa sm polychaetes @z
OUTB	B	7/12/2004	08:22:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SI	FALSE	9.11	9.52	0.41	9.32	0	0	0	0	0	0	0.22	3.57	2.71	0	9	Physical	NO	Tan silty sand/tan &blk sufldic sandy silt, red sed band, tubes, burrows, sm void
OUTC	B	7/12/2004	08:15:00	ST I	> 4 phi	2 phi	> 4 phi	UN.SI	TRUE	10.04	10.49	0.45	10.26	0	0	0	0	0	0	0.63	3.49	2.66	0	5	Physical	NO	Tan sandy silt/tan & blk sulfidic sandy silt, v red sed @z, red clasts, tubes
OUTC	C	7/12/2004	08:16:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	9.35	10.19	0.84	9.77	0	0	0	0	0	0	0.81	3.72	3.00	0	9	Physical	NO	Tan silty sand/tan & blk sufldic sandy silt, v red sed @z, tubes, sm polychaetes @z
OUTD	B	7/12/2004	08:10:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	10.52	11.68	1.16	11.1	0	0	0	0	0	0	0.59	3.38	2.70	0	9	Physical	NO	Tan silty sand/tan & blk sulfdic sandy silt, v red sed @z, lg voids, tubes, polychaetes @z
OUTD	C	7/12/2004	08:10:00	ST I	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	10.28	10.85	0.57	10.57	0	0	0	0	0	0	1.18	3.75	2.98	0	5	Physical	NO	Tan silty sand/tan & blk sulfidic sandy silt, v red sed @z, sm tubes, shell frags @z

Appendix A-3. REMOTS® Sediment-Profile Imaging Data from the Palos Verdes July 2004 Survey (NW Stations).

Station	Replicate	Date	Time	Successional Stage	Grain Size (phi) Min	Grain Size (phi) Max	Grain Size (phi) Maj Mode	Benthic Habitat	Mud Clasts Present	Camera Penetration (cm) Min	Camera Penetration (cm) Max	Camera Penetration (cm) Range	Camera Penetration (cm) Mean	Dredged Material Thickness (cm) Min	Dredged Material Thickness (cm) Max	Dredged Material Thickness (cm) Mean	Redox Rebound Thickness (cm) Min	Redox Rebound Thickness (cm) Max	Redox Rebound Thickness (cm) Mean	Apparent RPD Thickness (cm) Min	Apparent RPD Thickness (cm) Max	Apparent RPD Thickness (cm) Mean	Methane Count	OSI	Surface Roughness	Low DO	Comments
NW1	A	7/9/2004	08:47:00	ST I	3 phi	1 phi	2 to 1 phi	SA.M	FALSE	6.29	6.6	0.31	6.44	0	0	0	0	0	0	>6.29	>6.6	>6.44	0	7	Physical	NO	Tan medium sand, shell bits, bedforms-sand ripple, org @surf-far?, RPD >pen?
NW1	B	7/9/2004	08:48:00	ST I	3 phi	1 phi	2 to 1 phi	SA.M	FALSE	5.06	6.29	1.23	5.68	0	0	0	0	0	0	>5.06	>6.29	>5.68	0	7	Physical	NO	Tan medium sand, sand ripple, shell frags, RPD>pen
NW10	A	7/9/2004	10:18:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	10.99	13.84	2.85	12.41	0	0	0	0	0	0	0.26	3.79	1.96	0	8	Physical	NO	Tan/tan & gry mottled sandy m, dense surf tubes, burrow opening, fecal lyr, numerous voids, polychaete @z, iron oxide @z, red sed patches.
NW10	B	7/9/2004	10:19:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	10.35	12.32	1.97	11.34	0	0	0	0	0	0	0.70	4.12	2.26	0	9	Physical	NO	Tan silty sand/tan & gry mottled sandy m, tubes, voids, brittle star @ surf-far?, red sed @z, iron oxide @z, sm burrow opening?, polychaete @z
NW11	A	7/9/2004	11:13:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	TRUE	11.47	13.22	1.75	12.35	0	0	0	0	0	0	0.55	4.78	2.46	0	9	Physical	NO	Tan silty sand/tan & gry mottled sandy m, v red sed patch @z, sm ox & red clasts, sm tubes, numerous voids, sm polychaetes @z, burrow opening?
NW11	B	7/9/2004	11:14:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	TRUE	11.68	13.24	1.56	12.46	0	0	0	0	0	0	0.74	5.74	3.03	0	10	Biogenic	NO	Tan & gry silty sand/tan&gry mottled sandy m, tubes, fecal mound, ox clast, voids-occupied
NW12	A	7/9/2004	11:29:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	12.15	14.33	2.18	13.24	0	0	0	0	0	0	0.77	5.33	3.20	0	10	Biogenic	NO	Tan/gry sandy silt, tubes, fecal lyr, sm burrow openings, voids, lg burrow system-occupied, polychaetes @z.
NW12	B	7/9/2004	11:30:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	TRUE	10.82	12.94	2.12	11.88	0	0	0	0	0	0	0.74	5.44	2.04	0	8	Biogenic	NO	Tan/tan & blk mottled sandy silt, v red sed patch @z, ox & red clasts, voids, tubes, burrow opening
NW13	A	7/9/2004	12:42:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	TRUE	12.13	13.24	1.11	12.68	0	0	0	0	0	0	0.81	3.97	2.70	0	9	Physical	NO	Tan/tan & gry mottled sandy silt, sm tubes, red clasts, red sed @z, voids, sm polychaetes @z
NW13	B	7/9/2004	12:42:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	TRUE	12.44	13.46	1.02	12.95	0	0	0	0	0	0	0.37	4.67	2.21	0	8	Physical	NO	Tan/tan & gry sandy silt, red clasts, tubes, voids, iron oxide streaks, red sed @z, sm polychaetes @z
NW14	A	7/9/2004	12:54:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	TRUE	12.44	13.76	1.32	13.1	0	0	0	0	0	0	0.26	2.94	1.76	0	8	Physical	NO	Tan&gry mottled sandy silt, ox & red clasts, sm tubes, voids, red sed @z
NW14	C	7/9/2004	12:55:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	11.11	11.99	0.88	11.55	0	0	0	0	0	0	0.52	3.86	1.66	0	8	Physical	NO	Tan & gry mottled sandy silt, sm tubes, voids, sm polychaetes @z
NW15	A	7/9/2004	13:38:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	11.89	12.51	0.62	12.2	0	0	0	0	0	0	0.70	3.20	1.93	0	8	Physical	NO	Tan/gry mottled sandy silt, sm tubes, voids, polychaetes @z, red sed @z, iron oxide streaks
NW15	B	7/9/2004	13:38:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	TRUE	11.58	12.84	1.26	12.21	0	0	0	0	0	0	0.99	3.86	3.01	0	10	Physical	NO	Tan/gry mottled sandy silt, sm tubes, red clast, voids, lg polychaetes @z, iron oxide streaks, red sed @z
NW16	A	7/9/2004	13:46:00	ST I	> 4 phi	2 phi	4 to 3 phi	UN.SI	FALSE	9.33	10.71	1.38	10.02	0	0	0	0	0	0	0.33	2.91	1.67	0	4	Physical	NO	Tan/gry & blk silty sand, sand ripple, red sed @z, tubes, org @ surf?, green tint-shallow water?
NW16	B	7/9/2004	13:46:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SI	FALSE	9.9	11.61	1.71	10.75	0	0	0	0	0	0	0.37	3.68	2.00	0	8	Physical	NO	Tan/gry mottled silty sand, sand ripple, tubes, red sed @z, voids, polychates @z, iron oxide
NW17	A	7/9/2004	09:38:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	10.33	11.28	0.95	10.81	0	0	0	0	0	0	1.91	4.19	3.06	0	10	Physical	NO	Tan silty sand/gry sandy m, red sed @z, tubes, lg voids, polychaetes @z
NW17	C	7/9/2004	09:39:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	11.3	15.17	3.87	13.24	0	0	0	0	0	0	1.80	5.37	4.09	0	11	Physical	NO	Tan fine sand/tan & gry silty sand, sloping topo-sand ripple?, v sm tubes, ox voids, sm polychaetes @z
NW18	B	7/9/2004	09:23:00	ST I	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	7.01	7.91	0.9	7.46	0	0	0	0	0	0	0.18	3.53	2.62	0	5	Physical	NO	Tan silty sand, sm polychaetes @z, iron oxide
NW18	C	7/9/2004	09:24:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	8	11.2	3.2	9.6	0	0	0	0	0	0	0.59	3.38	2.18	0	8	Physical	NO	Tan/gry sandy silt, sea pen @ surf, numerous voids, v sm tubes
NW19	A	7/9/2004	11:06:00	ST I on III	> 4 phi	3 phi	4 to 3 phi	UN.SI	TRUE	12.23	13.37	1.14	12.8	0	0	0	0	0	0	0.37	4.12	3.07	0	10	Physical	NO	Tan fine sand/tan & blk mottled silty sand, red sed @z, ox clasts, tubes, numerous voids, polychaetes @z
NW19	B	7/9/2004	11:07:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	TRUE	9.21	10.54	1.33	9.88	0	0	0	0	0	0	0.52	4.19	2.93	0	9	Physical	NO	Tan muddy fine sand/gry & blk mottled silty sand, red sed @z, red clasts, ox burrow, fecal mound?, Poly@ surf, tubes, many voids, poly@z
NW2	A	7/9/2004	10:08:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SI	TRUE	11.32	12.58	1.26	11.95	0	0	0	0	0	0	0.44	3.79	2.15	0	8	Physical	NO	Tan/tan & gry silty sand, tubes, ox clast, lg oxidized burrow, iron oxide, voids
NW2	B	7/9/2004	10:09:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	9.49	11.7	2.21	10.59	0	0	0	0	0	0	0.85	2.94	1.98	0	8	Biogenic	NO	Tan/tan & gry sandy silt, burrow opening, voids, polychaetes @z, sm tubes?
NW20	A	7/9/2004	10:59:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	9.02	11.66	2.64	10.34	0	0	0	0	0	0	0.70	3.75	2.46	0	9	Physical	NO	Tan/tan & blk sandy silt, red sed @z, tubes, voids, polychaetes @z, iron oxide, surf rework
NW20	B	7/9/2004	11:00:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	10.38	12.39	2.01	11.39	0	0	0	0	0	0	0.52	3.35	2.08	0	8	Physical	NO	Tan/gry & blk silty sand, depositional or fecal lyr?, red sed @z, voids, sm tubes?
NW21	A	7/9/2004	10:43:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	11.94	12.32	0.38	12.13	0	0	0	0	0	0	0.48	2.80	1.70	0	8	Physical	NO	Tan/blk mottled sandy silt, shell frags, tubes, voids, hydroid?, sm polychaete @z, org @ surf=shrimp, v re
NW22	A	7/9/2004	12:27:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SI	FALSE	12.86	14.52	1.66	13.69	0	0	0	0	0	0	1.77	6.11	3.42	0	10	Physical	NO	Tan fine sand/tan & gry silty sand, red sed @z, bedforms-sand ripple?, v sm tubes, sm voids
NW22	B	7/9/2004	12:28:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	TRUE	10.85	13.1	2.25	11.98	0	0	0	0	0	0	2.21	5.00	3.62	0	10	Physical	NO	Tan/gry silty sand, tubes, red clast, voids, polychaetes @z, ox burrow, red sed @z
NW23	A	7/9/2004	16:01:00	INDET	3 phi	1 phi	2 to 1 phi	SA.M	FALSE	.	0.03	0.03	0.01	0	0	0	0	0	0	-99.00	-99.00	-99.00	0	99	Physical	NO	Hard bottom, underpen, tan medium sand
NW23	C	7/9/2004	16:02:00	INDET	4 phi	1 phi	2 to 1 phi	SA.M	FALSE	0.07	2.26	2.19	1.16	0	0	0	0	0	0	>0.07	>2.26	>1.16	0	99	Physical	NO	Tan medium sand, underpen, sand ripple, RPD>pen
NW24	A	7/9/2004	14:53:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	12.91	13.76	0.85	13.34	0	0	0	0	0	0	1.62	4.27	3.12	0	10	Physical	NO	Tan/gry & blk mottled sandy silt, red sed @z, smearing, decaying sea pen @ surf?, voids, sm tubes, polychaetes @z, burrow, burrowing anemone?
NW24	B	7/9/2004	14:54:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	13.6	14.9	1.3	14.25	0	0	0	0	0	0	1.21	4.71	2.83	0	9	Biogenic	NO	Tan/gry mottled sandy silt, tubes, numerous voids, fecal lyr, biogenic mound
NW25	A	7/9/2004	10:27:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	9.47	11.34	1.87	10.41	0	0	0	0	0	0	0.48	3.09	1.73	0	8	Physical	NO	Tan/tan & gry sandy silt, red sed @z, voids, polychaetes @z, sm tubes
NW25	B	7/9/2004	10:27:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SS	TRUE	13.01	13.57	0.56	13.29	0	0	0	0	0	0	0.26	2.80	1.91	0	8	Physical	NO	Tan silty sand/tan &gry sandy silt, ox & red clasts, voids, sm tubes, polychaete @z
NW26	A	7/9/2004	10:36:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	9.26	10.35	1.09	9.81	0	0	0	0	0	0	1.14	3.42	1.94	0	8	Physical	NO	Tan silty sand/tan & gry sandy silt, red sed @z, lg burrowing poly @z, voids, iron oxide, sm tubes
NW26	B	7/9/2004	10:36:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	TRUE	13.29	15.24	1.95	14.26	0	0	0	0	0	0	1.32	3.94	3.02	0	10	Physical	NO	Tan silty sand/gry sandy silt, numerous voids, ox clast?, sm tubes, red sed @
NW27	A	7/9/2004	11:38:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	10.63	12.65	2.02	11.64	0	0	0	0	0	0	0.11	2.98	1.22	0	7	Physical	NO	Tan silty sand/tan & blk sandy silt, tubes, voids, patchy RPD, red sed @z, fecal lyr?
NW27	B	7/9/2004	11:39:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	TRUE	12.01	14.13	2.12	13.07	0	0	0	0	0	0	1.43	5.66	4.12	0	11	Physical	NO	Tan fine sand/ tan & gry sandy m, numerous voids, tubes, ox & red clasts, red sed @z
NW28	A	7/9/2004	12:07:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	12.13	12.99	0.86	12.56	0	0	0	0	0	0	0.15	3.75	2.39	0	9	Physical	NO	Tan/gry &blk sandy silt, tubes, numerous voids, sm polychaetes @z, iron oxide, burrowing anemone or lg polychaete?
NW28	B	7/9/2004	12:07:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	TRUE	9.92	10.9	0.98	10.41	0	0	0	0	0	0	0.81	4.34	2.42	0	9	Biogenic	NO	Tan silty sand/tan & blk sandy silt, dense surf tubes, voids-active, polychaetes @z, red sed @z, sm burrow opening, red clasts
NW29	A	7/9/2004	13:01:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	12.51	14.19	1.68	13.35	0	0	0	0	0	0	1.99	3.75	2.77	0	9	Physical	NO	Tan/tan & gry mottled sandy silt, dense sm tubes, numerous sm voids, iron oxide, red sed @z, polychaete@z
NW29	B	7/9/2004	13:02:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	11.25	12.27	1.02	11.76	0	0	0	0	0	0	0.70	3.24	2.33	0	9	Biogenic	NO	Tan/tan & gry mottled sandy silt, dense sm tubes, burrow opening, sm voids, red sed @z, polychaetes @z
NW3	A	7/9/2004	11:21:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	12.63	15.12	2.49	13.88	0	0	0	0	0	0	0.92	4.23	3.09	0	10	Physical	NO	Tan/tan & gry mottled silty sand, voids, red sed @z, tubes, surf reworking, burrrows, iron oxide, fecal lyr, org @z?
NW3	B	7/9/2004	11:22:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	TRUE	10.42	11.56	1.14	10.99	0	0	0	0	0	0	0.55	3.38	1.45	0	7	Physical	NO	Tan & gry mottled sandy silt, red sed @z, m clumps, tubes, voids
NW30	A	7/9/2004	13:31:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	TRUE	12.65	13.34	0.69	12.99	0	0	0	0	0	0	1.03	3.86	2.86	0	9	Physical	NO	Tan/tan & gry mottled sandy silt, ox & red clasts, v red sed @z, tubes, voids, burrow or shell drag down?, iron oxide, sm polychaetes @z
NW30	B	7/9/2004	13:32:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	TRUE	12.37	13.27	0.9	12.82	0	0	0	0	0	0	1.14	3.83	2.54	0	9	Physical	NO	Tan/gry mottled sandy silt, ox & red clasts, tubes, sm burrow-opening, voids, red sed @z, iron oxide
NW31	A	7/9/2004	13:54:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	11.7	12.7	1	12.2	0	0	0	0	0	0	0.92	3.49	2.52	0	9	Physical	NO	Tan/gry mottled sandy silt, red sed @z, voids, iron oxide, sm tubes?
NW31	F	7/9/2004	14:48:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	TRUE	11.91	13.57	1.66	12.74	0	0	0	0	0	0	0.85	3.27	1.92	0	8	Physical	NO	Tan/gry mottled sandy silt, red clasts, red sed @z, voids, sm tubes, iron oxide, fecal lyr
NW32	A	7/9/2004	15:55:00	ST I on III	> 4 phi	1 phi	4 to 3 phi	UN.SS	FALSE	11.32	12.18	0.86	11.75	0	0	0	0	0	0	0.52	4.52	2.38	0	9	Physical	NO	Tan&gry sandy silt mixed w/med sand & shell hash, lg burrow, void, tubes
NW32	B	7/9/2004	15:55:00	ST I on III	> 4 phi	1 phi	> 4 phi	UN.SI	FALSE	11.47	12.06	0.59	11.77	0	0	0	0	0	0	1.07	4.49	3.24	0	10	Physical	NO	Tan silty sand mixed w/med sand & shell hash/sandy silt, hydroids?, tubes, void, iron oxide
NW33	A	7/9/2004	16:06:00	ST I on III	> 4 phi	1 phi	4 to 3 phi	UN.SS	FALSE	11.23	12.29	1.06	11.76	0	0	0	0	0	0	0.55	4.01	2.93	0	9	Biogenic	NO	Tan fine sand mixed w/tan & gry silty sand, tubes, voids, polychaetes @z, biogenic mound, iron oxide, burrow
NW33	B	7/9/2004	16:07:00	ST I on III	> 4 phi	1 phi	4 to 3 phi	UN.SI	FALSE	10.8	11.66	0.86	11.23	0	0	0	0	0	0	0.22	4.41	3.35	0	10	Physical	NO	Tan fine sand mixed w/tan & gry sandy silt, tubes, voids, burrow, iron oxide
NW34	B	7/10/2004	13:42:00	ST I	> 4 phi	2 phi	4 to 3 phi	UN.SI	FALSE	9.85	11.06	1.21	10.45	0	0	0	0	0	0	0.15	3.61	2.07	0	4	Physical	NO	Tan & gry silty sand, shell frags, tubes, polychaete @z, iron oxide, sm void?
NW34	C	7/10/2004	13:42:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SI	FALSE	10.35	12.99	2.64	11.67	0	0	0	0	0	0	0.92	4.41	2.96	0	9	Physical	NO	Tan fine sand mixed w/ tan & gry silty sand, sand ripple, tubes, voids, iron oxide
NW35	A	7/9/2004	11:59:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	7.45	12.77	5.32	10.11	0	0	0	0	0	0	1.88	4.75	3.35	0	10	Physical	NO	Tan fine sand/gry & blk silty sand, red sed @z, irreg topo, tubes, voids, sm polychaetes @ z, fecal lyr
NW35	B	7/9/2004	11:59:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	TRUE	10.42	12.91	2.49	11.66	0	0	0	0	0	0	0.07	4.67	2.81	0	9	Physical	NO	Tan fine sand/tan & blk silty sand, red sed @z, red clasts, sm tubes, voids, sm polychaetes @z, fecal mound?
NW36	A	7/9/2004	15:49:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	12.63	13.32	0.69	12.98	0	0	0	0	0	0	1.84	5.37	3.75	0	10	Physical	NO	Tan fine sand/tan & blk sandy m, sm tubes, voids, red sed @z, sm polychaetes @z, iron oxide streak
NW36	B	7/9/2004	15:50:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	12.01	13.29	1.28	12.65	0	0	0	0	0	0	2.43	4.78	3.80	0	11	Physical	NO	Tan fine sand/mottled tan & blk silty sand, sm tubes, polychaetes @z, v sm voids, red sed @z, wht clay @z
NW37	A	7/9/2004	11:48:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SI	FALSE	13.62	18.23	4.61	15.92	0	0	0	0	0	0	0.88	5.04	4.00	0	11	Physical	NO	Tan fine sand/tan & gry silty sand, sand ripple?, shell frags, sea pen @ surf, voids, polychaetes @z, sm tubes
NW37	B	7/9/2004	11:48:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	10.42	12.01	1.59	11.22	0	0	0	0	0	0	0.55	4.45	3.17	0	10	Physical	NO	Tan fine sand/tan & gry silty sand, irreg topo, shell frags, tubes, voids, red sed @z
NW38	A	7/9/2004	13:09:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	12.04	12.56	0.52	12.3	0	0	0	0	0	0	1.58	3.31	2.37	0	9	Physical	NO	Tan silty sand/gry sandy silt, red sed @z, tubes, voids, burrow, burrowing polychaete @z, shell -far
NW38	B	7/9/2004	13:09:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	TRUE	10.35	11.47	1.12	10.91	0	0	0	0	0	0	0.37	3.61	2.37	0	9	Physical	NO	Tan/gry & blk sandy silt, red sed @z, tubes, voids, red clasts, burrowing anemone?, burrow opening
NW39	A	7/9/2004	13:24:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	TRUE	11.89	13.48	1.59	12.68	0	0	0	0	0	0	0.52	5.04	3.30	0	10	Biogenic	NO	Tan/gry & blk mottled sandy m, dense tubes, polychaetes @z, sm void, surf rework, red sed patch @z, ox & red clasts, sm burrow opening
NW39	B	7/9/2004	13:25:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	TRUE	9.19	12.18	2.99	10.68	0	0	0	0	0	0	0.04	3.38	1.86	0	8	Biogenic	NO	Tan/blk silty sand, irreg surf, m clumps, v red sed @z, lg tubes, red clasts, voids, patchy RPD

Appendix A-3., continued.

