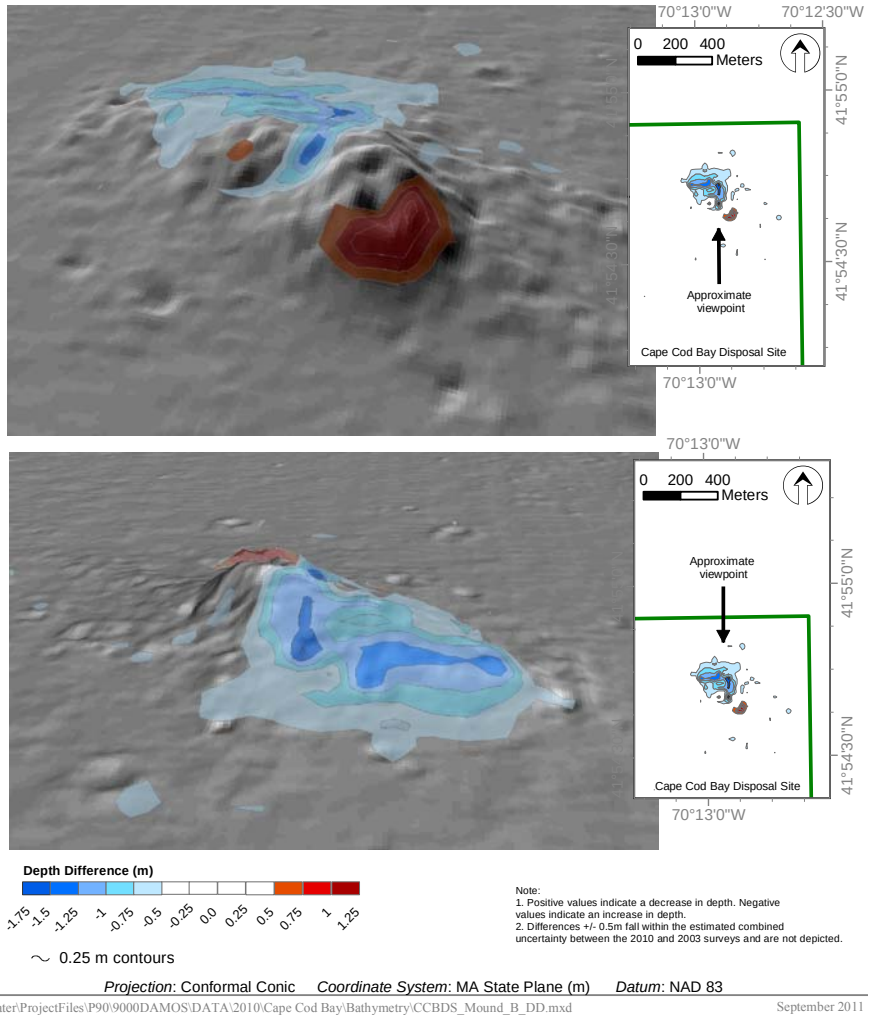
Monitoring Survey at the Cape Cod Bay Disposal Site
September 2010

Disposal Area Monitoring System DAMOS



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13. ABSTRACT

A monitoring survey was conducted in September 2010 at the Cape Cod Bay Disposal Site (CCBDS) as part of the Disposal Area Monitoring (DAMOS) Program. The 2010 field effort consisted of bathymetric, sediment-profile imaging (SPI), and plan-view imaging surveys designed to characterize the seafloor topography of the disposal site, document the distribution of dredged material at recent and historic disposal locations, and assess the benthic recolonization status of three disposal mounds.

The multibeam bathymetric survey was performed over a 2000 x 2100 m area that encompassed the entire disposal site. Dredged material distribution was mainly limited to four areas within CCBDS; the Historic Wellfleet Disposal site and three distinct disposal mounds. The Historic Wellfleet Disposal Site and Mound A exhibited no apparent changes in height or extent since the last bathymetric survey in 2003. Mound B was the largest feature observed at the site, and while the overall mound topography was stable, there was some minor reworking of surficial sediments near the mound apex. The sediment transport was likely due to enhanced tidal current or storm - generated waves around the steep mound peak and did not result in significant redistribution of dredged material beyond the original mound footprint.