Station	Replicate	Date	Time	Successional Stage	Grain Size (phi) Min	Grain Size (phi) Max	Grain Size (phi) Maj Mode	Benthic Habitat	Mud Clasts Present	Camera Penetration (cm) Min	Camera Penetration (cm) Max	Camera Penetration (cm) Range	Camera Penetration (cm) Mean	Dredged Material Thickness (cm) Min	Dredged Material Thickness (cm) Max	Dredged Material Thickness (cm) Mean	Redox Rebound Thickness (cm) Min	Redox Rebound Thickness (cm) Max	Redox Rebound Thickness (cm) Mean	Apparent RPD Thickness (cm) Min	Apparent RPD Thickness (cm) Max	Apparent RPD Thickness (cm) Mean	Methane Count	OSI	Surface Roughness	Low DO	Comments
NW4	A	7/9/2004	12:48:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SI	FALSE	11.61	13.41	1.8	12.51	0	0	0	0	0	0	0.70	4.75	3.67	0	10	Physical	NO	Tan fine sand/tan & gry sandy silt, tubes, void, burrowing polychaete, iron oxide CAUSE EFFECT BETWEEN ORGANISM AND IRON OXIDE PATTERN.
NW4	B	7/9/2004	12:49:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	TRUE	11.37	12.34	0.97	11.85	0	0	0	0	0	0	0.37	4.05	2.88	0	9	Physical	NO	Tan silty sand/tan & gry sandy silt, voids, polychaete @z, sm tubes, ox clasts
NW40	A	7/9/2004	15:00:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	12.04	13.27	1.23	12.66	0	0	0	0	0	0	0.52	4.19	2.31	0	9	Biogenic	NO	Tan silty sand/blk sulfidic sandy silt, tubes, biogenic mound?, burrow opening, voids, burrowing polychaete @z, iron oxide
NW40	B	7/9/2004	15:01:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SS	FALSE	11.82	12.94	1.12	12.38	0	0	0	0	0	0	0.26	3.57	2.32	0	9	Biogenic	NO	Tan silty sand/tan &blk mottled sandy silt, v red sed @z, tubes, burrow openings fecal mounds/lyrs, iron oxide Good ex. of biogenic surf roughness-fecal lyrs
NW41	A	7/9/2004	15:39:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	11.04	11.68	0.64	11.36	0	0	0	0	0	0	0.52	3.09	1.60	0	8	Physical	NO	Tan/gry & blk sandy silt, tubes, red sed @z, voids, sm polychaetes @z
NW41	B	7/9/2004	15:40:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	TRUE	12.7	13.84	1.14	13.27	0	0	0	0	0	0	1.32	4.45	2.94	0	9	Physical	NO	Tan silty sand/mottled blk sandy silt, red clasts, v red sed @z, numerous voids, lg polychaete @z, tubes
NW42	A	7/9/2004	16:13:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	8.88	10.9	2.02	9.89	0	0	0	0	0	0	0.70	3.16	1.79	0	8	Physical	NO	Tan/gry & blk sandy silt, bedforms-ripple?, ox clasts-far, shell frags @ surf, red sed @z, voids, sm polychaetes @z, sm tubes
NW42	C	7/9/2004	16:14:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	10.38	11.56	1.18	10.97	0	0	0	0	0	0	1.14	3.94	2.21	0	8	Physical	NO	Tan silty sand/tan & blk mottled sandy silt, red sed @z, tubes, voids, sm polychaetes @z, sm burrow
NW43	A	7/10/2004	13:35:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	10.2	11.68	1.48	10.94	0	0	0	0	0	0	0.74	3.27	1.92	0	8	Physical	NO	Tan/tan & gry mottled silty sand, grain size mm=4 to 3?, red sed @z, tubes, voids, sm polychaete @z, iron oxide, bedforms?
NW43	B	7/10/2004	13:35:00	ST III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	10.66	11.85	1.19	11.26	0	0	0	0	0	0	0.26	3.31	2.13	0	8	Physical	NO	Tan silty sand/tan & gry sandy silt, red sed @z, lg void, sm polychaete @z, abandoned tube @ surf?
NW44	A	7/9/2004	15:07:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	12.27	13.38	1.11	12.83	0	0	0	0	0	0	0.66	3.53	2.35	0	9	Physical	NO	Tan fine sand/gry & blk sulfidic sandy silt, tubes, v red sed @z, voids, sm polychaetes @z, burrow opening?
NW44	B	7/9/2004	15:08:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	TRUE	10.44	13.38	2.94	11.91	0	0	0	0	0	0	0.40	3.57	1.93	0	8	Biogenic	NO	Tan silty sand/tan & blk mottled sandy silt, red clasts, v red sed @z, tubes, voids, burrow, burrow opening, sm polychaetes
NW45	A	7/9/2004	15:31:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	12.65	14.41	1.76	13.53	0	0	0	0	0	0	0.44	4.71	3.01	0	10	Physical	NO	Tan fine sand/blk sandy silt, mm 4 to 3 phi?, v red sed @z, tubes, sea pen @ surf, lg polychaetes @z, voids, burrow
NW45	B	7/9/2004	15:32:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SS	TRUE	12.82	13.75	0.93	13.28	0	0	0	0	0	0	0.37	5.08	3.20	0	10	Biogenic	NO	Tan fine sand/blk & tan mottled silty sand, dense sm surf tubes, void, lg polychaete @z, v red sed @z, red clast
NW46	A	7/10/2004	13:28:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	11.77	12.72	0.95	12.25	0	0	0	0	0	0	1.25	4.41	3.09	0	10	Physical	NO	Tan fine sand/blk sulfidic silty sand, v red sed @z, tubes, m clumps or biogenic mounds @ surf, sm oxidized void, polychaete @z
NW46	B	7/10/2004	13:29:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	10.01	11.8	1.79	10.91	0	0	0	0	0	0	0.59	4.23	2.56	0	9	Biogenic	NO	Tan fine sand/blk sulfidic sandy m, v red sed @ z, tubes, biogenic mound, voids, lg burrow, sm polychaetes @z
NW47	A	7/9/2004	13:16:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	TRUE	11.49	13.65	2.16	12.57	0	0	0	0	0	0	0.66	4.23	2.86	0	9	Physical	NO	Tan silty sand/tan & blk sandy silt, lg m clumps @ surf, ox & red clasts, v red sed @z, voids, tubes, iron oxid wiper clast, burrow, sm polychaetes @z
NW47	B	7/9/2004	13:17:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	TRUE	12.04	12.82	0.78	12.43	0	0	0	0	0	0	0.59	3.49	2.36	0	9	Physical	NO	Tan silty sand/blk mottled sandy silt, red clasts, v red sed @z, sm tubes, void
NW48	A	7/9/2004	15:15:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	10.19	11.28	1.09	10.73	0	0	0	0	0	0	1.07	3.83	3.04	0	10	Physical	NO	Tan fine sand/tan & blk sandy silt, voids, v sm tubes, v red sed @z
NW48	B	7/9/2004	15:16:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	TRUE	12.29	18.99	6.7	15.64	0	0	0	0	0	0	1.55	8.42	5.39	0	11	Biogenic	NO	Tan fine sand/tan & blk sandy silt, irreg topo, m clump, lg tube, red sed @z, voids, shell frags
NW49	A	7/9/2004	15:23:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	13.27	15.81	2.54	14.54	0	0	0	0	0	0	1.32	4.82	3.30	0	10	Physical	NO	Tan fine sand/blk silty sand, sm dense surf tubes, numerous voids, v red sed @z, relic RPD?
NW49	B	7/9/2004	15:24:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	TRUE	12.84	14.1	1.26	13.47	0	0	0	0	0	0	0.15	5.19	3.30	0	10	Physical	NO	Tan fine sand/blk silty sand, red sed @z, red clasts, sm tubes, voids.
NW50	A	7/9/2004	16:20:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	10.44	11.7	1.26	11.07	0	0	0	0	0	0	0.59	3.05	2.01	0	8	Biogenic	NO	Tan silty sand/blk sandy silt, v red sed @z, dense tubes, biogenic mound, sm polychaetes @z, burrow, iron oxide
NW50	B	7/9/2004	16:21:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	11.47	12.32	0.85	11.9	0	0	0	0	0	0	1.03	3.13	2.58	0	9	Physical	NO	Tan silty sand/tan & blk sandy silt, v red sed @z, tubes, voids, shell frags, polychaetes @z
NW51	A	7/10/2004	13:21:00	ST I on III	> 4 phi	1 phi	> 4 phi	UN.SI	FALSE	11.58	12.08	0.5	11.83	0	0	0	0	0	0	0.55	4.05	2.60	0	9	Physical	NO	Tan silty sand/tan & blk sandy silt w/ gry sands, close to Cell LD (cap material @z?) v red sed @z, tubes, voids-active, polychaetes @z,
NW51	B	7/10/2004	13:22:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	10.85	12.06	1.21	11.45	0	0	0	0	0	0	0.44	3.49	2.49	0	9	Physical	NO	Tan silty sand/blk sandy silt w/gry sand, close to Cell LD (cap material @z?), dense surf tubes, voids, burrow, polychaetes @z
NW52	A	7/10/2004	13:06:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	10.9	11.15	0.25	11.02	0	0	0	0	0	0	0.40	2.94	1.91	0	8	Physical	NO	Tan & gry silty sand, shell frags, tubes, void, red sed @z
NW52	B	7/10/2004	13:06:00	ST I on III	> 4 phi	2 phi	4 to 3 phi	UN.SI	FALSE	8.64	11.3	2.66	9.97	0	0	0	0	0	0	0.26	3.46	1.78	0	8	Physical	NO	Tan & gry silty sand, red sed @z, void, tubes, biogenic mound?, polychaete @z
NW53	A	7/10/2004	13:12:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	9.97	11.85	1.88	10.91	0	0	0	0	0	0	1.07	4.01	2.31	0	9	Physical	NO	Tan silty sand/tan & blk mottled sandy silt, bedform?, red sed @z, burrow opening, voids, polychaetes @z, tubes
NW53	B	7/10/2004	13:13:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	10.63	11.42	0.79	11.02	0	0	0	0	0	0	0.37	3.35	2.26	0	9	Physical	NO	Tan fine sand/tan & blk sandy silt, v red sed @z, tubes, void-active, burrow, polychaete @x, iron oxide
NW54	A	7/10/2004	08:35:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	11.82	12.27	0.45	12.05	0	0	0	0	0	0	1.84	3.68	2.82	0	9	Biogenic	NO	Tan fine sand (dep lyr)/tan & blk sulfidic silty sand, v red sed @z, sm tubes, voids, burrow-opening, fecal lyr, sm polychaete @z, org @z?
NW54	B	7/10/2004	08:36:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	TRUE	12.06	14.38	2.32	13.22	0	0	0	0	0	0	1.73	4.38	3.50	0	10	Physical	NO	Tan fine sand (dep lyr)/blk sulfidic silty sand, bedforms?, v red sed @z, ox & red clasts, tubes, voids, lg polychaete @z
NW55	A	7/10/2004	08:21:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	12.34	13.76	1.42	13.05	0	0	0	0	0	0	0.07	3.68	2.22	0	8	Physical	NO	Tan fine sand/blk sulfidic sandy silt, sm tubes, voids, sm polychaetes @z
NW55	B	7/10/2004	08:22:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	TRUE	10.04	11.96	1.92	11	0	0	0	0	0	0	0.22	3.57	1.50	0	7	Biogenic	NO	Tan silty sand/blk sandy silt, v red sed @z, m clumps -far, tubes, ox clast, void
NW56	B	7/10/2004	08:30:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	TRUE	10.87	12.34	1.47	11.6	0	0	0	0	0	0	0.66	3.72	2.69	0	9	Biogenic	NO	Tan silty sand/blk sulfidic sandy silt, dense surf tubes, red clasts, voids, burrow Good ex of St I on III
NW56	C	7/10/2004	08:31:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SS	TRUE	12.42	12.96	0.54	12.69	0	0	0	0	0	0	0.44	3.31	2.18	0	8	Physical	NO	Tan silty sand/blk sulfidic sandy silt, ox & red clasts, lg m clump, voids, lg polychaetes @z, tubes
NW57	A	7/10/2004	08:42:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	11.06	11.91	0.85	11.49	0	0	0	0	0	0	0.70	3.75	2.75	0	9	Physical	NO	Tan fine sand/blk sulfidic sandy silt, tubes, voids, polychaetes @z, m clumps-far?, shell frags @z
NW57	B	7/10/2004	08:43:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	TRUE	11.49	12.53	1.04	12.01	0	0	0	0	0	0	0.26	4.71	2.28	0	9	Biogenic	NO	Tan fine sand/blk sulfidic sandy silt, red clasts, v red sed @z, tubes, voids, burrows, fecal mound, expelled anoxic sed
NW5	A	7/9/2004	10:00:00	ST I on III	> 4 phi	1 phi	3 to 2 phi	SA.F	FALSE	9.73	10.06	0.33	9.9	0	0	0	0	0	0	0.52	5.85	4.91	0	11	Physical	NO	Tan fine sand, iron oxide streaks, void, sm tubes, hydroids-far?
NW5	B	7/9/2004	10:01:00	ST I	> 4 phi	2 phi	4 to 3 phi	UN.SS	FALSE	9.97	10.52	0.55	10.25	0	0	0	0	0	0	1.66	4.71	3.06	0	6	Physical	NO	Tan fine sand mixed w/tan &gry silty sand, shell frags, biogenic mound-far?, hydroid-far?, polychaetes @z
NW6	A	7/9/2004	09:53:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	TRUE	11.18	12.39	1.21	11.78	0	0	0	0	0	0	0.70	4.56	2.47	0	9	Biogenic	NO	Tan/gry sandy m, red clasts, ox burrows-openings, numerous voids-active, sm tubes, polychaetes @z, red s @z, Biologically active station
NW6	B	7/9/2004	09:53:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	10.39	12.42	2.03	11.41	0	0	0	0	0	0	0.44	5.26	2.80	0	9	Physical	NO	Tan silty sand/tan & gry sandy m, red sed @z, tubes, voids, burrow
NW7	B	7/9/2004	09:01:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	10.2	11.47	1.27	10.84	0	0	0	0	0	0	0.70	3.61	2.73	0	9	Physical	NO	Tan/gry silty sand, sm tubes, sea pen @ surf, voids, polychaetes @z, red sed patch @z
NW7	C	7/9/2004	09:02:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	11.44	13.46	2.02	12.45	0	0	0	0	0	0	0.33	3.13	2.14	0	8	Biogenic	NO	Tan silty sand/gry sandy m, tubes, numerous voids, polychaetes @z.
NW8	A	7/9/2004	12:35:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	TRUE	12.39	14.84	2.45	13.61	0	0	0	0	0	0	0.88	4.38	2.87	0	9	Physical	NO	Tan fine sand/tan & gry mottled sandy m, ox clasts, red sed @z, v sm tubes, numerous voids, burrow, polychaete@z
NW8	B	7/9/2004	12:37:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	TRUE	12.42	12.94	0.52	12.68	0	0	0	0	0	0	1.99	4.60	3.26	0	10	Physical	NO	Tan fine sand/tan & gry sandy m, red sed @z, ox & red clasts, voids, tubes, sm burrow
NW9	A	7/9/2004	09:46:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	11.66	12.7	1.04	12.18	0	0	0	0	0	0	0.22	3.31	1.90	0	8	Physical	NO	Tan silty sand/tan & gry sandy silt, sand ripple?, tubes, numerous voids, iron oxide, sm polychaete @z
NW9	B	7/9/2004	09:46:00	ST I on III	> 4 phi	2 phi	> 4 phi	UN.SI	FALSE	11.58	12.75	1.17	12.16	0	0	0	0	0	0	0.99	3.24	2.17	0	8	Physical	NO	Tan silty sand/tan & gry sandy silt, tubes, voids, polychaetes @z, red sed @z

Appendix B
Plan-View Analysis

Appendix B. Plan-View Analysis.