The placement of approximately 137,000 m^3 of dredged material in the northwest quadrant of the site since 2003 resulted in the formation of a new mound, Mound C. The disposal events during this period were not focused in one precise location and thus created a low, wide feature that rose less than 1 m over ambient depths.

The 2010 imaging surveys were performed over Mounds A, B, and C as well as the three reference areas. The SPI stations on the three disposal mounds exhibited a high degree of sediment reworking and benthic communities that indicated advanced recolonization. Evidence of Stage 3 successional status was present in at least one replicate at each of the disposal mound stations suggesting that the infaunal community at each mound had fully recovered to conditions similar to those seen at reference areas. This reverses an apparent trend of decline in benthic conditions observed at Mounds A and B during the last two imaging surveys at CCBDS.

Standard confirmatory monitoring of CCBDS is recommended in order to document the continuing stability of mound topography and healthy benthic recolonization pattern at the three disposal mounds and to track the sediment transport processes observed at Mound B.

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EXECUTIVE SUMMARY

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Standard confirmatory monitoring of CCBDS is recommended in order to document the continuing stability of mound topography and healthy benthic recolonization pattern at the three disposal mounds and to track the sediment transport processes observed at Mound B.

1.0 INTRODUCTION

A monitoring survey was conducted at the Cape Cod Bay Disposal Site (CCBDS) as part of the U.S. Army Corps of Engineers (USACE) New England District (NAE) Disposal Area Monitoring System (DAMOS). DAMOS is a comprehensive monitoring and management program designed and conducted to address environmental concerns associated with use of aquatic disposal sites throughout the New England region. An introduction to the DAMOS Program and CCBDS, including a brief description of previous dredged material disposal activities and previous monitoring surveys, is provided below.

1.1 Overview of the DAMOS Program

The DAMOS Program features a tiered management protocol designed to ensure that any potential adverse environmental impacts associated with dredged material disposal are promptly identified and addressed (Germano et al. 1994). For over 30 years, the DAMOS Program has collected and evaluated disposal site data throughout New England. Based on these data, patterns of physical, chemical, and biological responses of seafloor environments to dredged material disposal activity have been documented (Fredette and French 2004).

DAMOS monitoring surveys fall into two general categories: confirmatory studies and focused studies. Confirmatory studies are designed to test hypotheses related to expected physical and ecological response patterns following placement of dredged material on the seafloor at established, active disposal sites. The data collected and evaluated during these studies provide answers to strategic management questions in determining the next step in the disposal site environmental management process. Focused studies are periodically undertaken within the DAMOS Program to evaluate inactive/historic disposal sites and contribute to the development of dredged material placement and capping techniques. The 2010 CCBDS investigation included elements of both types of studies, monitoring a mound actively receiving disposals as well as two mounds inactive for over seven years.

Two primary goals of DAMOS monitoring surveys are to document the physical location and stability of dredged material placed into the aquatic environment and to evaluate the biological recovery of the benthic community following placement of the dredged material. Several survey techniques are employed in order to characterize these responses to dredged material placement. Sequential bathymetric measurements are made to characterize the height and spread of discrete dredged material deposits or mounds created at open water sites as well as the accumulation/consolidation of dredged material into confined aquatic disposal (CAD) cells. Sediment-profile imaging (SPI) surveys are

performed to support evaluation of seafloor (benthic) habitat conditions and recovery over time. Each type of data collection activity is conducted periodically at disposal sites, and data are evaluated to determine the next step in the disposal site management process. The conditions found after a defined period of disposal activity are compared with the long-term data set at a specific site (Germano et al. 1994). DAMOS monitoring surveys may also feature additional types of data collection activities, such as plan-view underwater camera (PUC) photography, side-scan sonar, towed video, sediment coring, or grab sampling, as deemed appropriate to achieve specific survey objectives.