Date	Local Time	Station-Rep	Latitude	Longitude	Obscured	General Bottom Description	Hard Bottom/ Coral	Sand	Silt/Clay	Epifauna	Infauna	Burrows	Bedforms	Shell Material	Other Notables
7/9/2004	08:48:27	NW1-B	33.7343785	-118.4048688	no	coarse sand	no	coarse	no	no	no	0	no	shell hash	possible discarded tube on surface
7/9/2004	10:18:32	NW10-A	33.7292664	-118.3965211	no	soft/burrow pitts	no	fine	yes	no	tube worm? R. side	19+	no	yes	Many small burrow pits seen on surface.
7/9/2004	11:13:38	NW11-A	33.7288356	-118.3910233	no	burrows/soft sed	no	fine	yes	no	Tube worm?	16+	No	no	Possible fecal mound
7/9/2004	11:29:50	NW12-A	33.7284229	-118.3855590	no	soft/sand ripples	no	fine	yes	no	tube worms	7+	sand ripples	no	Fecal mound (center of image).
7/9/2004	12:42:16	NW13-A	33.7279822	-118.3800338	no	few burrows/soft sed w/ fine sand	no	fine	yes	SeaPen/Filtering worm?	tube worms	17+	no	no	Possible fecal mound
7/9/2004	12:54:42	NW14-A	33.7276150	-118.3745589	yes, film proc error	soft/sand ripples	no	fine	yes	no	no	2+	sand ripples	no	Debris on lens (bottom right).
7/9/2004	13:39:04	NW15-C	33.7271400	-118.3690701	no	3 large burrows/soft sed w/ fine sand	no	fine	yes	Poss. Ghost Shrimp	tube worms	5+	no	no	
7/9/2004	13:46:02	NW16-A	33.7267323	-118.3635766	no	soft/large sand ripples	no	fine	yes	no	no	1+	sand ripples	no	Debris on lens (bottom right). Well-defined sand ripples.
7/9/2004	09:38:02	NW17-A	33.7281518	-118.4040528	no	burrows/silt/fine sand	no	fine	yes	star fish	tube worms	36+	no	no	fecal mound, organism tracks
7/9/2004	09:23:30	NW18-B	33.7275921	-118.4086021	no	soft	no	fine	yes	Sea Urchin	no	10+	no	yes	Many samll burrow holes. Organism trail marks. Possible organism/Hydroid right side of Urchin.
7/9/2004	11:06:39	NW19-A	33.7266474	-118.3914874	no	sea pens/burrows/soft sed w/ fine sand	no	fine	yes	Sea Pens	tube worms	24+	no	no	fecal mound, something in large burrow on right side
7/9/2004	10:09:58	NW2-C	33.7334635	-118.3939220	no	soft	no	fine	yes	no	tube worms	6+	sand ripples	yes	Possible organism (right side of image).
7/9/2004	10:59:33	NW20-A	33.7262511	-118.3908262	no	soft/fish	no	fine	yes	Fish	no	10+	no	yes	Many small burrow pitts. Organism trail marks in mud.
7/9/2004	10:43:37	NW21-A	33.7259941	-118.3902933	no	large burrow/medium to fine sand	no	medium to fine	yes	no	tube worms	6+	no	shells and hash	large burrow
7/9/2004	12:27:21	NW22-A	33.7250999	-118.3833522	no	soft	no	fine	yes	no	tube worms	10+	no	yes	Organism trail marks in mud. Debris on lense (bottom right).
7/9/2004	16:01:51	NW23-A	33.7239785	-118.3556297	no	coarse sand w/ sect of silt/clay	no	coarse to medium	yes	no	tube worms	0	no	yes	center of pic shows silt section, possible biological org on right side
7/9/2004	14:53:53	NW24-A	33.7232174	-118.3675738	no	soft/sand ripples	no	fine	yes	no	tube worms	4+	sand ripples	no	Organism trail in mud. Sand ripples.
7/9/2004	10:27:15	NW25-A	33.7250656	-118.3990642	no	sea pens/burrows/soft sed w/ fine sand	no	fine	yes	Sea Pens	tube worms	24+	no	no	fecal mound, organism tracks
7/9/2004	10:36:01	NW26-A	33.7246228	-118.3935707	no	soft/large burrow	no	fine	yes	no	no	11+	no	yes	Very large burow at bottom of image. Organism trails in mud.
7/9/2004	11:38:59	NW27-A	33.7242197	-118.3880801	no	bio org/burrows/soft sed w/ fine sand	no	fine	yes	sea Pens/cuddle fish?	tube worms	46+	no	no	possible cuddle fish or egg sack at left of image
7/9/2004	12:07:00	NW28-A	33.7237598	-118.3825843	no	soft/burrows	no	fine	yes	no	tube worm	12+	no	no	Worm-like organism (left side of image). Star fish mark in mud (bottom left).
7/9/2004	13:01:31	NW29-A	33.7233090	-118.3770800	no	brittle star/burrows/soft sed w/ fine sand	no	fine	yes	brittle stars	tube worms	25+	no	no	fecal mounds, organism tracks
7/9/2004	11:21:46	NW3-A	33.7330490	-118.3884914	no	burrows/soft sed w/ fine sand	no	fine	yes	no	tube worms	8+	no	no	possible fecal mound
7/9/2004	13:31:46	NW30-A	33.7229147	-118.3716150	yes, film proc error	soft/sand ripples	no	fine	yes	no	no	3+	sand ripples	no	Debris on lens (bottom right).
7/9/2004	14:48:43	NW31-G	33.7224562	-118.3660174	no	soft sed w/ clay clasts	no	fine	yes/clay clasts	no	tube worms	2+	no	no	clouds of sediment in corners of pic
7/9/2004	15:55:00	NW32-A	33.7220578	-118.3606186	no	soft-firm	no	med.	yes	no	tube worm	4+	sand ripples	yes	Dark (black) sediment with lots of shell material.
7/9/2004	16:06:34	NW33-A	33.7216594	-118.3551781	no	urchin/sandy sed	no	medium to fine	yes	urchin/anemone ?	tube worms	8+	no	yes	debris on right side of slide
7/10/2004	13:41:48	NW34-A	33.7212263	-118.3496278	no	soft/sand ripples	no	medium to fine	yes	no	tube worms	2+	sand ripples	yes	Small sand ripples.
7/9/2004	11:59:38	NW35-B	33.7215405	-118.3848303	no	large burrow/sea pens/soft sed w/ fine sand	no	fine	yes	sea pens	sea cucumber/ tube worms	19+	no	shell hash	burrowing sea cucumber at left of image, one large burrow, possible ghost shrimp
7/9/2004	15:50:47	NW36-C	33.7203713	-118.3632016	no	soft	no	fine	yes	no	tube worms	6+	sand ripples	no	Organism trails in mud.
7/9/2004	11:48:00	NW37-A	33.7199839	-118.3906111	no	burrows/soft sed w/ fine sand	no	fine	yes	no	tube worms	60+	no	few shell hash	organism tracks
7/9/2004	13:09:13	NW38-A	33.7191162	-118.3796316	no	soft/Tube worms	no	fine	yes	Sea Pen	tube worms	6+	no	yes	Sea Pens (top Left of image). Possible Gastropod (top right corner of image). Debris on lenz (bottom right).
7/9/2004	13:24:45	NW39-A	33.7186759	-118.3741387	no	burrows/soft sed w/ fine sand	no	fine	yes	no	tube worms	24+	no	no	
7/9/2004	12:49:20	NW4-B	33.7322009	-118.3775009	no	soft-firm	no	fine	yes	no	no	3+	sand ripples	yes	Small sand ripples. Debris on lenz (bottom right).
7/9/2004	15:00:56	NW40-A	33.7182764	-118.3686420	no	soft/Brittle stars	no	fine	yes	Brittle Stars	no	6+	no	no	Debris on lenz (bottom right). Five Brittle stars on sediment surface.

Appendix B., continued.

Date	Local Time	Station-Rep	Latitude	Longitude	Obscured	General Bottom Description	Hard Bottom/ Coral	Sand	Silt/Clay	Epifauna	Infauna	Burrows	Bedforms	Shell Material	Other Notables
7/9/2004	15:39:30	NW41-A	33.7178479	-118.3631877	no	few burrows/soft sed w/ fine sand	no	fine	yes	no	few tube worms	8+	no	no	organism tracks
7/9/2004	16:13:48	NW42-A	33.7174233	-118.3576794	yes, film proc error	soft	no	fine	yes	no	tube worm	3+	sand ripples	no	Small sand ripples. Tube worm bottom center of image.
7/10/2004	13:35:20	NW43-A	33.7170218	-118.3522032	no	few burrows/soft sed w/ fine sand	no	fine	yes	no	tube worms	8+	no	no	organism tracks
7/9/2004	09:17:23	NW44-D	33.7165877	-118.3711202	no	soft	no	fine	yes	no	tube worms	7+	no	no	Organism trails in mud.
7/9/2004	15:31:40	NW45-A	33.7161080	-118.3646632	no	large burrows/soft sed w/ fine sand	no	fine	yes	brittle stars	tube worms	18+	no	no	unknown biological feature in upper right corner
7/10/2004	13:28:22	NW46-A	33.7138192	-118.3536369	no	soft	no	fine	yes	Sea Pen	no	3+	no	yes	Sea Pen (top right of image).
7/9/2004	13:16:43	NW47-A	33.7168806	-118.3764269	no	burrows/soft sed w/ fine sand	no	fine	yes	no	tube worms	25+	no	few shell hash	organism tracks
7/9/2004	15:15:22	NW48-A	33.7140736	-118.3712139	no	Flat/soft/organism trails	no	fine	yes	no	tube worm	3+	no	yes	Three tube worms (bottom of image). Organism trails in mud. Debris on lenz (bottom right).
7/9/2004	15:23:32	NW49-A	33.7129814	-118.3658218	no	brittle stars/burrows/soft sed w/ fine sand	no	fine	yes	brittle stars	tube worms	14+	no	few shell hash	organism tracks
7/9/2004	10:01:27	NW5-B	33.7331680	-118.4009113	no	medium to fine sand	no	medium to fine	yes	no	tube worms	8+	no	little shell hash	fecal mounds
7/9/2004	09:28:37	NW50-F	33.7132365	-118.3602565	no	soft/fish	no	fine	yes	Flounder?	no	4+	no	no	Flounder (top left of image)?
7/10/2004	13:21:48	NW51-A	33.7127723	-118.3547366	no	burrows/soft sed w/ fine sand	no	fine	yes	no	tube worms	21+	no	no	fecal mound
7/10/2004	13:06:07	NW52-A	33.7123662	-118.3492550	no	soft	no	fine	yes	no	tube worms	3+	sand ripples	yes	Small sand ripples.
7/10/2004	13:12:58	NW53-A	33.7103508	-118.3512450	no	few burrows/soft sed w/ fine sand	no	fine	yes	no	tube worms	6+	no	no	organism tracks
7/10/2004	08:35:26	NW54-A	33.7092214	-118.3558013	no	soft/Brittle stars	no	fine	yes	Brittle Stars	no	10+	no	yes	One Brtittle star at bottom of image.
7/10/2004	08:21:38	NW55-A	33.7099491	-118.3623245	no	few burrows/soft sed w/ fine sand	no	fine	yes	brittle star/sea pen	tube worms	9+	no	no	organism tracks
7/10/2004	08:29:52	NW56-A	33.7085843	-118.3573004	no	gastropod/brittle stars/large tube worm	no	fine	yes	Brittle Star/Gastropod	tube worm	3+	no	yes	Tube worms extend above sediment (top left). Gastropod/snail? (top right). One Brittle star.
7/10/2004	08:43:05	NW57-B	33.7081366	-118.3517755	no	few burrows/soft sed w/ fine sand	no	fine	yes	no	no	13+	no	little shell hash	
7/9/2004	09:53:56	NW6-B	33.7313218	-118.4018681	no	soft	no	fine	yes	no	tube worms	3+	no	yes	Fish (flounder?) mark in sediment. Small tube in top left corner of image.
7/9/2004	09:00:53	NW7-A	33.7305738	-118.4064801	no	burrows/soft sed w/ fine sand	no	fine	yes/clay clasts	no	tube worms	17+	no	little shell hash	possible bio org in top-bright object
7/9/2004	12:35:52	NW8-A	33.7293699	-118.3810357	no	soft/ripples	no	fine	yes	no	no	5+	sand ripples	no	Debris on slide (bottom right). Small sand ripples.
7/9/2004	09:47:35	NW9-C	33.7296762	-118.4019562	no	burrows/soft sed w/ fine sand	no	fine	yes	no	tube woms	25+	no	no	extruded sediment
7/10/2004	13:48:44	OUT1-A	33.7161456	-118.3412368	no	coarse sand	no	coarse to medium	no	no	no	0	no	lots of shells and hash	partial sand ridge in part of image
7/10/2004	15:11:41	OUT10-A	33.7059912	-118.3243602	no	Tubes/crab	no	medium to fine	yes	crab	tube worms	3+	no	yes	Organism/spider crab (right side)? White shell-like object (bottom left).
7/10/2004	15:20:19	OUT11-C	33.7056120	-118.3188517	no	medium to fine sand	no	medium to fine	yes	unidentified org	tube worms	1	no	shells and hash	unidentified org in center of image
7/10/2004	12:50:19	OUT12-A	33.7068914	-118.3448566	yes, film proc error	soft	no	fine	yes	no	no	3+	no	no	Slide Processing error (red/purple color). Dead sea pen? (lower left)
7/10/2004	08:50:12	OUT13-A	33.7061676	-118.3475050	no	few burrows/soft sed w/ fine sand	no	fine	yes	no	no	14+	no	no	organism tracks
7/10/2004	08:58:02	OUT14-A	33.7040393	-118.3489207	no	soft/brittle stars	no	fine	yes	Brittle Stars/Sea pen	tube worm	3+	no	yes	Many brittle stars. Tube Worms and sea pen (center of image).
7/10/2004	09:05:58	OUT15-A	33.7030642	-118.3433757	no	few burrows/soft sed w/ fine sand	no	fine	yes	brittle star	tube worms	8+	no	no	large hole in upper left, tubes cases visible
7/10/2004	12:00:46	OUT16-A	33.7026706	-118.3378811	no	soft/fecal mound	no	fine	yes	Gastropod	tube worms	4+	no	yes	Extruded sediment/fecal mound (bottom right of image). Possible gastropod (center of image).
7/10/2004	14:49:10	OUT17-A	33.7022520	-118.3324015	no	few burrows/soft sed w/ fine sand	no	fine	yes	no	tube worms	9+	no	no	possible discarded tubes on surface
7/10/2004	15:06:19	OUT18-B	33.7018009	-118.3269087	no	soft/urchins	no	fine	yes	Urchins	tube worms	4+	no	yes	Two sea urchins. One possible gastropod (top center of image).
7/10/2004	15:27:32	OUT19-C	33.7013718	-118.3213544	no	fine sand w/soft sed	no	fine	yes	no	tube worms	4+	no	few	organism tracks, discarded tubes
7/10/2004	13:57:00	OUT2-A	33.7149710	-118.3435985	no	shells/sandy	no	medium to fine	yes	Gastropod	tube worms	1+	no	yes	Gastropod (center-top right). Indistinguishable organism at sediment surface (bottom right of image)

Appendix B., continued.

Date	Local Time	Station-Rep	Latitude	Longitude	Obscured	General Bottom Description	Hard Bottom/ Coral	Sand	Silt/Clay	Epifauna	Infauna	Burrows	Bedforms	Shell Material	Other Notables
7/10/2004	15:58:02	OUT20-A	33.7009394	-118.3159095	no	soft	no	fine	yes	no	tube worms	4+	no	yes	Tube worms extended above sediment (left side of image). Brown bacteria mat on sed. Surface.
7/11/2004	07:55:59	OUT21-A	33.7005034	-118.3104352	no	slight bedforms/soft sed w/ fine sand	no	fine	yes	no	tube worms	4+	yes/slight	some shell hash	
7/10/2004	09:11:41	OUT22-A	33.7014711	-118.3417290	no	soft/brittle star	no	fine	yes	Brittle Star	no	1+	no	yes	Brittle Star (top left). Sediment cloud from organism (bottom right).
7/10/2004	09:18:34	OUT23-A	33.6984556	-118.3404109	no	soft sed w/ fine sand	no	fine	yes	no	tube worms	10+	no	little shell hash	bottom right side light colored sed than rest of image
7/10/2004	11:51:09	OUT24-A	33.6980218	-118.3349413	no	soft	no	fine	yes	Brittle Star?	no	2+	no	yes	Possible brittle star (top of image). Dead sea pen (center of image)?
7/10/2004	14:57:21	OUT25-A	33.6975742	-118.3294342	no	lots of Brittle stars/soft sed w/ fine sand	no	medium to fine	yes	brittle stars	tube worms	2	no	little shell hash	
7/10/2004	15:33:44	OUT26-A	33.6971503	-118.3239595	no	soft/Sea Pen	no	fine	yes	Sea Pen	tube worms	3+	no	yes	Sea Pen (top right of image).
7/10/2004	15:41:08	OUT27-A	33.6967339	-118.3184510	no	few burrows/soft sed w/ fine sed	no	fine	yes	no	tube worms	8+	no	little shell hash	fecal mound, possible discarded tube on surface
7/10/2004	15:48:54	OUT28-A	33.6957305	-118.3142435	no	Soft/large tube worms	no	fine	yes	no	tube worms	4+	no	yes	large Tube worms (center of image)
7/11/2004	08:03:54	OUT29-A	33.6958653	-118.3089869	no	soft sed w/ fine sand	no	fine	yes	no	tube worms	5+	no	little shell hash	fecal mound
7/10/2004	14:03:58	OUT3-B	33.7119087	-118.3436921	no	Sand dab, medium to fine sand	no	medium to fine	yes	sand dab	tube worms	0	no	shell hash	possible fecal mound
7/11/2004	08:11:53	OUT30-A	33.6956856	-118.3032665	no	soft/beautiful sea pen	no	fine	yes	Sea Pen	tube worms	4+	no	yes	Organism trails in mud. Beautifully displayed Sea Pen
7/10/2004	11:42:32	OUT31-A	33.6960061	-118.3336842	no	brittle star/soft sed w/ fine sand	no	fine	yes	brittle star	tube worms	10+	no	little shell hash	organism tracks, exruded sediment
7/10/2004	09:26:12	OUT32-A	33.6952215	-118.3373582	no	soft	no	fine	yes	no	tube worms	2+	no	yes	Brown bacteria mat (top left of image)?
7/10/2004	09:33:47	OUT33-A	33.6933846	-118.3319692	no	fish tail/soft sed w/ fine sand	no	fine	yes	Fish	tube worms	10+	no	little shell hash	fecal mound
7/10/2004	11:32:50	OUT34-C	33.6931699	-118.3268528	no	soft/Brittle Star	no	fine	yes	Brittle Star	no	2+	no	yes	Brittle Star (top left). Fecal material throughout image.
7/10/2004	11:22:40	OUT35-A	33.6925234	-118.3210223	no	soft sed w/ fine sand	no	fine	yes	gastropod?	tube worms	2+	no	shell hash	
7/10/2004	11:14:15	OUT36-A	33.6920718	-118.3154930	no	soft	no	fine	yes	no	no	5+	no	yes	Star fish markings in sediment.
7/11/2004	16:03:19	OUT37-C	33.6917198	-118.3101119	no	sea stars/meduim to fine sand	no	medium to fine	yes	ses stars	no	1+	no	shell hash	sea stars are buried
7/11/2004	15:46:31	OUT38-A	33.6912100	-118.3045944	no	soft	no	fine	yes	Sea Pen	no	4+	no	yes	Organism trail marks in mud. Possible Sea Pen (center left of image).
7/10/2004	11:08:35	OUT39-A	33.6908745	-118.3162634	no	medium to fine sand	no	medium to fine	yes	no	tube worms	5+	no	little shell hash	discarded tube on surface at top of image
7/10/2004	14:23:57	OUT4-A	33.7121706	-118.3336244	no	Coral/Hard	coral	Coarse	yes	soft & hard coral	no	no	no	yes	Fan coral, hard coral, Green algal coral (all replicate images, A,B,C)
7/11/2004	15:54:14	OUT40-A	33.6896504	-118.3068857	no	Soft/Brittle Star	no	fine	yes	Brittle Star	no	7+	no	yes	One brittle star (top of image).
7/10/2004	09:41:06	OUT41-A	33.6901090	-118.3280951	no	medium to fine sand	no	medium to fine	yes	sea star?/gastropod?	tube worms	1+	no	little shell hash	
7/10/2004	09:49:48	OUT42-B	33.6883120	-118.3235236	no	soft/large burrow	no	fine	yes	no	no	3+	no	yes	Large burrow. Brown bacteria mat.
7/10/2004	11:00:38	OUT43-A	33.6878474	-118.3180376	no	medium to fine sand	no	medium to fine	yes	no	tube worms	11+	no	little shell hash	organism tracks
7/11/2004	14:26:29	OUT44-A	33.6874468	-118.3125403	no	soft	no	fine	yes	no	tube Worm	4+	no	yes	Debris in burrow (lower right of image).
7/11/2004	14:35:02	OUT45-B	33.6870385	-118.3070737	no	medium to fine sand	no	medium to fine	yes	brittle star	tube worms	3+	no	no	extruded sediment
7/10/2004	10:54:30	OUT46-A	33.6858500	-118.3185688	no	soft/dean sea pens	no	fine	yes	Sea Pen	tube Worms	9+	no	yes	Dead Sea Pens.
7/10/2004	09:57:42	OUT47-A	33.6844900	-118.3205226	no	sea pens/burrows/soft sed w/ fine sand	no	fine	yes	sea pens	tube worms	5+	no	little shell hash	sediment cloud in top of image
7/10/2004	10:07:43	OUT48-C	33.6832259	-118.3150549	no	soft/Organism trails	no	fine	yes	Sea Pen	no	6+	no	yes	Prominent organism trails in mud. Sea Pen (Top left corner of image). Organsim suspended in image (right side).
7/10/2004	10:45:10	OUT49-A	33.6826932	-118.3107912	no	sea pen/sand dab/soft sed w/ fine sand	no	fine	yes	sea pen/sand dab	tube worms	3+	no	little shell hash	good image
7/10/2004	14:18:41	OUT5-C	33.7115311	-118.3382406	no	coarse to medium sand	no	coarse to medium	silt	crab or gastropod?	no	0	no	shells and hash	debris of some sort on bottom right
7/10/2004	10:18:35	OUT50-A	33.6798985	-118.3128766	no	soft sed w/ fine sand	no	fine	yes	no	no	5+	no	yes	Extruded sediment from organism burrow/fecal mound. Organism trails in mud. Brown bacteria mat.
7/10/2004	10:26:53	OUT51-A	33.6765189	-118.3133674	no	soft sed w/ fine sand	no	fine	yes	no	tube worms	10+	no	little shell hash	organism trails

Appendix B., continued.

Date	Local Time	Station-Rep	Latitude	Longitude	Obscured	General Bottom Description	Hard Bottom/ Coral	Sand	Silt/Clay	Epifauna	Infauna	Burrows	Bedforms	Shell Material	Other Notables
7/10/2004	12:57:12	OUT6-A	33.7087944	-118.3451639	no	soft	no	fine	yes	Organism?	tube worm	5+	no	yes	Organism (left side of image). Possible dead sea pen (bottom right). Brown algal mat.
7/10/2004	14:10:27	OUT7-B	33.7072792	-118.3407944	no	slight bedforms/soft sed w/ fine sand	no	fine	yes	no	tube worms	7+	slight	little shell hash	detrtius on surface
7/10/2004	14:33:18	OUT8-A	33.7068595	-118.3353251	no	soft/large burrow	no	fine	yes	no	tube worms	1+	no	yes	One large burrow.
7/10/2004	14:41:34	OUT9-A	33.7064309	-118.3298105	no	soft sed w/ fine sand	no	fine	yes	no	tube worms	2+	very slight bedforms	no	extruded sediment
7/12/2004	08:26:39	OUTA-A	33.6921645	-118.3134785	no	Soft/Star fish	no	fine	yes	Star fish	no	2+	no	yes	Two star-fish. Organism trails in mud.
7/12/2004	08:22:19	OUTB-B	33.6921043	-118.3133481	no	sea stars/meduim to fine sand	no	medium to fine	yes	sea stars	tube worms	8+	no	few shell hash	organisms trails
7/12/2004	08:15:16	OUTC-A	33.6919750	-118.3131736	no	soft	no	fine	yes	no	tube worms	3+	no	yes	Organism trails in mud.
7/12/2004	08:10:47	OUTD-C	33.6919455	-118.3129872	no	sea stars/meduim to fine sand	no	medium to fine	yes	sea stars	tube worm	7+	no	little shell hash	possible discarded tubes on surface
7/12/2004	08:46:14	SE1-A	33.6950294	-118.2965208	no	soft sed w/ fine sand	no	fine	yes	no	tube worm	4+	no	little shell hash	extruded sediment, filtering tube worm in upper right
7/11/2004	14:55:34	SE10-A	33.6847140	-118.2901220	no	soft/large burrow	no	fine	yes	no	tube worms	2+	no	yes	Two large Burrows (topleft of image). Brown algal mat. Fecal mounds.
7/11/2004	14:16:27	SE11-B	33.6823683	-118.3040977	no	medium to fine sand	no	medium to fine	yes	brittle star	tube worm	0	no	few shell hash	
7/11/2004	14:06:04	SE12-A	33.6819535	-118.2986417	no	soft/organism	no	fine	yes	organism	no	no	no	yes	Object/organism (left side of image). Fecal mounds. Brown bacteria mat.
7/11/2004	13:58:03	SE13-A	33.6815173	-118.2931718	no	medium to fine sand	no	medium to fine	yes	no	tube worm	0	no	little shell hash	detritus on surface
7/11/2004	13:50:35	SE14-A	33.6811183	-118.2876840	no	soft	no	fine	yes	no	no	3+	no	yes	Dead Sea Pen (center of image). Fecal mounds. Brown bacteria mat.
7/11/2004	13:42:59	SE15-A	33.6806552	-118.2821927	no	soft sed w/ fine sand	no	fine	yes	sand dab	tube worms	3+	no	shell hash	organisms trails
7/11/2004	13:20:22	SE16-A	33.6802442	-118.2766964	no	soft/fish?	no	fine	yes	fish?	tube worms	2+	no	yes	Possible fish (top right corner of image). Brown bacteria mat. Fecal mounds
7/11/2004	13:11:53	SE17-A	33.6798138	-118.2712515	no	soft sed w/ fine sand	no	fine	yes	no	tube worm	1	no	shells and hash	debris/detritus
7/11/2004	13:37:07	SE18-C	33.6801591	-118.2796940	no	shells/coral	coral	medium to fine	yes	fan coral/gastropod	no	no	no	yes	Possible urchin (top left of image). Gastropod (orange in color)? Fan coral.
7/11/2004	13:28:44	SE19-B	33.6787952	-118.2772723	no	coarse sand w/ shell hash	no	coarse to medium	yes	goby, hydroid, sponge, soft coral	no	no	no	shell and hash, lots	lots of detritus
7/12/2004	08:38:06	SE2-A	33.6929815	-118.2942331	no	soft	no	fine	yes	no	tube worms	1+	no	yes	Brown debris (bottom left). Fecal mound (top left).
7/10/2004	10:36:24	SE20-B	33.6781578	-118.3066374	no	soft/brittle star	no	fine	yes	Brittle Star	tube worms	4+	no	yes	One Brittle star (bottom of image). Small fecal mounds
7/11/2004	11:42:17	SE21-A	33.6777528	-118.3011906	no	soft sed w/ fine sand	no	fine	yes	no	tube worm	5+	no	few shell hash	organism trails, fecal mounds
7/11/2004	12:21:12	SE22-A	33.6773126	-118.2956825	yes, film proc error	soft	no	fine	yes	Sea Pen	tube worms	1+	no	yes	Sea Pen (top right corner of image). Extruded sediment from burrows/small fecal mounds.
7/11/2004	12:31:16	SE23-C	33.6762892	-118.2897309	no	soft sed w/ fine sand	no	fine	yes	no	tube worm, sea cucumber?	5+	no	few shell hash	burrowing sea cucumber in upper left?, fecal mounds
7/11/2004	12:37:24	SE24-A	33.6764611	-118.2847188	no	soft	no	fine	yes	no	tube worm?	3+	no	yes	Possible dead Sea Pen (left side of image)? Brown bacteria mat. Small fecal mounds.
7/11/2004	12:46:41	SE25-C	33.6760442	-118.2791844	no	fish/medium to fine sand	no	medium to fine	yes	fish	tube worms	0	no	shell hash	fish bottom center
7/11/2004	12:52:42	SE26-A	33.6756141	-118.2737624	no	soft/organism	no	fine	yes	Organism	tube worms	1+	no	yes	Large Organism (bottom Left)? Brown bacteria mat. Fecal mound.
7/11/2004	12:59:16	SE27-A	33.6751871	-118.2682826	no	medium to fine sand	no	medium to fine	yes	no	tube worms	0	no	little shell hash	
7/11/2004	10:29:17	SE28-A	33.6745107	-118.2854854	no	soft	no	fine	yes	Sea Pen	tube worms	2+	no	yes	Sea Pens (right side of image). Dead sea Pens (left side of image). Brown bacteria mat.
7/11/2004	10:26:03	SE29-A	33.6744487	-118.2853800	no	soft sed w/ fine sand	no	fine	yes	no	tube worms	5+	no	no	fecal mounds
7/11/2004	15:19:49	SE3-A	33.6899794	-118.2880986	no	soft sed w/ fine sand	no	fine	yes	no	tube worms	2+	no	little shell hash	fecal mounds
7/11/2004	10:23:58	SE30-B	33.6743436	-118.2852227	no	Coral/Hard	coral	fine	yes	coral/fish	no	no	no	yes	Fish (red in color, in coral at bottom). Soft coral, fan coral.
7/11/2004	10:16:48	SE31-A	33.6728258	-118.2849951	no	medium to fine sand	no	medium to fine	yes	soft coral, hydroids	tube worms	3+	no	shells and hash	detritus, fecal mounds, discarded tubes on surface
7/11/2004	09:47:24	SE32-C	33.6725397	-118.2770598	no	Soft/Tube worms	no	fine	yes	no	tube worms	2+	no	yes	Dead Sea pens. Brown bacteria mat.
7/11/2004	11:31:47	SE33-A	33.6750663	-118.3081999	no	brittle star/sea pen/soft sed	no	fine	yes	brittle star/sea pen	tube worms	15+	no	no	sed cloud, extruded sediment

Appendix B., continued.

Date	Local Time	Station-Rep	Latitude	Longitude	Obscured	General Bottom Description	Hard Bottom/ Coral	Sand	Silt/Clay	Epifauna	Infauna	Burrows	Bedforms	Shell Material	Other Notables
7/11/2004	11:04:28	SE34-B	33.6734962	-118.3036923	no	Soft/Star fish	no	fine	yes	Star fish	tube worms	2+	no	yes	Star fish (top left of image). Possible anenome (top center of image). Fecal mounds. Brown bacteria mat.
7/11/2004	10:54:22	SE35-A	33.6730836	-118.2982318	no	urchins/medium to fine sand	no	medium to fine	yes	urchins/unidentified org/sea pen	no	2+	no	some shell hash	unidentified org in bottom center of image, fecal mound
7/11/2004	10:45:42	SE36-A	33.6726539	-118.2927584	no	soft/Sea Pens	no	fine	yes	Sea pens	tube worms	6+	no	yes	Sea Pens. Extruded sediment around burrows/fecal mounds. Brown bacteria mat.
7/11/2004	10:38:36	SE37-C	33.6722513	-118.2872211	no	soft sed w/ fine sand	no	fine	yes	urchin	tube worm	3+	no	some shell hash	fecal mounds, dicarded tubes on surface
7/11/2004	10:03:34	SE38-C	33.6718191	-118.2817510	no	soft/gastropod?	no	fine	yes	Gastropod?	tube worm	5+	no	yes	Gastropod (center of image)? Sediment extruded from burrows/fecal mounds. Brown bacteria mat.
7/11/2004	09:54:55	SE39-C	33.6712329	-118.2803365	no	soft coral/coarse to medium sand	no	coarse to medium	yes	soft coral	no	0	no	shell and hash, lots	fecal mound
7/11/2004	15:38:36	SE4-A	33.6908369	-118.2990894	no	Soft/Tube worms/anenome?	no	fine	yes	Anenome?	tube worms	4+	no	yes	Possible anenome (top left of image).
7/11/2004	09:37:08	SE40-A	33.6709642	-118.2708281	no	soft/bacteria mat	no	fine	yes	no	tube worms	1+	no	yes	Brown bacteria mat.
7/11/2004	10:09:57	SE41-A	33.6705271	-118.2850082	no	shells and hash/coarse to medium sand	no	coarse to medium	yes	no	no	0	no	lots of shells and hash	calcified tubes on surface, detritus
7/11/2004	08:56:47	SE42-A	33.6698588	-118.3004388	no	soft	no	fine	yes	no	tube worms	5+	no	yes	Large spiral-shaped fecal mound (top right of image)? Fecal mounds. Brown bacteria mat.
7/11/2004	09:05:01	SE43-B	33.6696143	-118.2957314	no	soft sed w/ fine sand	no	fine	yes	no	tube worms	0	no	some shell hash	fecal mounds, detritus
7/11/2004	09:14:53	SE44-C	33.6680271	-118.2898070	no	soft/bacteria mat	no	fine	yes	Sea Pen	no	4+	no	yes	Sea Pen (top left of image). Two dead Sea Pens. Brown bacteria mat. Fecal mounds
7/11/2004	09:22:53	SE45-C	33.6680271	-118.2898070	no	medium to fine sand	no	medium to fine	yes	no	no	1+	no	some shell hash	fecal mound, organism tracks
7/11/2004	09:28:51	SE46-A	33.6671502	-118.2788181	no	soft/Sea Pen	no	fine	yes	Sea Pen	no	1+	no	yes	Organism trails in mud. Spiral organism mark in mud (right side of image). Fecal mounds.
7/11/2004	08:45:41	SE47-A	33.6670791	-118.2965449	no	soft sed w/ fine sand	no	fine	yes	no	tube worms	6+	no	few shell hash	fecal mounds, organism tracks
7/11/2004	08:34:31	SE48-A	33.6633684	-118.2868555	no	soft	no	fine	yes	no	tube worms	3+	no	yes	Dead Sea pen. Fecal mounds
7/11/2004	15:28:30	SE5-A	33.6894357	-118.2926322	no	soft sed w/ fine sand	no	fine	yes	poss sea pen	tube worms	3+	no	few shell hash	
7/11/2004	14:41:47	SE6-A	33.6866122	-118.3015953	no	soft	no	fine	yes	no	tube worms	2+	no	yes	Extruded sediment/fecal mound (left side of image).
7/11/2004	14:48:49	SE7-A	33.6861588	-118.2961054	no	soft sed w/ fine sand	no	fine	yes	fish/sea pen?	tube worms	1+	no	little shell hash	
7/11/2004	15:03:29	SE8-A	33.6853084	-118.2851499	no	soft/brown bacteria mat	no	fine	yes	Sea Pen	tube worms	3+	no	yes	Sea Pen (right side of image). Star fish markings in mud (top-right side of image). Fecal mounds. Brown bacteria mat
7/11/2004	15:11:01	SE9-B	33.6849188	-118.2796311	no	sea pens/medium to fine sand	no	medium to fine	yes	sea pens	tube worms	1+	no	little shell hash	possible sea cucumber in center of image

Appendix C
Geotech Lab Data
Core Samples

Appendix C. SE12-B.

SAIC Sample ID: AMS Sample ID:		SE12-B_0-4cm 20092		SE12-B_4-8cm 20093		SE12-B_8-12cm 20094		SE12-B_12-16cm 20095		SE12-B_16-20cm 20096	
Size Classification	**Phi Interval (ϕ)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**
V. Large Pebble	<-5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Large Pebble	-4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Medium Pebble	-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Small Pebble	-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gravel	-1	0.00	0.00	0.00	0.00	0.09	0.09	0.00	0.00	0.24	0.24
Very Coarse Sand	0	0.00	0.00	0.00	0.00	0.06	0.15	0.06	0.06	0.33	0.57
Coarse Sand	1	0.05	0.05	0.04	0.04	0.10	0.24	0.10	0.16	0.24	0.81
Medium Sand	2	0.31	0.36	0.40	0.44	0.72	0.96	0.53	0.69	0.60	1.41
Fine Sand	3	8.03	8.40	6.38	6.82	8.19	9.15	6.64	7.33	6.56	7.97
Very Fine Sand	4	67.56	75.96	66.29	73.11	65.36	74.52	61.09	68.42	60.30	68.28
Coarse Silt	5	7.88	83.83	8.76	81.87	8.87	83.39	8.71	77.14	9.18	77.45
Medium Silt	6	3.25	87.08	3.41	85.27	3.20	86.58	4.50	81.63	4.46	81.92
Fine Silt	7	2.18	89.26	2.61	87.88	2.53	89.12	3.25	84.88	3.63	85.55
V. Fine Silt	8	1.21	90.47	1.60	89.48	1.55	90.67	2.23	87.12	2.39	87.93
Clay	9	0.86	91.32	1.07	90.55	1.31	91.98	1.70	88.82	1.73	89.66
Clay	10	0.85	92.17	1.05	91.60	1.14	93.12	1.32	90.13	1.51	91.17
Clay	>10	7.83	100.00	8.40	100.00	6.88	100.00	9.87	100.00	8.83	100.00
Total Organic Carbon, (%)		0.44		0.55		0.58		0.89		0.80	
Wet Bulk Density (g/cm^3)		1.75		1.81		1.88		1.77		1.78	
Dry Bulk Density (g/cm^3)		1.14		1.25		1.39		1.21		1.22	
Water Content, (%)		53		45		35		47		46	
Salt Corrected-Wet Bulk Density (g/cm^3)		1.73		1.79		1.86		1.75		1.76	
Salt Corrected-Dry Bulk Density (g/cm^3)		1.12		1.23		1.37		1.19		1.20	
Salt Corrected-Water Content, (%)		56		48		37		49		48	
Aggregate Sediment Analysis	**Sieve #**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**
	18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	35	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	60	0.25	0.74	0.63	0.63	1.14	1.14	1.43	1.43	3.44	3.44
	120	7.65	8.40	8.95	9.59	7.00	8.14	8.40	9.83	8.25	11.68
	170	44.18	52.57	37.30	46.88	41.84	49.98	34.56	44.39	32.19	43.87
	230	28.25	80.83	28.62	75.51	31.86	81.84	26.63	71.02	26.23	70.10
	325	7.49	88.31	6.42	81.92	8.23	90.06	9.55	80.56	7.45	77.55
	635	6.29	94.60	5.43	87.35	5.25	95.32	8.02	88.58	6.30	83.85
	Passing #635	5.40	100.00	12.65	100.00	4.68	100.00	11.42	100.00	16.15	100.00

Appendix C. SE21-I.

SAIC Sample ID: **AMS Sample ID:**		**SE21-I_0-4cm** **20097**		**SE21-I_4-8cm** **20098**		**SE21-I_8-12cm** **20099**		**SE21-I_12-16cm** **20100**		**SE21-I_16-20cm** **20101**	
Size Classification	**Phi Interval (ϕ)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**
V. Large Pebble	<-5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Large Pebble	-4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Medium Pebble	-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Small Pebble	-2	0.00	0.00	0.00	0.00	0.56	0.56	0.25	0.25	6.23	6.23
Gravel	-1	0.00	0.00	0.17	0.17	0.86	1.42	0.43	0.68	1.78	8.01
Very Coarse Sand	0	0.00	0.00	0.08	0.25	0.46	1.88	0.41	1.09	1.25	9.26
Coarse Sand	1	0.07	0.07	0.15	0.40	0.34	2.22	0.26	1.35	0.73	9.99
Medium Sand	2	0.38	0.45	0.40	0.80	1.30	3.52	0.46	1.80	0.70	10.68
Fine Sand	3	6.23	6.68	6.53	7.33	7.64	11.16	6.43	8.23	5.65	16.33
Very Fine Sand	4	68.41	75.09	66.96	74.29	61.17	72.33	59.38	67.61	56.29	72.62
Coarse Silt	5	8.18	83.27	8.08	82.37	7.43	79.76	9.23	76.84	8.35	80.97
Medium Silt	6	2.91	86.18	2.85	85.22	3.31	83.06	4.52	81.36	4.24	85.21
Fine Silt	7	2.42	88.60	2.69	87.90	3.15	86.21	5.75	87.11	2.98	88.19
V. Fine Silt	8	1.39	90.00	1.52	89.43	1.90	88.11	0.16	87.27	2.03	90.22
Clay	9	1.02	91.02	1.14	90.57	1.47	89.58	1.94	89.20	1.13	91.35
Clay	10	0.84	91.85	0.99	91.56	1.38	90.95	1.73	90.93	1.03	92.38
Clay	>10	8.15	100.00	8.44	100.00	9.05	100.00	9.07	100.00	7.62	100.00
Total Organic Carbon, (%)		0.60		0.53		0.76		0.57		0.91	
Wet Bulk Density (g/cm^3)		1.77		1.86		1.83		1.85		1.85	
Dry Bulk Density (g/cm^3)		1.19		1.33		1.29		1.34		1.33	
Water Content, (%)		49		40		41		39		40	
Salt Corrected-Wet Bulk Density (g/cm^3)		1.75		1.84		1.81		1.84		1.84	
Salt Corrected-Dry Bulk Density (g/cm^3)		1.17		1.31		1.27		1.32		1.31	
Salt Corrected-Water Content, (%)		51		42		44		41		42	
Aggregate Sediment Analysis	**Sieve #**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**
	18	0.00	0.00	0.00	0.00	1.56	1.56	0.66	0.66	9.04	9.04
	35	0.76	0.76	0.16	0.16	0.07	1.63	1.68	2.35	8.25	17.29
	60	0.92	1.68	0.82	0.99	0.07	1.69	0.20	2.55	0.05	17.33
	120	9.03	10.71	7.95	8.93	8.00	9.69	6.12	8.68	4.47	21.81
	170	36.40	47.12	42.48	51.41	35.49	45.18	38.94	47.61	26.47	48.28
	230	27.64	74.76	28.89	80.30	25.03	70.20	17.71	65.32	22.83	71.11
	325	6.76	81.52	6.30	86.60	6.83	77.03	5.41	70.73	20.97	92.08
	635	5.68	87.20	4.82	91.43	6.83	83.85	0.82	71.54	5.96	98.04
	Passing #635	12.80	100.00	8.57	100.00	16.15	100.00	28.45	100.00	1.96	100.00

Appendix C. Core L10_SE47-E.