1.2 CCBDS Background

CCBDS is a dredged material disposal site within the state waters of Massachusetts (Figure 1-1). It is located in Cape Cod Bay, approximately 15 km (8 nmi) southwest of Long Point, Provincetown, Massachusetts. CCBDS is defined as a 1.85 x 1.85 km (1 nmi x 1 nmi) area on the seafloor, centered at 41° 54.406' N, 70° 13.268' W (NAD 83) which has a relatively flat topography and no natural bathymetric features (ENSR 2004, Figure 1-2). The seafloor slopes gently to the northwest across the site, with water depths ranging from 28 m (92 ft) in the southeast corner to 31.5 m (103 ft) in the northwest corner.

CCBDS was selected as an open water disposal site in 1990 in response to an increase in dredging needs at many regional harbors due to a steady rise in population and recreational boating activities on Cape Cod (SAIC 2003). The current site boundaries were established around the historic Wellfleet Disposal Site, which received material from several small Wellfleet Harbor dredging projects in the 1970's and 1980's (Figure 1-2). This area of Cape Cod Bay is characterized by relatively low currents, which contributed to its selection as a depositional disposal site. A historic absence of endangered right whale sightings or commercially important lobster grounds in the vicinity also supported this site selection decision (SAIC 2003).

Monitoring and management of CCBDS is the joint responsibility of the Commonwealth of Massachusetts Department of Conservation and Recreation (DCR) and the DAMOS Program. DCR maintains the disposal buoy, and the DAMOS Program performs monitoring and provides input for buoy placement decisions. The disposal season at the site is limited to June–December due to concerns over seasonal marine mammal populations (SAIC 2003). Although the site was officially selected by the Commonwealth of Massachusetts in 1990, a disposal buoy was not placed at the site and disposal operations did not commence at the current disposal site until 1994 (SAIC 2003).

1.3 Previous Disposal Activity at CCBDS

During the winter of 1994–1995, approximately 112,000 m^3 (146,000 yd^3) of material from Wellfleet Harbor was deposited in the southeast quadrant of CCBDS forming Mound A (SAIC 2003, Figure 1-3). The disposal buoy was then moved to the northeast quadrant of the site, and approximately 509,000 m^3 (666,000 yd^3) of material was placed at this location between 1996 and 2001, forming Mound B (SAIC 2003, Figure 1-3). In 2002 approximately 5,200 m^3 (6,800 yd^3) of material from Provincetown Harbor was deposited at a new buoy location in the northwest quadrant of CCBDS. Later that year, a small amount of additional material (2,500 m^3 [3,300 yd^3]) from the same dredging project was placed on top of Mound A (ENSR 2004, Figure 1-4).

Since 2003, all disposal activity at CCBDS has been directed to a buoy located in the northwest quadrant of the site, forming a third directed placement mound termed "Mound C" (Figure 1-5). Five regional dredging projects have resulted in the disposal of approximately 137,000 m^3 (179,000 yd^3) of material at the new buoy location (Table 1-1 and Appendix A). More than half of this volume came from dredging around Pope's Island in New Bedford Harbor with the remainder of the material originating from a variety of small harbor projects in Massachusetts.

1.4 Previous Surveys at CCBDS

A baseline survey of CCBDS was performed in 1994 with subsequent monitoring surveys conducted in 1995, 1996, 2001, and 2003 (Table 1-2).

Bathymetric data from the 1995 post-disposal survey documented the formation of Mound A in the southeastern corner of CCBDS (Ocean Surveys 1995b). The 1996 survey found Mound A to be a stable bathymetric feature with little topographic change in one year since disposal (CR Environmental 1997). The 1996 study also surveyed the established Cape Cod Bay Reference Site (CCBRS) and evaluated two additional reference sites (Northwest Reference [NWREF] and Southwest Reference [SWREF]) for potential comparison with future CCBDS monitoring data (Figure 1-2). It was recommended that NWREF and SWREF be included as additional reference sites to aid in CCBDS management decisions (CR Environmental 1997).