SAIC Sample ID: AMS Sample ID:			L10_SE47-E_0-4cm 20077		L10_SE47-E_4-8cm 20078		L10_SE47-E_8-12cm 20079		L10_SE47-E_12-16cm 20080		L10_SE47-E_16-20cm 20081	
Size	Classification	Phi Interval (ϕ)	Frequency Weight (%)	Cumulative Weight (%)	Frequency Weight (%)	Cumulative Weight (%)	Frequency Weight (%)	Cumulative Weight (%)	Frequency Weight (%)	Cumulative Weight (%)	Frequency Weight (%)	Cumulative Weight (%)
V. Large Pebble		<-5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Large Pebble		-4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.06	1.06
Medium Pebble		-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.06
Small Pebble		-2	0.00	0.00	0.14	0.14	0.00	0.00	0.00	0.00	0.00	1.06
Gravel		-1	0.00	0.00	0.29	0.43	3.79	3.79	0.33	0.33	0.60	1.66
Very Coarse Sand		0	0.07	0.07	0.37	0.80	2.55	6.34	0.32	0.65	0.24	1.90
Coarse Sand		1	0.15	0.22	0.33	1.13	1.45	7.78	0.24	0.89	0.22	2.12
Medium Sand		2	0.59	0.81	0.87	1.99	1.10	8.88	0.45	1.33	0.35	2.47
Fine Sand		3	11.28	12.09	11.54	13.54	10.45	19.34	8.04	9.37	5.03	7.50
Very Fine Sand		4	69.43	81.52	60.48	74.02	49.32	68.65	48.43	57.80	32.73	40.22
Coarse Silt		5	7.94	89.46	11.31	85.33	11.91	80.56	15.36	73.16	20.29	60.52
Medium Silt		6	1.97	91.44	3.49	88.82	4.66	85.22	7.65	80.81	13.85	74.37
Fine Silt		7	1.21	92.65	2.07	90.89	2.65	87.87	4.90	85.71	8.95	83.32
V. Fine Silt		8	1.00	93.65	1.30	92.19	2.44	90.31	3.12	88.83	5.43	88.74
Clay		9	0.74	94.39	1.15	93.34	1.49	91.80	2.32	91.15	3.62	92.37
Clay		10	1.07	95.46	1.42	94.76	1.45	93.25	1.98	93.13	2.72	95.09
Clay		>10	4.54	100.00	5.24	100.00	6.75	100.00	6.87	100.00	4.91	100.00
Total Organic Carbon, (%)			0.51		0.44		0.90		0.51		0.39	
Wet Bulk Density (g/cm^3)			1.78		1.87		1.88		1.87		1.82	
Dry Bulk Density (g/cm^3)			1.21		1.41		1.37		1.35		1.26	
Water Content, (%)			47		33		37		38		44	
Salt Corrected-Wet Bulk Density (g/cm^3)			1.76		1.85		1.86		1.85		1.79	
Salt Corrected-Dry Bulk Density (g/cm^3)			1.19		1.39		1.35		1.34		1.24	
Salt Corrected-Water Content, (%)			50		34		39		40		47	
Aggregate Sediment Analysis		**Sieve #**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**
		18	0.00	0.00	0.00	0.00	3.17	3.17	0.00	0.00	0.00	0.00
		35	0.00	0.00	1.33	1.33	0.48	3.65	2.29	2.29	0.00	0.00
		60	0.69	0.69	1.08	2.41	0.04	3.69	0.65	2.95	0.00	0.00
		120	12.72	13.41	10.47	12.89	10.36	14.05	7.70	10.64	4.35	4.35
		170	36.20	49.62	24.19	37.07	31.92	45.98	19.81	30.45	6.52	10.87
		230	31.55	81.17	25.52	62.60	25.22	71.19	26.44	56.89	8.30	19.17
		325	9.66	90.83	11.24	73.83	7.99	79.18	11.21	68.11	13.83	33.00
		635	5.70	96.52	9.71	83.54	7.83	87.01	14.24	82.35	47.63	80.63
		Passing #635	3.48	100.00	16.45	100.00	12.98	100.00	17.65	100.00	19.37	100.00

Appendix C. Core OUT7-A.

SAIC Sample ID: AMS Sample ID:		OUT7-A_0-4cm 20072		OUT7-A_4-8cm 20073		OUT7-A_8-12cm 20074		OUT7-A_12-16cm 20075		OUT7-A_16-20cm 20076	
Size Classification	**Phi Interval (φ)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**
V. Large Pebble	<-5	0.00	0.00	1.15	1.15	0.00	0.00	0.00	0.00	0.00	0.00
Large Pebble	-4	0.00	0.00	0.00	1.15	0.00	0.00	0.00	0.00	0.00	0.00
Medium Pebble	-3	0.00	0.00	0.00	1.15	0.00	0.00	0.00	0.00	0.00	0.00
Small Pebble	-2	0.00	0.00	0.00	1.15	0.00	0.00	0.00	0.00	0.00	0.00
Gravel	-1	0.00	0.00	0.40	1.55	0.00	0.00	0.00	0.00	0.02	0.02
Very Coarse Sand	0	0.02	0.02	0.06	1.61	0.05	0.05	0.04	0.04	0.23	0.25
Coarse Sand	1	0.59	0.61	0.72	2.33	0.72	0.77	0.50	0.55	1.20	1.45
Medium Sand	2	3.26	3.87	3.56	5.88	4.03	4.81	3.47	4.02	5.02	6.47
Fine Sand	3	8.88	12.75	11.32	17.21	12.61	17.42	14.78	18.80	10.15	16.62
Very Fine Sand	4	54.69	67.44	52.34	69.55	51.83	69.24	48.07	66.87	48.71	65.33
Coarse Silt	5	14.86	82.30	13.27	82.82	12.92	82.16	13.28	80.15	13.50	78.83
Medium Silt	6	4.39	86.70	4.11	86.94	4.20	86.37	4.71	84.86	4.97	83.80
Fine Silt	7	1.99	88.69	2.28	89.22	2.57	88.94	2.80	87.66	1.78	85.58
V. Fine Silt	8	1.82	90.50	1.68	90.90	1.89	90.83	1.99	89.64	3.14	88.72
Clay	9	1.15	91.66	1.26	92.17	1.32	92.15	1.49	91.13	1.52	90.24
Clay	10	1.56	93.22	1.61	93.78	1.54	93.69	1.65	92.78	1.69	91.93
Clay	>10	6.78	100.00	6.22	100.00	6.31	100.00	7.22	100.00	8.07	100.00
Total Organic Carbon, (%)		0.71		0.78		0.79		0.81		0.90	
Wet Bulk Density (g/cm^3)		1.68		1.78		1.78		1.74		1.75	
Dry Bulk Density (g/cm^3)		1.07		1.22		1.23		1.17		1.18	
Water Content, (%)		57		46		45		48		49	
Salt Corrected-Wet Bulk Density (g/cm^3)		1.66		1.76		1.76		1.72		1.73	
Salt Corrected-Dry Bulk Density (g/cm^3)		1.05		1.20		1.21		1.15		1.15	
Salt Corrected-Water Content, (%)		61		48		47		51		52	
Aggregate Sediment Analysis	**Sieve #**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**
	18	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0.6406	0.64
	35	0.00	0.00	0.3607	0.36	1.13	1.128	1.08	1.08	2.456	3.10
	60	1.07	1.07	3.547	3.91	4.61	5.741	4.56	5.63	6.299	9.40
	120	7.67	8.74	9.559	13.47	9.64	15.38	8.03	13.66	10.78	20.18
	170	25.16	33.90	22.9	36.37	23.88	39.26	28.17	41.84	33.74	53.92
	230	36.57	70.47	31.44	67.81	35.26	74.53	33.33	75.16	24.56	78.47
	325	13.56	84.03	13.71	81.52	12.51	87.03	11.03	86.19	9.823	88.30
	635	10.35	94.38	10.58	92.10	9.43	96.46	9.35	95.54	10.57	98.87
	Passing #635	5.62	100.00	7.899	100.00	3.54	100	4.46	100.00	1.132	100.00

Appendix C. Core OUT27-D.

SAIC Sample ID: AMS Sample ID:		OUT27-D_0-4cm 20082		OUT27-D_4-8cm 20083		OUT27-D_8-12cm 20084		OUT27-D_12-16cm 20085		OUT27-D_16-20cm 20086	
Size Classification	**Phi Interval (ϕ)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**
V. Large Pebble	<-5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Large Pebble	-4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Medium Pebble	-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Small Pebble	-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gravel	-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Very Coarse Sand	0	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.02	0.02
Coarse Sand	1	0.13	0.13	0.10	0.10	0.04	0.04	0.13	0.16	0.11	0.12
Medium Sand	2	0.38	0.52	0.77	0.87	0.44	0.48	0.30	0.47	0.86	0.99
Fine Sand	3	4.91	5.43	7.68	8.55	6.20	6.68	6.22	6.68	5.76	6.74
Very Fine Sand	4	55.52	60.95	57.61	66.16	64.23	70.91	56.75	63.43	53.87	60.61
Coarse Silt	5	24.82	85.77	22.56	88.72	18.52	89.43	22.80	86.23	21.06	81.67
Medium Silt	6	5.52	91.28	4.34	93.06	3.94	93.37	5.12	91.35	6.24	87.91
Fine Silt	7	2.50	93.78	1.89	94.95	1.93	95.30	2.55	93.89	3.37	91.28
V. Fine Silt	8	1.62	95.40	1.36	96.32	1.38	96.68	1.82	95.71	2.14	93.42
Clay	9	1.18	96.59	1.03	97.35	0.92	97.60	1.25	96.96	1.60	95.01
Clay	10	1.47	98.06	1.17	98.52	1.23	98.83	1.31	98.27	1.62	96.63
Clay	>10	1.94	100.00	1.48	100.00	1.17	100.00	1.73	100.00	3.37	100.00
Total Organic Carbon, (%)		0.68		0.69		1.09		0.72		0.93	
Wet Bulk Density (g/cm^3)		1.71		1.75		1.79		1.74		1.78	
Dry Bulk Density (g/cm^3)		1.12		1.18		1.28		1.18		1.24	
Water Content, (%)		52		48		40		48		43	
Salt Corrected-Wet Bulk Density (g/cm^3)		1.69		1.73		1.77		1.72		1.76	
Salt Corrected-Dry Bulk Density (g/cm^3)		1.10		1.16		1.26		1.16		1.22	
Salt Corrected-Water Content, (%)		55		51		42		51		45	
Aggregate Sediment Analysis	**Sieve #**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**
	18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	35	0.00	0.00	0.39	0.39	0.00	0.00	0.00	0.00	0.00	0.00
	60	0.72	0.72	0.59	0.98	0.10	0.10	0.00	0.00	0.41	0.41
	120	1.45	2.17	2.88	3.86	2.70	2.81	4.14	4.14	4.34	4.75
	170	14.10	16.27	19.94	23.80	19.39	22.19	14.98	19.12	20.54	25.30
	230	32.54	48.81	37.92	61.72	40.87	63.06	41.78	60.90	42.67	67.96
	325	17.72	66.52	17.91	79.63	18.67	81.73	20.10	81.00	18.25	86.22
	635	9.76	76.28	8.70	88.33	10.97	92.70	13.40	94.40	11.39	97.60
	Passing #635	23.72	100.00	11.67	100.00	7.30	100.00	5.60	100.00	2.40	100.00

Appendix C. Core OUT29-B.

SAIC Sample ID: AMS Sample ID:		OUT29-B_0-4cm 20087		OUT29-B_4-8cm 20088		OUT29-B_8-12cm 20089		OUT29-B_12-16cm 20090		OUT29-B_16-20cm 20091	
Size Classification	**Phi Interval (ϕ)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**
V. Large Pebble	<-5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Large Pebble	-4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Medium Pebble	-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Small Pebble	-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gravel	-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Very Coarse Sand	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coarse Sand	1	0.05	0.05	0.03	0.03	0.06	0.06	0.07	0.07	0.05	0.05
Medium Sand	2	0.14	0.18	0.17	0.20	0.22	0.28	0.20	0.27	0.46	0.51
Fine Sand	3	7.59	7.77	4.19	4.39	5.17	5.45	4.27	4.54	5.13	5.64
Very Fine Sand	4	70.68	78.45	71.74	76.13	77.07	82.52	74.14	78.67	67.08	72.72
Coarse Silt	5	12.31	90.76	13.46	89.59	10.49	93.01	11.86	90.53	10.87	83.59
Medium Silt	6	3.35	94.11	3.98	93.56	2.64	95.65	3.49	94.02	3.16	86.75
Fine Silt	7	1.42	95.53	2.05	95.61	1.12	96.77	1.67	95.69	2.09	88.85
V. Fine Silt	8	1.21	96.74	1.40	97.01	1.15	97.92	1.57	97.26	1.48	90.33
Clay	9	0.97	97.71	1.18	98.20	0.80	98.72	0.90	98.16	1.06	91.39
Clay	10	0.95	98.66	1.06	99.25	0.85	99.57	1.00	99.16	0.94	92.32
Clay	>10	1.34	100.00	0.75	100.00	0.43	100.00	0.84	100.00	7.67	100.00
Total Organic Carbon, (%)		0.65		0.71		0.54		0.61		0.70	
Wet Bulk Density (g/cm^3)		1.81		1.81		1.84		1.83		1.87	
Dry Bulk Density (g/cm^3)		1.29		1.31		1.36		1.36		1.40	
Water Content, (%)		40		38		35		34		34	
Salt Corrected-Wet Bulk Density (g/cm^3)		1.79		1.79		1.82		1.81		1.85	
Salt Corrected-Dry Bulk Density (g/cm^3)		1.27		1.30		1.34		1.34		1.38	
Salt Corrected-Water Content, (%)		43		39		37		36		35	
Aggregate Sediment Analysis	**Sieve #**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**
	18	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00
	35	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00
	60	0.1604	0.16	0.06	0.0646	0.07828	0.08	0.27	0.2745	1.575	1.58
	120	3.61	3.77	4.78	4.845	4.932	5.01	5.86	6.13	4.223	5.80
	170	33.53	37.30	37.53	42.38	36.87	41.88	50.14	56.27	36.51	42.30
	230	33.53	70.84	37.34	79.72	40.55	82.43	28.82	85.09	34.43	76.74
	325	8.424	79.26	10.53	90.24	9.786	92.22	7.69	92.77	8.59	85.32
	635	7.782	87.04	6.46	96.7	5.088	97.31	5.67	98.44	7.23	92.56
	Passing #635	12.96	100.00	3.29	100	2.693	100.00	1.56	100	7.444	100.00

Appendix C. Core R_OUT31-H.

SAIC Sample ID: AMS Sample ID:		R_OUT31-H_0-4cm 20025		R_OUT31-H_4-8cm 20026		R_OUT31-H_8-12cm 20027		R_OUT31-H_12-16cm 20028		R_OUT31-H_16-20cm 20029		R_OUT31-H_4-8cm_dup 20030	
Size Classification	**Phi Interval (ϕ)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**
V. Large Pebble	<-5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Large Pebble	-4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Medium Pebble	-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Small Pebble	-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gravel	-1	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Very Coarse Sand	0	0.00	0.04	0.04	0.04	0.26	0.26	0.19	0.19	0.10	0.10	0.06	0.06
Coarse Sand	1	0.04	0.08	0.29	0.33	0.96	1.21	1.15	1.34	0.46	0.56	0.14	0.21
Medium Sand	2	0.35	0.42	1.93	2.25	4.79	6.00	2.04	3.37	2.70	3.26	1.41	1.61
Fine Sand	3	1.89	2.31	4.98	7.24	7.66	13.66	2.42	5.80	4.54	7.81	4.97	6.58
Very Fine Sand	4	38.01	40.33	33.26	40.50	15.77	29.43	7.12	12.91	13.84	21.64	32.06	38.63
Coarse Silt	5	34.51	74.83	28.10	68.59	19.77	49.20	15.46	28.37	21.03	42.67	27.13	65.76
Medium Silt	6	7.81	82.64	8.57	77.17	11.33	60.54	15.98	44.35	13.06	55.73	9.06	74.83
Fine Silt	7	3.17	85.81	4.63	81.80	8.71	69.24	14.79	59.15	11.05	66.78	5.36	80.18
V. Fine Silt	8	2.32	88.13	3.12	84.91	6.78	76.02	9.09	68.24	7.54	74.32	3.61	83.79
Clay	9	1.72	89.85	2.53	87.44	5.01	81.02	7.49	75.73	5.73	80.06	2.65	86.44
Clay	10	2.42	92.28	3.17	90.62	5.37	86.39	7.31	83.03	5.55	85.60	3.61	90.05
Clay	>10	7.73	100.00	9.38	100.00	13.61	100.00	16.97	100.00	14.39	100.00	9.95	100.00
Total Organic Carbon, (%)		1.09		1.73		6.68		7.58		7.21		1.98	
Wet Bulk Density (g/cm^3)		1.61		1.60		1.40		1.30		1.40		1.60	
Dry Bulk Density (g/cm^3)		1.01		0.97		0.69		0.55		0.69		0.95	
Water Content, (%)		60		66		104		139		102		68	
Salt Corrected-Wet Bulk Density (g/cm^3)		1.59		1.58		1.37		1.27		1.38		1.58	
Salt Corrected-Dry Bulk Density (g/cm^3)		0.99		0.94		0.66		0.52		0.67		0.93	
Salt Corrected-Water Content, (%)		64		70		112		152		110		72	
Aggregate Sediment Analysis	**Sieve #**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**
	18.00	0.00	0.00	0.00	0.00	0.62	0.62	0.53	0.53	0.44	0.44	2.68	2.68
	35	0	0	1.74	1.74	1.692	2.308	1.939	2.467	3.506	3.944	2.45	5.134
	60.00	1.00	1.00	1.37	3.11	7.39	9.69	12.16	14.63	8.62	12.56	3.62	8.75
	120	1.289	2.291	1.491	4.598	11.69	21.38	11.46	26.08	9.787	22.35	3.967	12.72
	170.00	8.16	10.45	6.71	11.31	8.00	29.38	9.87	35.95	9.35	31.70	9.45	22.17
	230	33.79	44.24	27.09	38.4	19.54	48.92	14.1	50.05	16.21	47.91	27.07	49.24
	325.00	20.90	65.15	22.00	60.40	17.69	66.61	13.22	63.27	16.36	64.27	20.30	69.54
	635	13.89	79.04	14.54	74.94	15.08	81.69	18.33	81.6	21.18	85.45	13.65	83.2
	Passing #635	20.96	100.00	25.06	100.00	18.31	100.00	18.40	100.00	14.55	100.00	16.80	100.00

Appendix C. OUT40

SAIC Sample ID: AMS Sample ID:		OUT_40_0-4cm 20107		OUT_40_4-8cm 20108		OUT_40_8-12cm 20109		OUT_40_12-16cm 20110		OUT_40_16-20cm 20111	
Size Classification	Phi Interval (ϕ)	Frequency Weight (%)	Cumulative Weight (%)	Frequency Weight (%)	Cumulative Weight (%)	Frequency Weight (%)	Cumulative Weight (%)	Frequency Weight (%)	Cumulative Weight (%)	Frequency Weight (%)	Cumulative Weight (%)
V. Large Pebble	<-5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Large Pebble	-4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Medium Pebble	-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Small Pebble	-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gravel	-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Very Coarse Sand	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.06
Coarse Sand	1	0.02	0.02	0.03	0.03	0.04	0.04	0.04	0.04	0.13	0.19
Medium Sand	2	0.32	0.35	0.14	0.17	0.28	0.33	0.31	0.34	0.45	0.64
Fine Sand	3	4.16	4.51	3.87	4.04	3.49	3.82	5.12	5.46	3.90	4.54
Very Fine Sand	4	57.27	61.78	54.39	58.43	53.59	57.40	48.22	53.67	51.37	55.91
Coarse Silt	5	16.53	78.31	17.95	76.38	17.75	75.15	18.38	72.05	17.59	73.50
Medium Silt	6	5.01	83.32	5.61	81.99	5.24	80.39	6.51	78.56	6.52	80.02
Fine Silt	7	2.98	86.30	3.58	85.56	3.91	84.29	4.42	82.98	3.20	83.23
V. Fine Silt	8	1.73	88.03	2.19	87.75	2.32	86.61	2.88	85.86	2.58	85.81
Clay	9	1.22	89.24	1.27	89.02	1.52	88.13	1.88	87.75	1.98	87.79
Clay	10	1.26	90.51	1.54	90.56	1.74	89.87	2.03	89.78	1.46	89.25
Clay	>10	9.49	100.00	9.44	100.00	10.13	100.00	10.22	100.00	10.74	100.00
Total Organic Carbon, (%)		0.65		0.75		0.98		0.90		1.20	
Wet Bulk Density (g/cm^3)		1.72		1.75		1.80		1.76		1.78	
Dry Bulk Density (g/cm^3)		1.13		1.18		1.27		1.20		1.22	
Water Content, (%)		52		48		42		47		46	
Salt Corrected-Wet Bulk Density (g/cm^3)		1.70		1.73		1.78		1.74		1.76	
Salt Corrected-Dry Bulk Density (g/cm^3)		1.11		1.16		1.25		1.18		1.20	
Salt Corrected-Water Content, (%)		55		51		44		49		48	
Aggregate Sediment Analysis	Sieve #	Frequency Weight (%)	Cumulative Weight (%)	Frequency Weight (%)	Cumulative Weight (%)	Frequency Weight (%)	Cumulative Weight (%)	Frequency Weight (%)	Cumulative Weight (%)	Frequency Weight (%)	Cumulative Weight (%)
	18	0.93	0.93	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.20
	35	0.00	0.93	0.00	0.00	0.00	0.00	0.10	0.10	0.20	0.40
	60	0.34	1.26	0.25	0.25	0.51	0.51	0.86	0.95	0.15	0.54
	120	4.63	5.90	3.46	3.71	4.82	5.33	2.82	3.77	3.11	3.66
	170	29.65	35.55	27.16	30.87	29.70	35.02	15.43	19.20	25.04	28.70
	230	36.14	71.69	33.28	64.15	36.80	71.83	20.56	39.75	33.79	62.49
	325	15.00	86.69	14.10	78.26	15.74	87.56	9.53	49.29	14.18	76.66
	635	9.35	96.04	10.46	88.72	12.44	100.00	8.27	57.55	11.06	87.73
	Passing #635	3.96	100.00	11.28	100.00	0.00	100.00	42.44	100.00	12.27	100.00

Appendix C. Core R_OUT49-I.

SAIC Sample ID: AMS Sample ID:		R_OUT_49-I_0-4cm 20048		R_OUT_49-I_4-8cm 20049		R_OUT_49-I_8-12cm 20050		R_OUT_49-I_12-16cm 20051		R_OUT_49-I_16-20cm 20052	
Size Classification	**Phi Interval (ϕ)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**
V. Large Pebble	<-5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Large Pebble	-4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Medium Pebble	-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Small Pebble	-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gravel	-1	0.00	0.00	0.00	0.00	0.10	0.10	0.12	0.12	0.02	0.02
Very Coarse Sand	0	0.02	0.02	0.11	0.11	0.09	0.20	0.07	0.19	0.07	0.09
Coarse Sand	1	0.09	0.12	0.22	0.33	0.17	0.37	0.07	0.26	0.15	0.23
Medium Sand	2	0.46	0.58	2.17	2.50	0.79	1.15	0.20	0.46	0.42	0.65
Fine Sand	3	8.79	9.37	8.55	11.04	8.20	9.35	4.92	5.37	5.83	6.48
Very Fine Sand	4	63.79	73.16	50.08	61.12	56.08	65.43	58.36	63.73	57.13	63.61
Coarse Silt	5	11.60	84.77	12.36	73.48	13.33	78.76	13.83	77.56	14.22	77.83
Medium Silt	6	3.35	88.11	5.51	79.00	5.23	84.00	5.90	83.46	6.65	84.48
Fine Silt	7	2.24	90.36	4.22	83.22	3.41	87.41	3.78	87.24	3.58	88.06
V. Fine Silt	8	1.52	91.87	3.15	86.37	2.47	89.88	2.47	89.70	2.28	90.33
Clay	9	1.17	93.05	2.48	88.85	1.65	91.53	1.71	91.41	1.49	91.82
Clay	10	0.90	93.95	2.07	90.92	1.54	93.07	1.67	93.09	1.41	93.22
Clay	>10	6.05	100.00	9.08	100.00	6.93	100.00	6.91	100.00	6.78	100.00
Total Organic Carbon, (%)		0.62		1.64		0.79		0.69		0.48	
Wet Bulk Density (g/cm^3)		1.79		1.68		1.79		1.82		1.86	
Dry Bulk Density (g/cm^3)		1.25		1.08		1.24		1.30		1.36	
Water Content, (%)		44		56		44		40		37	
Salt Corrected-Wet Bulk Density (g/cm^3)		1.77		1.66		1.77		1.80		1.84	
Salt Corrected-Dry Bulk Density (g/cm^3)		1.23		1.06		1.22		1.28		1.34	
Salt Corrected-Water Content, (%)		46		59		47		42		39	
Aggregate Sediment Analysis	**Sieve #**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**
	18.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	35.00	0.24	0.24	0.00	0.00	0.00	0.00	1.40	1.40	0.00	0.00
	60.00	1.07	1.31	2.55	2.55	0.58	0.58	1.68	3.09	1.23	1.23
	120.00	4.16	5.46	4.72	7.27	2.33	2.91	3.44	6.52	3.78	5.01
	170.00	36.10	41.57	24.44	31.72	27.25	30.16	27.43	33.96	26.48	31.49
	230.00	39.55	81.12	36.59	68.31	42.74	72.91	37.60	71.56	39.16	70.65
	325.00	7.48	88.60	12.07	80.38	13.98	86.88	12.42	83.98	13.19	83.84
	635.00	3.09	91.69	10.05	90.43	9.20	96.09	9.96	93.94	10.33	94.17
	Passing #635	8.31	100.00	9.57	100.00	3.91	100.00	6.06	100.00	5.83	100.00

Appendix C. Core D_NW7-E.

SAIC Sample ID: AMS Sample ID:		**D_NW_7_E_0-4cm 20117**		**D_NW_7_E_4-8cm 20118**		**D_NW_7_E_8-12cm 20119**		**D_NW_7_E_12-16cm 20120**		**D_NW_7_E_16-20cm 20121**	
Size Classification	**Phi Interval (ϕ)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**
V. Large Pebble	<-5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Large Pebble	-4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Medium Pebble	-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Small Pebble	-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gravel	-1	0.08	0.08	0.23	0.23	0.21	0.21	0.24	0.24	0.53	0.53
Very Coarse Sand	0	0.35	0.43	0.55	0.77	0.78	0.99	0.62	0.86	0.36	0.90
Coarse Sand	1	2.54	2.97	2.61	3.38	2.92	3.91	2.99	3.85	3.29	4.18
Medium Sand	2	8.44	11.41	7.76	11.14	8.58	12.49	10.37	14.21	10.18	14.36
Fine Sand	3	14.86	26.28	14.90	26.03	15.06	27.55	15.38	29.60	14.61	28.97
Very Fine Sand	4	22.77	49.05	22.44	48.47	23.99	51.54	20.62	50.21	20.63	49.60
Coarse Silt	5	14.17	63.22	13.86	62.33	14.20	65.74	12.08	62.29	12.26	61.86
Medium Silt	6	8.50	71.72	8.52	70.86	7.81	73.55	7.80	70.09	7.77	69.63
Fine Silt	7	5.39	77.11	5.79	76.65	5.06	78.61	6.11	76.20	5.51	75.14
V. Fine Silt	8	4.26	81.37	3.99	80.63	3.56	82.17	4.05	80.25	4.40	79.54
Clay	9	2.76	84.13	2.65	83.28	2.53	84.70	3.03	83.28	3.36	82.90
Clay	10	1.68	85.81	1.60	84.89	1.79	86.49	2.21	85.48	2.28	85.18
Clay	>10	14.19	100.00	15.11	100.00	13.51	100.00	14.52	100.00	14.82	100.00
Total Organic Carbon, (%)		1.31		1.59		1.48		1.77		1.94	
Wet Bulk Density (g/cm^3)		1.64		1.63		1.70		1.69		1.68	
Dry Bulk Density (g/cm^3)		1.01		1.00		1.10		1.08		1.06	
Water Content, (%)		63		63		55		56		58	
Salt Corrected-Wet Bulk Density (g/cm^3)		1.61		1.60		1.68		1.67		1.65	
Salt Corrected-Dry Bulk Density (g/cm^3)		0.98		0.98		1.08		1.06		1.04	
Salt Corrected-Water Content, (%)		66		67		58		59		61	
Aggregate Sediment Analysis	**Sieve #**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**
	18	0.21	0.21	0.67	0.67	0.78	0.78	0.00	0.00	0.00	0.00
	35	3.69	3.90	2.00	2.67	2.02	2.80	7.15	7.15	4.67	4.67
	60	9.84	13.74	9.27	11.94	9.03	11.83	15.16	22.31	10.18	14.86
	120	16.10	29.83	19.68	31.62	18.84	30.67	21.29	43.60	17.20	32.05
	170	12.30	42.14	7.01	38.63	15.41	46.08	15.84	59.43	15.86	47.91
	230	11.89	54.03	14.01	52.64	13.54	59.63	14.30	73.74	13.02	60.93
	325	8.71	62.74	9.74	62.38	7.63	67.26	7.32	81.06	11.52	72.45
	635	6.25	69.00	16.48	78.86	12.30	79.56	11.58	92.64	13.52	85.98
	Passing #635	31.00	100.00	21.14	100.00	20.44	100.00	7.36	100.00	14.02	100.00

Appendix C. Core R_NW-19D.

SAIC Sample ID: AMS Sample ID:		R_NW19D_0-4cm 20020		R_NW19D_4-8cm 20021		R_NW19D_8-12cm 20022		R_NW19D_12-16cm 20023		R_NW19D_16-20cm 20024	
Size Classification	**Phi Interval (ϕ)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**
V. Large Pebble	<-5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Large Pebble	-4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Medium Pebble	-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Small Pebble	-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gravel	-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.05
Very Coarse Sand	0	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.07	0.16	0.21
Coarse Sand	1	0.03	0.03	0.04	0.04	0.04	0.04	0.10	0.17	0.14	0.34
Medium Sand	2	0.42	0.45	0.24	0.29	0.24	0.28	0.85	1.02	0.73	1.07
Fine Sand	3	2.78	3.22	2.91	3.19	2.71	2.99	3.27	4.29	4.36	5.43
Very Fine Sand	4	25.25	28.48	23.65	26.85	26.14	29.13	26.53	30.82	29.80	35.23
Coarse Silt	5	24.09	52.57	23.77	50.62	22.30	51.43	23.58	54.40	23.21	58.43
Medium Silt	6	13.27	65.84	14.01	64.63	13.41	64.84	11.90	66.30	10.96	69.39
Fine Silt	7	8.70	74.54	8.71	73.34	8.40	73.24	7.75	74.05	6.80	76.19
V. Fine Silt	8	5.51	80.05	5.98	79.32	5.62	78.87	5.35	79.40	5.31	81.50
Clay	9	3.33	83.39	3.71	83.03	4.08	82.95	4.07	83.47	3.80	85.30
Clay	10	3.63	87.01	4.05	87.08	3.87	86.81	4.17	87.64	3.92	89.22
Clay	>10	12.99	100.00	12.92	100.00	13.18	100.00	12.36	100.00	10.78	100.00
Total Organic Carbon, (%)		1.52		1.65		1.64		1.60		1.65	
Wet Bulk Density (g/cm^3)		1.55		1.64		1.59		1.61		1.62	
Dry Bulk Density (g/cm^3)		0.89		1.02		0.98		0.98		1.02	
Water Content, (%)		74.00		61.00		62.00		64.00		59.00	
Salt Corrected-Wet Bulk Density (g/cm^3)		1.53		1.62		1.57		1.58		1.60	
Salt Corrected-Dry Bulk Density (g/cm^3)		0.87		1.00		0.96		0.95		0.99	
Salt Corrected-Water Content, (%)		79.00		64.00		66.00		68.00		63.00	
Aggregate Sediment Analysis	**Sieve #**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**
	18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	35	0.22	0.22	0.00	0.00	0.15	0.15	0.00	0.00	0.55	0.55
	60	1.30	1.52	0.61	0.61	0.15	0.29	0.09	0.09	0.00	0.55
	120	5.15	6.66	2.97	3.58	2.28	2.57	2.25	2.35	3.97	4.52
	170	9.86	16.52	8.59	12.17	10.51	13.08	7.04	9.39	9.05	13.57
	230	22.54	39.06	20.56	32.73	19.84	32.92	18.69	28.08	33.44	47.01
	325	17.71	56.77	19.03	51.76	13.89	46.80	20.94	49.02	25.16	72.17
	635	22.75	79.52	22.71	74.47	20.87	67.67	20.10	69.11	26.26	98.43
	Passing #635	20.48	100.00	25.53	100.00	32.33	100.00	30.88	100.00	1.57	100.00

Appendix C. Core D_NW39-I.

SAIC Sample ID: AMS Sample ID:		D_NW_39_I_0-4cm 20112		D_NW_39_I_4-8cm 20113		D_NW_39_I_8-12cm 20114		D_NW_39_I_12-16cm 20115		D_NW_39_I_16-20cm 20116	
Size Classification	**Phi Interval (ϕ)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**
V. Large Pebble	<-5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Large Pebble	-4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Medium Pebble	-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Small Pebble	-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gravel	-1	0.00	0.00	0.00	0.00	0.03	0.03	0.00	0.00	0.00	0.00
Very Coarse Sand	0	0.07	0.07	0.00	0.00	0.02	0.05	0.02	0.02	0.02	0.02
Coarse Sand	1	0.05	0.12	0.02	0.02	0.10	0.15	0.03	0.05	0.12	0.14
Medium Sand	2	0.13	0.25	0.14	0.16	0.33	0.48	0.26	0.31	0.15	0.29
Fine Sand	3	1.82	2.07	2.88	3.04	3.62	4.10	1.76	2.06	3.07	3.36
Very Fine Sand	4	13.62	15.69	15.12	18.16	11.94	16.04	8.69	10.75	8.29	11.65
Coarse Silt	5	25.86	41.55	24.73	42.89	24.52	40.56	19.82	30.57	21.10	32.76
Medium Silt	6	17.39	58.94	16.01	58.91	15.85	56.41	16.26	46.84	17.60	50.35
Fine Silt	7	9.51	68.46	9.47	68.38	9.71	66.11	11.21	58.05	11.22	61.57
V. Fine Silt	8	5.68	74.14	6.05	74.42	7.01	73.12	8.02	66.07	7.83	69.41
Clay	9	3.54	77.68	3.85	78.27	4.75	77.88	5.82	71.90	5.89	75.29
Clay	10	2.47	80.15	3.04	81.32	3.56	81.44	3.75	75.65	4.38	79.68
Clay	>10	19.85	100.00	18.68	100.00	18.56	100.00	24.35	100.00	20.32	100.00
Total Organic Carbon, (%)		1.46		1.59		1.81		2.31		2.99	
Wet Bulk Density (g/cm^3)		1.47		1.52		1.56		1.52		1.53	
Dry Bulk Density (g/cm^3)		0.77		0.87		0.89		0.83		0.83	
Water Content, (%)		93		76		74		82		85	
Salt Corrected-Wet Bulk Density (g/cm^3)		1.45		1.50		1.53		1.49		1.50	
Salt Corrected-Dry Bulk Density (g/cm^3)		0.74		0.84		0.87		0.81		0.80	
Salt Corrected-Water Content, (%)		48		81		79		88		90	
Aggregate Sediment Analysis	**Sieve #**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**
	18	3.71	3.71	1.69	1.69	0.00	0.00	0.00	0.00	0.00	0.00
	35	1.61	5.32	1.21	2.90	0.00	0.00	0.65	0.65	2.10	2.10
	60	1.11	6.44	1.93	4.83	4.68	4.68	3.07	3.72	5.59	7.69
	120	0.37	6.81	3.86	8.69	3.64	8.31	7.43	11.15	4.55	12.24
	170	4.08	10.89	5.19	13.88	5.37	13.68	8.72	19.87	9.44	21.68
	230	18.56	29.45	14.97	28.86	19.23	32.91	24.07	43.94	22.26	43.94
	325	16.83	46.28	15.82	44.68	19.92	52.83	20.19	64.14	17.48	61.42
	635	27.47	73.75	24.51	69.19	23.73	76.56	30.05	94.18	19.00	80.42
	Passing #635	26.25	100.00	30.81	100.00	23.44	100.00	5.82	100.00	19.58	100.00

Appendix C. L5_NW45-D.

SAIC Sample ID: AMS Sample ID:		L5_NW_45_D_0-4cm 20102		L5_NW_45_D_4-8cm 20103		L5_NW_45_D_8-12cm 20104		L5_NW_45_D_12-16cm 20105		L5_NW_45_D_16-20cm 20106	
Size Classification	**Phi Interval (ϕ)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**
V. Large Pebble	<-5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Large Pebble	-4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Medium Pebble	-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Small Pebble	-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gravel	-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Very Coarse Sand	0	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coarse Sand	1	0.12	0.15	0.03	0.03	0.15	0.15	0.05	0.05	0.00	0.00
Medium Sand	2	0.45	0.59	0.40	0.43	0.82	0.96	0.74	0.79	1.49	1.49
Fine Sand	3	2.23	2.82	2.29	2.73	2.89	3.86	2.17	2.96	3.37	4.86
Very Fine Sand	4	20.36	23.19	20.78	23.51	18.50	22.36	15.24	18.20	19.43	24.29
Coarse Silt	5	28.01	51.20	28.14	51.64	27.14	49.49	26.27	44.47	27.24	51.54
Medium Silt	6	14.05	65.24	13.86	65.50	13.22	62.71	14.00	58.47	12.41	63.94
Fine Silt	7	8.54	73.78	8.36	73.86	8.97	71.68	9.04	67.51	8.58	72.53
V. Fine Silt	8	4.58	78.36	4.74	78.60	5.11	76.79	5.66	73.17	4.57	77.10
Clay	9	2.66	81.02	2.94	81.54	3.28	80.07	3.97	77.15	3.16	80.26
Clay	10	2.23	83.25	2.50	84.04	3.80	83.88	2.64	79.78	3.11	83.37
Clay	>10	16.75	100.00	15.95	100.00	16.12	100.00	20.22	100.00	16.63	100.00
Total Organic Carbon, (%)		1.45		1.66		2.14		1.76		1.87	
Wet Bulk Density (g/cm^3)		1.50		1.53		1.58		1.60		1.57	
Dry Bulk Density (g/cm^3)		0.80		0.86		0.93		0.95		0.90	
Water Content, (%)		88		77		71		69		74	
Salt Corrected-Wet Bulk Density (g/cm^3)		1.48		1.50		1.56		1.57		1.55	
Salt Corrected-Dry Bulk Density (g/cm^3)		0.77		0.84		0.90		0.92		0.88	
Salt Corrected-Water Content, (%)		95		82		75		73		79	
Aggregate Sediment Analysis	**Sieve #**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**
	18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.98	1.98
	35	0.00	0.00	0.13	0.13	0.00	0.00	0.00	0.00	1.04	3.02
	60	2.40	2.40	1.78	1.91	2.51	2.51	2.52	2.52	2.55	5.57
	120	0.92	3.32	1.58	3.49	3.38	5.89	4.37	6.89	5.29	10.85
	170	7.65	10.97	5.39	8.88	6.86	12.75	8.35	15.24	8.40	19.25
	230	22.30	33.27	21.24	30.12	22.02	34.77	23.30	38.54	21.90	41.15
	325	21.84	55.12	20.84	50.96	18.83	53.60	19.02	57.56	18.12	59.27
	635	25.71	80.83	21.30	72.26	24.72	78.33	23.30	80.86	23.88	83.15
	Passing #635	19.17	100.00	27.74	100.00	21.67	100.00	19.14	100.00	16.85	100.00

Appendix C. Core NW46-A.