Following the 1996 survey, the disposal buoy was relocated to the northeast corner of CCBDS, and monitoring surveys were conducted over this portion of the site in 2001 and 2003 (Table 1-2). These surveys reconfirmed the stable topography of Mound A, documented the formation of Mound B at the site of the new disposal buoy location, and confirmed the presence of a less defined mound at the historic Wellfleet Disposal Site at the center of CCBDS (SAIC 2003 & ENSR 2004, Figure 1-2 & 1-3).

Along with acoustic data to document the physical extent and stability of disposal features, several monitoring surveys collected benthic grabs and/or SPI images to assess the biological conditions of disposal mounds and reference areas (Table 1-2). The 1994 baseline pre-disposal SPI study found a healthy, established benthic community at CCBDS characterized by a deep oxidized layer, subsurface voids, and a high abundance of deep burrowing organisms (Ocean Surveys 1995a). The 1996 SPI and sediment grab surveys suggested the complete recovery of the benthic community at Mound A, 16 months after the disposal of 112, 000 m3 (146,000 yd3) of fine-grained dredged material from Wellfleet Harbor. The mean apparent redox potential discontinuity (aRPD) depth (a measure of effective biological mixing) at Mound A exceeded the mean aRPD depth at the established reference site (CCBRS), and Stage 3 infauna (head-down deposit feeding organisms indicative of healthy conditions) were present in at least one replicate at 85% of the disposal mound stations (CR Environmental 1997).

The 2001 and 2003 SPI surveys revisited Mound A and also investigated the newly formed Mound B in the northeastern quadrant of the site. In 2001, even though it had been more than six years since the cessation of disposal activities at that location, decreased mean aRPD depths were observed at Mound A in comparison to those measured during the 1996 survey (SAIC 2003). aRPD depths at Mound A remained low in the 2003 survey with the mean depth decreasing from 5.5 cm in 1996 to 1.9 cm in 2001 to 1.2 cm in 2003 (ENSR 2004).

The 2001 SPI data also showed a lower occurrence of Stage 3 infauna as compared to the 1996 data for both the Mound A and reference area stations. However, the decrease was more pronounced for the Mound A stations (69% with Stage 3 infauna in 2001 vs. 85% in 1996). Occurrence of Stage 3 organisms rebounded to 92% of stations at Mound A in 2003, but with Stage 1 only organisms present in at least one replicate at every station (ENSR 2004). This patchy distribution of Stage 3 infauna and the reduction in aRPD depth between 1996 and 2003 was hypothesized to be indicative of either a regional trend, seasonal variation in benthic community structure, or the low population density of the Cape Cod Bay keystone species (*Molpadia oolitica*), and not related to disturbance due to dredged material disposal (ENSR 2004).

SPI data from the 2001 and 2003 surveys at Mound B revealed an apparent decline in benthic successional status after the cessation of disposal activity. The successional status at Mound B consisted of a mixed assemblage of Stage 1 and Stage 3 organisms; in 2001, 92% of stations had Stage 3 infauna while the number of stations with Stage 3 infauna dropped to 69% in 2003 (ENSR 2004). aRPD depth ranges were shallower than reference areas (Mound B mean = 1.3 cm, CCBRS mean = 2.3 cm in 2003) and reflective of the moderately disturbed benthic environment of a recently active mound (ENSR 2004).

1.5 MWRA Studies

The Massachusetts Water Resource Authority (MWRA) has regularly monitored stations around Boston Harbor, Massachusetts Bay, and Cape Cod Bay since 1992 as part of its Harbor and Outfall Monitoring (HOM) Program. These stations include two benthic grab stations and one winter flounder trawl location in eastern Cape Cod Bay (Figure 1-1). MWRA Station FF06 is located approximately 15 km (8 nmi) to the west of CCBDS, Station FF07 is located within the CCBRS, and the Eastern Cape Cod Bay (ECCB) winter flounder trawl location is approximately 7 km (4 nmi) to the east of CCBDS.