SAIC Sample ID: AMS Sample ID:		NW46A_0-4cm 20031		NW46A_0-4cm dup 20046		NW46A_4-8cm 20032		NW46A_8-12cm 20033		NW46A_12-16cm 20034		NW46A_16-20cm 20035	
Size Classification	**Phi Interval (ϕ)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**
V. Large Pebble	<-5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Large Pebble	-4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Medium Pebble	-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.98	1.98	0.00	0.00
Small Pebble	-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.36	3.34	1.21	1.21
Gravel	-1	0.00	0.00	0.00	0.00	0.11	0.11	1.18	1.18	2.58	5.93	2.77	3.99
Very Coarse Sand	0	0.48	0.48	0.54	0.54	0.82	0.93	4.12	5.30	9.57	15.49	6.98	10.97
Coarse Sand	1	3.11	3.59	2.90	3.44	4.03	4.97	14.18	19.47	29.01	44.50	27.26	38.23
Medium Sand	2	8.32	11.91	7.24	10.68	8.16	13.12	21.30	40.77	37.90	82.40	40.49	78.72
Fine Sand	3	7.57	19.48	7.57	18.25	4.76	17.89	9.52	50.29	11.82	94.23	13.17	91.90
Very Fine Sand	4	43.92	63.40	34.54	52.79	23.38	41.26	21.02	71.31	2.32	96.54	3.29	95.19
Coarse Silt	5	16.84	80.24	16.89	69.68	37.40	78.66	11.13	82.44	0.94	97.49	1.37	96.56
Medium Silt	6	5.19	85.43	8.30	77.98	3.42	82.08	4.64	87.08	0.38	97.87	0.56	97.12
Fine Silt	7	2.91	88.34	5.25	83.23	6.44	88.53	2.85	89.94	0.33	98.20	0.47	97.59
V. Fine Silt	8	1.81	90.14	3.09	86.32	2.18	90.71	1.84	91.78	0.18	98.38	0.27	97.86
Clay	9	1.24	91.38	2.28	88.60	1.57	92.27	1.01	92.79	0.08	98.46	0.22	98.08
Clay	10	1.46	92.84	2.50	91.10	1.56	93.83	1.61	94.40	0.26	98.72	0.25	98.33
Clay	>10	7.16	100.00	8.90	100.00	6.17	100.00	5.60	100.00	1.28	100.00	1.67	100.00
Total Organic Carbon, (%)		0.87		1.13		1.09		0.68		0.19		0.23	
Wet Bulk Density (g/cm^3)		1.65		1.70		1.74		1.88		1.96		1.86	
Dry Bulk Density (g/cm^3)		1.17		1.11		1.15		1.39		1.59		1.50	
Water Content, (%)		41		53		52		35		23		24	
Salt Corrected-Wet Bulk Density (g/cm^3)		1.63		1.68		1.72		1.86		1.94		1.85	
Salt Corrected-Dry Bulk Density (g/cm^3)		1.15		1.08		1.13		1.38		1.58		1.49	
Salt Corrected-Water Content, (%)		42		56		55		37		24		25	
Aggregate Sediment Analysis	**Sieve #**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**
	18.00	0.00	0.00	0.00	0.00	12.47	12.47	17.33	17.33	20.65	20.65	12.56	12.56
	35.00	5.04	5.04	1.78	1.78	6.54	19.01	10.93	28.26	30.15	50.80	30.91	43.48
	60.00	6.49	11.53	6.50	8.28	10.11	29.12	16.78	45.03	32.16	82.96	41.32	84.80
	120.00	6.72	18.24	5.35	13.63	6.98	36.09	6.29	51.32	11.51	94.46	11.15	95.95
	170.00	15.72	33.97	14.40	28.03	11.51	47.60	6.95	58.28	1.03	95.49	0.13	96.09
	230.00	25.72	59.69	18.73	46.76	17.96	65.56	10.15	68.43	2.57	98.06	0.34	96.42
	325.00	13.21	72.90	10.07	56.83	11.07	76.63	4.64	73.07	0.72	98.78	0.47	96.90
	635.00	10.00	82.90	11.98	68.81	11.86	88.49	5.74	78.81	0.67	99.44	0.47	97.36
	Passing #635	17.10	100.00	31.19	100.00	11.51	100.00	21.19	100.00	0.55	100.00	2.63	100.00

Appendix C. Core NW46-A.

SAIC Sample ID: AMS Sample ID:		NW46A_20-24cm 20036		NW46A_24-28cm 20037		NW46A_28-32cm 20038		NW46A_32-36cm 20039		NW46A_36-40cm 20040	
Size Classification	Phi Interval (ϕ)	Frequency Weight (%)	Cumulative Weight (%)	Frequency Weight (%)	Cumulative Weight (%)	Frequency Weight (%)	Cumulative Weight (%)	Frequency Weight (%)	Cumulative Weight (%)	Frequency Weight (%)	Cumulative Weight (%)
V. Large Pebble	<-5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Large Pebble	-4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Medium Pebble	-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Small Pebble	-2	0.00	0.00	0.00	0.00	0.35	0.35	0.00	0.00	0.31	0.31
Gravel	-1	0.56	0.56	0.32	0.32	0.69	1.04	1.07	1.07	0.79	1.10
Very Coarse Sand	0	4.70	5.27	1.20	1.53	1.57	2.61	0.98	2.05	1.60	2.70
Coarse Sand	1	15.15	20.42	3.75	5.28	3.43	6.04	2.14	4.20	3.90	6.61
Medium Sand	2	19.73	40.15	4.49	9.77	3.52	9.56	2.86	7.05	4.39	11.00
Fine Sand	3	6.66	46.81	4.48	14.25	5.25	14.81	5.64	12.69	5.64	16.64
Very Fine Sand	4	24.78	71.59	46.66	60.91	46.01	60.82	42.92	55.61	39.88	56.51
Coarse Silt	5	11.05	82.64	18.37	79.28	16.80	77.61	17.31	72.92	16.87	73.38
Medium Silt	6	4.45	87.09	5.97	85.25	6.34	83.95	6.99	79.91	6.91	80.30
Fine Silt	7	2.82	89.91	3.35	88.60	3.61	87.56	4.61	84.53	4.08	84.37
V. Fine Silt	8	1.77	91.68	1.88	90.47	2.25	89.81	3.02	87.54	2.95	87.32
Clay	9	1.32	93.00	1.46	91.94	1.52	91.33	2.26	89.81	2.12	89.44
Clay	10	1.39	94.39	1.77	93.70	1.64	92.96	2.05	91.86	2.21	91.66
Clay	>10	5.61	100.00	6.30	100.00	7.04	100.00	8.14	100.00	8.34	100.00
Total Organic Carbon, (%)		0.78		1.05		1.06		1.16		1.30	
Wet Bulk Density (g/cm^3)		1.88		1.83		1.79		1.77		1.74	
Dry Bulk Density (g/cm^3)		1.39		1.32		1.25		1.21		1.19	
Water Content, (%)		35		39		43		47		46	
Salt Corrected-Wet Bulk Density (g/cm^3)		1.86		1.81		1.77		1.75		1.72	
Salt Corrected-Dry Bulk Density (g/cm^3)		1.37		1.30		1.23		1.19		1.17	
Salt Corrected-Water Content, (%)		37		41		46		49		49	
Aggregate Sediment Analysis	Sieve #	Frequency Weight (%)	Cumulative Weight (%)	Frequency Weight (%)	Cumulative Weight (%)	Frequency Weight (%)	Cumulative Weight (%)	Frequency Weight (%)	Cumulative Weight (%)	Frequency Weight (%)	Cumulative Weight (%)
	18.00	6.99	6.99	0.00	0.00	0.00	0.00	1.79	1.79	0.12	0.12
	35.00	15.50	22.49	5.66	5.66	0.00	0.00	0.78	2.57	5.82	5.94
	60.00	17.43	39.92	2.56	8.21	0.00	0.00	2.35	4.92	7.15	13.09
	120.00	7.85	47.77	3.77	11.98	2.70	2.70	3.24	8.16	3.03	16.12
	170.00	12.51	60.28	21.01	32.99	15.89	18.59	15.20	23.37	13.70	29.81
	230.00	20.69	80.97	26.80	59.79	31.92	50.51	29.74	53.11	21.94	51.75
	325.00	6.99	87.95	14.68	74.47	12.06	62.57	10.51	63.62	13.70	65.45
	635.00	6.32	94.27	10.64	85.11	11.21	73.78	11.96	75.58	12.97	78.41
	Passing #635	5.73	100.00	14.89	100.00	26.22	100.00	24.42	100.00	21.58	100.00

Appendix C. Core NW46-A.

SAIC Sample ID: AMS Sample ID:		NW46A_40-44cm 20041		NW46A_44-48cm 20042		NW46A_44-48cm dup 20047		NW46A_48-52cm 20043		NW46A_52-56cm 20044		NW46A_56-60cm 20045	
Size Classification	**Phi Interval (ϕ)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**
V. Large Pebble	<-5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Large Pebble	-4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Medium Pebble	-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Small Pebble	-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.22	0.00	0.00
Gravel	-1	0.14	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.37	0.59	0.41	0.41
Very Coarse Sand	0	1.12	1.26	0.19	0.19	0.44	0.44	0.11	0.11	0.38	0.97	0.10	0.51
Coarse Sand	1	3.35	4.61	0.15	0.34	1.26	1.70	0.35	0.47	0.66	1.63	0.21	0.73
Medium Sand	2	3.43	8.04	0.51	0.84	1.71	3.41	1.07	1.54	1.54	3.17	1.15	1.88
Fine Sand	3	5.76	13.80	4.72	5.56	7.43	10.83	6.14	7.68	5.87	9.04	6.46	8.34
Very Fine Sand	4	42.04	55.84	47.79	53.36	46.09	56.92	44.92	52.60	42.83	51.87	42.57	50.91
Coarse Silt	5	16.69	72.52	17.77	71.12	15.32	72.24	18.31	70.90	17.24	69.11	17.57	68.48
Medium Silt	6	7.23	79.75	7.15	78.27	6.94	79.17	7.08	77.98	7.41	76.52	8.31	76.79
Fine Silt	7	4.42	84.17	4.66	82.93	4.54	83.71	4.87	82.85	5.16	81.68	5.29	82.09
V. Fine Silt	8	3.04	87.21	3.15	86.08	3.08	86.79	3.32	86.17	3.62	85.29	3.50	85.58
Clay	9	2.25	89.46	2.23	88.31	2.34	89.13	2.41	88.58	2.72	88.01	2.89	88.47
Clay	10	2.48	91.95	2.52	90.82	1.92	91.05	2.44	91.02	2.51	90.53	2.55	91.02
Clay	>10	8.05	100.00	9.18	100.00	8.95	100.00	8.98	100.00	9.47	100.00	8.98	100.00
Total Organic Carbon, (%)		1.10		1.33		1.34		1.20		1.98		1.71	
Wet Bulk Density (g/cm^3)		1.73		1.74		1.73		1.72		1.68		1.71	
Dry Bulk Density (g/cm^3)		1.18		1.16		1.16		1.14		1.08		1.12	
Water Content, (%)		47		50		49		51		55		52	
Salt Corrected-Wet Bulk Density (g/cm^3)		1.71		1.72		1.71		1.70		1.66		1.69	
Salt Corrected-Dry Bulk Density (g/cm^3)		1.16		1.14		1.14		1.12		1.06		1.10	
Salt Corrected-Water Content, (%)		50		52		52		54		58		55	
Aggregate Sediment Analysis	**Sieve #**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**
	18.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	35.00	4.20	4.20	0.16	0.16	0.36	0.36	0.86	0.86	0.45	0.45	1.13	1.13
	60.00	2.70	6.90	2.18	2.34	1.51	1.87	0.67	1.53	1.88	2.34	0.00	1.13
	120.00	4.10	11.01	4.51	6.85	3.17	5.04	5.45	6.97	3.77	6.10	2.16	3.29
	170.00	17.31	28.32	18.06	24.91	21.83	26.87	17.00	23.98	20.19	26.30	15.70	18.99
	230.00	25.62	53.93	30.79	55.70	34.94	61.82	31.43	55.41	27.43	53.72	30.18	49.17
	325.00	11.51	65.44	14.75	70.45	15.20	77.02	14.90	70.31	12.13	65.85	12.97	62.15
	635.00	12.31	77.75	13.30	83.75	11.89	88.90	14.14	84.45	11.53	77.38	15.14	77.28
	Passing #635	22.25	100.00	16.25	100.00	11.10	100.00	15.55	100.00	22.62	100.00	22.72	100.00

Appendix C. Core R_NW54-I.

SAIC Sample ID: AMS Sample ID:		R_NW_54-I_0-4cm 20053		R_NW_54-I_4-8cm 20054		R_NW_54-I_8-12cm 20055		R_NW_54-I_12-16cm 20056		R_NW_54-I_16-20cm 20057	
Size Classification	**Phi Interval (ϕ)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**
V. Large Pebble	<-5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Large Pebble	-4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Medium Pebble	-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Small Pebble	-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gravel	-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Very Coarse Sand	0	0.11	0.11	0.04	0.04	0.13	0.13	0.06	0.06	0.11	0.11
Coarse Sand	1	0.17	0.28	0.22	0.26	0.30	0.42	0.64	0.69	0.56	0.67
Medium Sand	2	0.76	1.04	2.31	2.57	3.21	3.63	4.83	5.52	4.25	4.92
Fine Sand	3	4.13	5.17	5.52	8.09	5.62	9.25	5.35	10.87	5.20	10.13
Very Fine Sand	4	27.78	32.95	18.76	26.85	15.68	24.93	12.33	23.20	10.53	20.66
Coarse Silt	5	28.63	61.58	25.97	52.82	24.32	49.25	21.26	44.46	20.58	41.24
Medium Silt	6	11.19	72.77	13.65	66.47	13.72	62.97	14.71	59.18	14.02	55.26
Fine Silt	7	7.17	79.94	7.48	73.95	8.85	71.82	9.41	68.59	9.39	64.66
V. Fine Silt	8	3.60	83.54	5.29	79.24	5.95	77.77	6.88	75.46	7.15	71.81
Clay	9	2.42	85.96	3.70	82.94	4.37	82.14	5.18	80.64	5.79	77.60
Clay	10	2.23	88.18	3.03	85.96	3.57	85.71	4.29	84.93	5.74	83.34
Clay	>10	11.82	100.00	14.03	100.00	14.29	100.00	15.07	100.00	16.65	100.00
Total Organic Carbon, (%)		1.57		2.93		3.14		3.41		4.05	
Wet Bulk Density (g/cm^3)		1.55		1.53		1.51		1.47		1.46	
Dry Bulk Density (g/cm^3)		0.86		0.87		0.83		0.79		0.76	
Water Content, (%)		79		77		83		86		92	
Salt Corrected-Wet Bulk Density (g/cm^3)		1.52		1.51		1.49		1.45		1.44	
Salt Corrected-Dry Bulk Density (g/cm^3)		0.84		0.84		0.80		0.77		0.74	
Salt Corrected-Water Content, (%)		84		82		88		92		99	
Aggregate Sediment Analysis	**Sieve #**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**	**Frequency Weight (%)**	**Cumulative Weight (%)**
	18	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	35	0	0.00	2.15	2.15	0.00	0.00	2.23	2.23	2.95	2.95
	60	1.182	1.18	3.61	5.76	2.27	2.27	4.63	6.87	5.56	8.51
	120	1.497	2.68	3.90	9.66	4.53	6.80	7.04	13.90	11.78	20.29
	170	6.936	9.62	8.59	18.24	6.32	13.11	7.55	21.46	6.22	26.50
	230	28.96	38.58	24.20	42.44	22.89	36.00	16.48	37.93	19.96	46.46
	325	22.97	61.55	20.88	63.32	19.67	55.67	14.25	52.18	20.29	66.75
	635	19.39	80.94	24.78	88.10	22.29	77.97	18.02	70.20	28.47	95.22
	Passing #635	19.06	100.00	11.90	100.00	22.03	100.00	29.80	100.00	4.78	100.00

APPENDIX D

REMOTS® Sediment-Profile Image Analysis

1.0 REMOTS® SEDIMENT-PROFILE IMAGE ANALYSIS

Summaries of the standard REMOTS® measurement parameters presented in this report are presented below.

1.1 Sediment Type Determination

The sediment grain-size major mode and range are estimated visually from the photographs by overlaying a grain size comparator of the same scale. This comparator was prepared by photographing a series of Udden-Wentworth size classes (equal to or less than coarse silt up to granule and larger sizes) through the REMOTS sediment-profile camera. Seven grain size classes are on this comparator: >4 phi, 4 to 3 phi, 3 to 2 phi, 2 to 1 phi, 1 to 0 phi, 0 to –1 phi, and <-1 phi. Table D-1 is provided to allow conversion of phi units to other commonly used grain size scales. The lower limit of optical resolution of the photographic system is about 62 microns (4 phi), allowing recognition of grain sizes equal to or greater than coarse silt. The accuracy of this method has been documented by comparing REMOTS sediment-profile image estimates with grain size statistics determined from laboratory sieve analyses.

The major modal grain size that is assigned to an image is the dominant grain size as estimated by area within the imaged sediment column. In those images that show layering of sand and mud, the dominant major mode assigned to a replicate therefore depends on how much area of the image is represented by sand versus mud. These textural assignments may or may not correspond to traditional sieve analyses depending on how closely the vertical sampling intervals are matched between the grab or core sample and the depth of the imaged sediment. Layering is noted as a comment accompanying the REMOTS sediment-profile image data file.

1.2 Benthic Habitat Classification

Based on extensive past REMOTS sediment-profile survey experience in coastal New England, five basic benthic habitat types have been found to exist in shallow-water estuarine and open-water near shore environments: AM = Ampelisca mat, SH = shell bed, SA = hard sand bottom, HR = hard rock/gravel bottom, and UN = unconsolidated soft bottom (Table D-2). Several sub-habitat types exist within these major categories (Table D-2). Each of the REMOTS sediment-profile images obtained in the present study was assigned one of the habitat categories listed in Table D-2.

Table D-1. Grain Size Scales for Sediments

ASTM (Unified) Classification [1]	U.S. Std. Mesh [2]	Size in mm	PHI Size	Wentworth Classification [3]
Boulder		4096.	-12.0	
		1024.	-10.0	Boulder
	12 in (300 mm)	256.	-8.0	
		128.	-7.0	Large Cobble
Cobble		107.64	-6.75	
		90.51	-6.5	Small Cobble
	3 in. (75 mm)	76.11	-6.25	
		64.00	-6.0	
		53.82	-5.75	
		45.26	-5.5	Very Large Pebble
Coarse Gravel		38.05	-5.25	
		32.00	-5.0	
		26.91	-4.75	
		22.63	-4.5	Large Pebble
	3/4 in (19 mm)	19.03	-4.25	
		16.00	-4.0	
		13.45	-3.75	
		11.31	-3.5	Medium Pebble
Fine Gravel		9.51	-3.25	
	2.5	8.00	-3.0	
	3	6.73	-2.75	
	3.5	5.66	-2.5	Small Pebble
	4	4.76	-2.25	
	5	4.00	-2.0	
Coarse Sand	6	3.36	-1.75	
	7	2.83	-1.5	Granule
	8	2.38	-1.25	
	10	2.00	-1.0	
	12	1.68	-0.75	
	14	1.41	-0.5	Very Coarse Sand
	16	1.19	-0.25	
Medium Sand	18	1.00	0.0	
	20	0.84	0.25	
	25	0.71	0.5	Coarse Sand
	30	0.59	0.75	
	35	0.50	1.0	
	40	0.420	1.25	
	45	0.354	1.5	Medium Sand
	50	0.297	1.75	
	60	0.250	2.0	
	70	0.210	2.25	
Fine Sand	80	0.177	2.5	Fine Sand
	100	0.149	2.75	
	120	0.125	3.0	
	140	0.105	3.25	
	170	0.088	3.5	Very Fine Sand
	200	0.074	3.75	
	230	0.0625	4.0	
Fine-grained Soil:	270	0.0526	4.25	
	325	0.0442	4.5	Coarse Silt
Clay if PI $\geq$ 4	400	0.0372	4.75	
Silt if PI < 4		0.0312	5.0	Medium Silt
		0.0156	6.0	Fine Silt
		0.0078	7.0	Very Fine Silt
		0.0039	8.0	Coarse Clay
		0.00195	9.0	Medium Clay
		0.00098	10.0	Fine Clay
		0.00049	11.0	
		0.00024	12.0	
		0.00012	13.0	
		0.000061	14.0	

1. ASTM Standard D 2487-92. This is the ASTM version of the Unified Soil Classification System. Both systems are similar (from ASTM (1993)).
2. Note that British Standard, French, and German DIN mesh sizes and classifications are different.
3. Wentworth sizes (in inches) cited in Krumbein and Sloss (1963).

Source: U.S. Army Corps of Engineers. (1995). Engineering and Design Coastal Geology, "Engineer Manual 1110-2-1810, Washington, D.C.

1.3 Mud Clasts

When fine-grained, cohesive sediments are disturbed, either by physical bottom scour or faunal activity (e.g., decapod foraging), intact clumps of sediment are often scattered about the seafloor. These mud clasts can be seen at the sediment-water interface in REMOTS sediment-profile images. During image analysis, the number of clasts are counted, the diameter of a typical clast is measured, and their oxidation state is assessed. Depending on their place of origin and the depth of disturbance of the sediment column, mud clasts can be reduced or oxidized. Also, once at the sediment-water interface, these sediment clumps are subject to bottom-water oxygen levels and bottom currents. Based on laboratory microcosm observations of reduced sediments placed within an aerobic environment, oxidation of reduced surface layers by diffusion alone is quite rapid, occurring within 6–12 hours (Germano 1983). Consequently, the detection of reduced mud clasts in an obviously aerobic setting suggests a recent origin. The size and shape of mud clasts, e.g., angular versus rounded, are also considered. Mud clasts may be moved about and broken by bottom currents and/or animals (macro- or meiofauna; Germano 1983). Over time, large angular clasts become small and rounded. Overall, the abundance, distribution, oxidation state, and angularity of mud clasts are used to make inferences about the recent pattern of seafloor disturbance in an area.

1.4 Sedimentary Methane

At extreme levels of organic-loading, pore-water sulphate is depleted, and methanogenesis occurs. The process of methanogenesis is detected by the appearance of methane bubbles in the sediment column. These gas-filled voids are readily discernable in REMOTS sediment-profile images because of their irregular, generally circular aspect and glassy texture (due to the reflection of the strobe off the gas). If present, the number and total areal coverage of all methane pockets are measured.

1.5 Measurement of Dredged Material and Cap Layers

The recognition of dredged material from REMOTS sediment-profile images is usually based on the presence of anomalous sedimentary materials within an area of ambient sediment. The ability to distinguish between ambient sediment and dredged or cap material demands that the survey extend well beyond the margins of a disposal site so that an accurate characterization of the ambient bottom is obtained. The distributional anomalies may be manifested in topographic roughness, differences in grain size, sorting, shell content, optical reflectance, fabric, or sediment compaction (i.e., camera prism penetration depth). Second-order anomalies may also provide information about the effects of dredged material on the benthos and benthic processes such as bioturbation (see following sections).

1.6 Boundary Roughness

Small-scale boundary roughness is measured from an image with the computer image analysis system. This vertical measurement is from the highest point at the sediment-water interface to the lowest point. This measurement of vertical relief is made within a horizontal distance of 15 cm (the total width of the optical window). Because the optical window is 20 cm high, the greatest possible roughness value is 20 cm. The source of the roughness is described if known. In most cases this is either biogenic (mounds and depressions formed by bioturbation or foraging activity) or relief formed by physical processes (ripples, scour depressions, rip-ups, mud clasts, etc.).

Table D-2. Benthic Habitat Categories Assigned to Sediment-Profile Images Obtained in this Study

Habitat AM: *Ampelisca* Mat Uniformly fine-grained (i.e., silty) sediments having well-formed amphipod (*Ampelisca* spp.) tube mats at the sediment-water interface.
Habitat SH: Shell Bed A layer of dead shells and shell fragments at the sediment surface overlying sediment ranging from hard sand to silts. Epifauna (e.g., bryozoans, tube-building polychaetes) commonly found attached to or living among the shells. Two distinct shell bed habitats: **SH.SI: Shell Bed over silty sediment -** shell layer overlying sediments ranging from fine sands to silts to silt-clay. **SH.SA: Shell Bed over sandy sediment -** shell layer overlying sediments ranging from fine to coarse sand.
Habitat SA: Hard Sand Bottom Homogeneous hard sandy sediments, do not appear to be bioturbated, bedforms common, successional stage mostly indeterminate because of low prism penetration. **SA.F: Fine sand -** uniform fine sand sediments (grain size: 4 to 3 phi). **SA.M: Medium sand -** uniform medium sand sediments (grain size: 3 to 2 phi). **SA.G: Medium sand with gravel -** predominately medium to coarse sand with a minor gravel fraction.
Habitat HR: Hard Rock/Gravel Bottom Hard bottom consisting of pebbles, cobbles and/or boulders, resulting in no or minimal penetration of the REMOTS camera prism. Some images showed pebbles overlying silty-sediments. The hard rock surfaces typically were covered with epifauna (e.g., bryozoans, sponges, tunicates).
Habitat UN: Unconsolidated Soft Bottom Fine-grained sediments ranging from very fine sand to silt-clay, with a complete range of successional stages (I, II and III). Biogenic features were common (e.g., amphipod and polychaete tubes at the sediment surface, small surface pits and mounds, large borrow openings, and feeding voids at depth). Several sub-categories: **UN.SS: Fine Sand/Silty -** very fine sand mixed with silt (grain size range from 4 to 2 phi), with little or no shell hash. **UN.SI: Silty -** homogeneous soft silty sediments (grain size range from >4 to 3 phi), with little or no shell hash. Generally deep prism penetration. **UN.SF: Very Soft Mud -** very soft muddy sediments (>4 phi) of high apparent water content, methane gas bubbles present in some images, deep prism penetration.

1.7 Optical Prism Penetration Depth

The optical prism of the REMOTS sediment-profile camera penetrates the bottom under a static driving force imparted by its weight. The penetration depth into the bottom depends on the force exerted by the optical prism and the bearing strength of the sediment. If the weight of the camera prism is held constant, the change in penetration depth over a surveyed region will reflect horizontal variability in geotechnical properties of the seafloor. In this sense, the camera prism acts as a static-load penetrometer. The depth of penetration of the optical prism into the bottom can be a useful parameter, because dredged and capped materials often have different shear strengths and bearing capacities.

1.8 Infaunal Successional Stage

Determination of the infaunal successional stage applies only to soft-bottom habitats, where the REMOTS camera is able to penetrate into the sediment. In hard bottom environments (i.e., rocky substrates), camera penetration is prevented and the standard suite of REMOTS measurements cannot be made. In such instances, the infaunal successional stage is considered to be “indeterminate.” Hard bottom areas can support abundant and diverse epibenthic communities and therefore may represent habitat which is biologically productive or otherwise is of value as refuge or living space for organisms. However, the value of hard bottom habitats is not reflected in the REMOTS successional stage designation.

The mapping of infaunal successional stages is based on the theory that organism-sediment interactions in marine soft-bottom habitats follow a predictable sequence after a major seafloor perturbation (e.g., passage of a storm, disturbance by bottom trawlers, dredged material deposition, hypoxia). The theory states that primary succession results in "the predictable appearance of macrobenthic invertebrates belonging to specific functional types following a benthic disturbance. These invertebrates interact with sediment in specific ways. Because functional types are the biological units of interest, our definition does not demand a sequential appearance of particular invertebrate species or genera" (Rhoads and Boyer 1982). This theory is formally developed in Rhoads and Germano (1982) and Rhoads and Boyer (1982).

Benthic disturbance can result from natural processes, such as seafloor erosion, changes in seafloor chemistry, and predator foraging, as well as from human activities like dredged material or sewage sludge disposal, thermal effluent from power plants, bottom trawling, pollution from industrial discharge, and excessive organic loading. Evaluation of successional stages involves deducing dynamics from structure, a technique pioneered by R. G. Johnson (1972) for marine soft-bottom habitats. The application of this approach to benthic monitoring requires *in situ* measurements of salient structural features of organism-sediment relationships as imaged through REMOTS technology.

Pioneering assemblages (Stage I assemblages) usually consist of dense aggregations of near-surface living, tube-dwelling polychaetes (Figure D-1); alternately, opportunistic bivalves may colonize in dense aggregations after a disturbance (Rhoads and Germano 1982, Santos and Simon 1980a). These functional types are usually associated with a shallow redox boundary; and bioturbation depths are shallow, particularly in the earliest stages of colonization (Figure D-1). In the absence of further disturbance, these early successional assemblages are eventually replaced by infaunal deposit feeders; the start of this "infaunalization" process is designated arbitrarily as Stage II. Typical Stage II species are shallow dwelling bivalves or, as is common in New England waters, tubicolous amphipods. In studies of hypoxia-induced benthic defaunation events in Tampa Bay, Florida, Ampeliscid amphipods appeared as the second temporal dominant in two of the four recolonization cycles (Santos and Simon 1980a, 1980b).

Stage III taxa, in turn, represent high-order successional stages typically found in low-disturbance regimes. These invertebrates are infaunal, and many feed at depth in a head-down orientation. The localized feeding activity results in distinctive excavations called feeding voids (Figure D-1). Diagnostic features of these feeding structures include a generally semicircular shape with a flat bottom and arched roof, and a distinct granulometric change in the sediment particles overlying the floor of the structure. This granulometric change is caused by the accumulation of coarse particles that are rejected by the animals feeding selectively on fine-grained material. Other subsurface structures, such as burrows or methane gas bubbles, do not exhibit these characteristics and therefore are quite distinguishable from these distinctive feeding structures. The bioturbational activities of these deposit-feeders are responsible for aerating the sediment. In the retrograde transition of Stage III to Stage I, it is sometimes possible to recognize the presence of relict (i.e., collapsed and inactive) feeding voids.

The end-member stages (Stages I and III) are easily recognized in REMOTS images by the presence of dense assemblages of near-surface polychaetes (Stage I) or the presence of subsurface feeding voids (Stage III; Figure D-1). The presence of tubicolous amphipods at the sediment surface is indicative of Stage II. It is possible for Stage I polychaetes or Stage II tubicolous amphipods to be present at the sediment surface, while at the same time, Stage III organisms are present at depth within the sediment. In such instances, where two types of assemblages are visible in a REMOTS image, the image is designated as having either a Stage I on Stage III (I–III) or Stage II on Stage III (II–III) successional stage. Additional information on REMOTS image interpretation can be found in Rhoads and Germano (1982, 1986).

1.9 Apparent Redox Potential Discontinuity Depth

Aerobic near-surface marine sediments typically have higher reflectance values relative to underlying anoxic sediments. Sand also has higher optical reflectance than mud. These differences in optical reflectance are readily apparent in REMOTS sediment-profile images; the oxidized surface sediment contains particles coated with ferric hydroxide (an olive color when associated with particles), while reduced and muddy sediments below this oxygenated layer are darker, generally gray to black. The boundary between the colored ferric hydroxide surface sediment and underlying gray to black sediment is called the apparent redox potential discontinuity (aRPD).

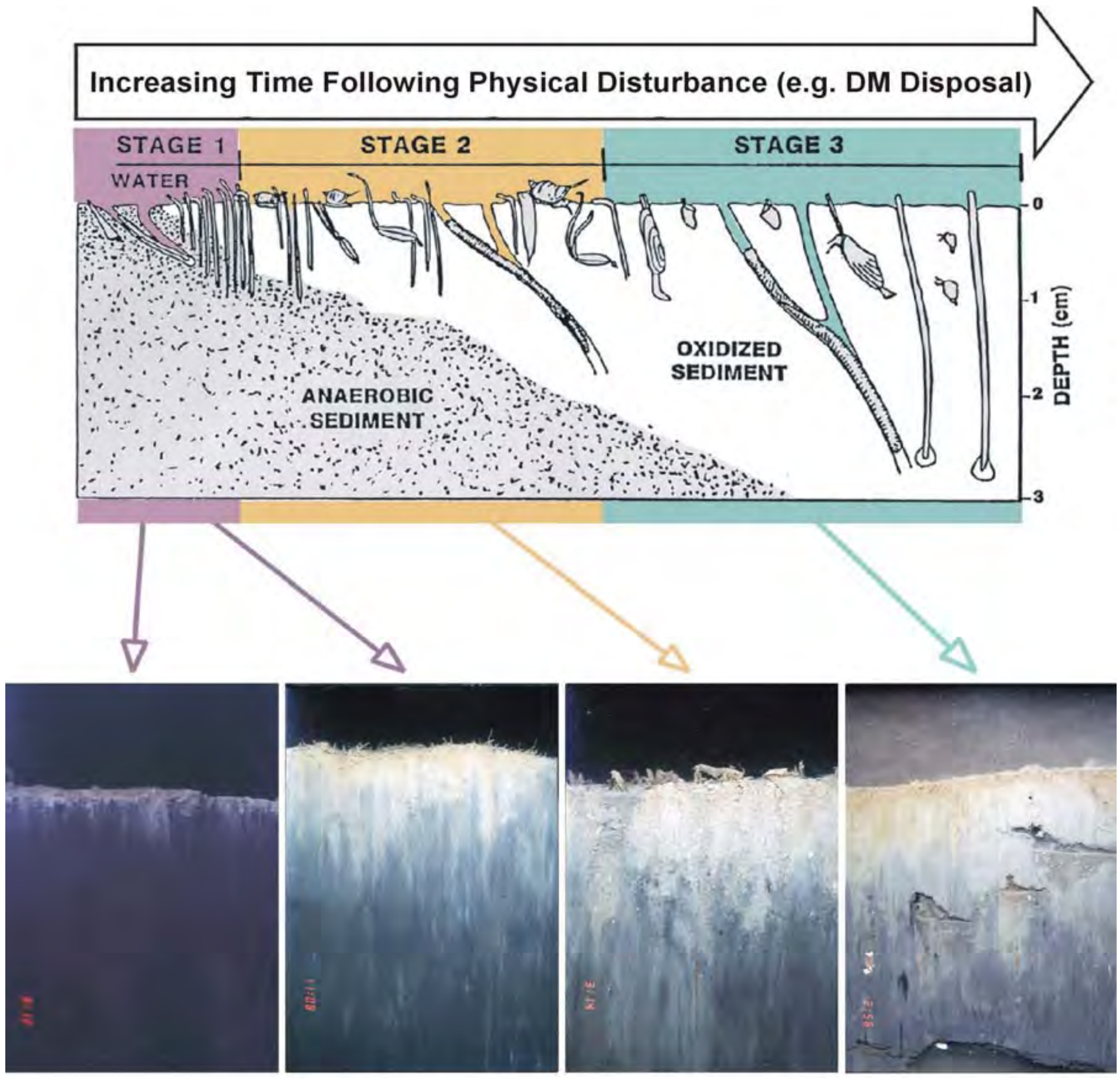

Figure D-1. The drawing at the top illustrates the development of infaunal successional stages over time following a physical disturbance or with distance from an organic loading source (from Rhoads and Germano 1986). The REMOTS images below the drawing provide examples of the different successional stages. Image A shows highly reduced sediment with a very shallow redox layer (contrast between light colored surface sediments and dark underlying sediments) and little evidence of infauna. Numerous small polychaete tubes are visible at the sediment surface in image B (Stage I), and the redox depth is deeper than in image A. A mixture of polychaete and amphipod tubes occurs at the sediment surface in image C (Stage II). Image D shows numerous burrow openings and feeding pockets (voids) at depth within the sediment; these are evidence of deposit-feeding, Stage III infauna. Note the aRPD is relatively deep in this image, as bioturbation by the Stage III organisms has resulted in increased sediment aeration, causing the redox horizon to be located several centimeters below the sediment-water interface.

The depth of the aRPD in the sediment column is an important time-integrator of dissolved oxygen conditions within sediment pore waters. In the absence of bioturbating organisms, this high reflectance layer (in muds) will typically reach a thickness of 2 mm (Rhoads 1974). This depth is related to the supply rate of molecular oxygen by diffusion into the bottom and the consumption of that oxygen by the sediment and associated microflora. In sediments that have very high sediment-oxygen demand, the sediment may lack a high reflectance layer even when the overlying water column is aerobic.

In the presence of bioturbating macrofauna, the thickness of the high reflectance layer may be several centimeters. The relationship between the thickness of this high reflectance layer and the presence or absence of free molecular oxygen in the associated pore waters must be made with caution. The boundary (or horizon) which separates the positive Eh region (oxidized) from the underlying negative Eh region (reduced) can only be determined accurately with microelectrodes. For this reason, we describe the optical reflectance boundary, as imaged, as the "apparent" RPD (aRPD), and it is mapped as a mean value.

The depression of the aRPD within the sediment is relatively slow in organic-rich muds (on the order of 200 to 300 micrometers per day); therefore, this parameter has a long time constant (Germano and Rhoads 1984). The rebound in the aRPD is also slow (Germano 1983). Measurable changes in the aRPD depth using the REMOTS sediment-profile image optical technique can be detected over periods of one or two months. This parameter is used effectively to document changes (or gradients), which develop over a seasonal or yearly cycle related to water temperature effects on bioturbation rates, seasonal hypoxia, sediment oxygen demand, and infaunal recruitment. In sediment-profile surveys of ocean disposal sites sampled seasonally or on an annual basis throughout the New England region performed under the DAMOS (Disposal Area Monitoring System) Program for the USACE, New England Division, SAIC repeatedly has documented a drastic reduction in aRPD depths at disposal sites immediately after dredged material disposal, followed by a progressive postdisposal aRPD deepening (barring further physical disturbance). Consequently, time-series aRPD measurements can be a critical diagnostic element in monitoring the degree of recolonization in an area by the ambient benthos.

The depth of the mean aRPD also can be affected by local erosion. The peaks of disposal mounds commonly are scoured by divergent flow over the mound. This can result in washing away of fines, development of shell or gravel lag deposits, and very thin aRPD depths. During storm periods, erosion may completely remove any evidence of the aRPD (Fredette et al. 1988).

Another important characteristic of the aRPD is the contrast in reflectance values at this boundary. This contrast is related to the interactions among the degree of organic-loading, bioturbational activity in the sediment, and the levels of bottom-water dissolved oxygen in an area. High inputs of labile organic material increase sediment oxygen demand and, subsequently, sulfate reduction rates (and the abundance of sulfide end-products). This results in more highly reduced (lower reflectance) sediments at depth and higher aRPD contrasts. In a region of generally low aRPD contrasts, images with high aRPD contrasts indicate localized sites of relatively high past inputs of organic-rich material (e.g., organic or phytoplankton detritus, dredged material, sewage sludge, etc.).

1.10 Organism-Sediment Index (OSI)

The multi-parameter REMOTS Organism-Sediment Index (OSI) has been constructed to characterize benthic habitat quality. Benthic habitat quality is defined relative to two end-member standards. The lowest value is given to those bottoms which have low or no dissolved oxygen in the overlying bottom water, no apparent macrofaunal life, and methane gas present in the sediment (see Rhoads and Germano 1982, 1986, for REMOTS criteria for these conditions). The OSI for such a condition is –10 (highly disturbed or degraded benthic habitat quality). At the other end of the scale, an aerobic bottom with a deeply depressed aRPD, evidence of a mature macrofaunal assemblage, and no apparent methane gas bubbles at depth will have an OSI value of +11 (unstressed or undisturbed benthic habitat quality).

The OSI is a sum of the subset indices shown in Table D-3. The OSI is calculated automatically by SAIC software after completion of all measurements from each REMOTS photographic negative. The index has proven to be an excellent parameter for mapping disturbance gradients in an area and documenting ecosystem recovery after disturbance (Germano and Rhoads 1984, Revelas et al. 1987, Valente et al. 1992).

The OSI may be subject to seasonal changes because the mean aRPD depths vary as a result of temperature-controlled changes of bioturbation rates and sediment oxygen demand. Furthermore, the successional status of a station may change over the course of a season related to recruitment and mortality patterns or the disturbance history of the bottom. The sub-annual change in successional status is generally limited to Stage I (polychaete-dominated) and Stage II (amphipod-dominated) seres. Stage III seres tend to be maintained over periods of several years unless they are eliminated by increasing organic loading, extended periods of hypoxia, or burial by thick layers of dredged material. The recovery of Stage III seres following abatement of such events may take several years (Rhoads and Germano 1982). Stations that have low or moderate OSI values (< +6) are indicative of recently disturbed areas and tend to have greater temporal and spatial variation in benthic habitat quality than stations with higher OSI values (> +6).

Table D-3. Calculation of REMOTS Organism-Sediment Index Value

A. CHOOSE ONE VALUE:

Mean aRPD Depth	Index Value
0.00 cm	0
> 0 - 0.75 cm	1
0.75 - 1.50 cm	2
1.51 - 2.25 cm	3
2.26 - 3.00 cm	4
3.01 - 3.75 cm	5
> 3.75 cm	6

B. CHOOSE ONE VALUE:

Successional Stage	Index Value
Azoic	-4
Stage I	1
Stage I to II	2
Stage II	3
Stage II to III	4
Stage III	5
Stage I on III	5
Stage II on III	5

C. CHOOSE ONE OR BOTH IF APPROPRIATE:

Chemical Parameters	Index Value
Methane Present	-2
No/Low Dissolved Oxygen**	-4

REMOTS ORGANISM-SEDIMENT INDEX = Total of above subset indices (A+B+C)

RANGE: -10 - +11

** Note: This is not based on a Winkler or polarigraphic electrode measurement. It is based on the imaged evidence of reduced, low reflectance (i.e., high oxygen demand) sediment at the sediment-water interface.