1.5.1 Benthic Monitoring

The MWRA benthic monitoring program near CCBDS began in 1992 and consists of three replicate 0.04 m^2 Ted Young grabs collected at Station FF06 in odd numbered years through 2009 and at Station FF07 in even numbered years through 2010 (Figure 1-1). The sampling occurs in August when peak infaunal densities are expected in Cape Cod Bay. Companion samples were also collected for grain-size, TOC, and Clostridium analysis. Benthic diversity, species richness parameters, and community structure were assessed and compared over time. The long-term period represented by this dataset allows it to be used as a baseline to detect natural changes in the habitat.

Since data collection began in 1992 there has been no indication of stressed habitat conditions at Station FF07 (CCBRS) or Station FF06. Throughout the program, the infaunal species assemblage of Cape Cod Bay has remained stable but with variable densities. *Molpadia oolitica* has been identified as a key species in the region, but densities have varied over time (Werme et al. 2010).

1.5.2 Flounder Monitoring

The MWRA long-term flounder monitoring program annually collects fish with an otter-trawl tow in the waters east of CCBDS (Figure 1-1). The fish are examined for morphology and histopathology every year with additional parameters, including concentrations of inorganic and organic compounds in tissue, analyzed every third year (Moore et al. 2010b).

In 2009, flounder from the ECCB trawl began to show increased signs of biliary proliferation in liver tissues (Moore et al. 2010a). Identification of unicellular parasites within the bile ducts of several fish from ECCB suggested that this liver condition may be due to the presence of the parasites and not a response to environmental toxicity (Moore et al. 2010a).

1.6 Study Objectives

The disposal of 137,000 m^3 (179,000 yd^3) of material at CCBDS since the 2003 survey, coupled with the potential decline in benthic conditions at CCBDS and CCBRS identified in the 2001 and 2003 surveys, provided the basis for the September 2010 survey.

The 2010 survey was designed to document the changes in seafloor topography over the entire disposal site, perform a follow-up assessment of benthic conditions at Mound A, assess the benthic recolonization of Mound B seven years post-disposal, and assess the benthic recolonization at a newly created disposal mound. The SPI survey was scheduled in late summer to coincide with the 2003 survey and to eliminate potential seasonal variation issues encountered by previous monitoring efforts. The number of SPI stations at the reference areas was also increased in order to improve the statistical power of reference area and disposal mound comparisons.

Specific objectives of the September 2010 study were to:

- Use multibeam bathymetry to document the seafloor topography of CCBDS in order to assess the stability of Mounds A and B and determine the extent and remaining capacity of newly formed Mound C;
- Use SPI and PUC imaging techniques to assess the benthic recolonization status of Mounds A, B, and, C in comparison to three reference areas; and
- Assess benthic community trends at CCBDS and CCBRS since 1996 relative to available MWRA monitoring data

Table 1-1.

Summary of Recent Disposals at CCBDS (2003–2010)

Project	Permitee	Disposal Dates	Volume (m^3)	Volume (yd^3)
James Landing/Marina Basin	Rolling Lakes II	11/2004 – 12/2004	12,769	16,701
Green Harbor Yacht Club/Green Harbor River	Green Harbor Yacht Club	8/2008 – 9/2008	10,857	14,200
Pope's Island	City Of New Bedford	8/2008 – 10/2008	76,583	100,167
Westport Harbor	Town Of Westport	11/2008 – 6/2009	30,382	39,738
Green Harbor Marina	Green Harbor Marina	12/2009 – 1/2010	6,079	7,951
Total			136,670	178,758

Table 1-2.

Previous Surveys at CCBDS

Date	Survey Type	Bathymetry Area (meters)	Side Scan	Sub-bottom	No. SPI Stations	Other	Citation
April 1994	Pre-disposal	Site: 1000x1000 Ref: 1000x1000		√	√*	Grab sampling	OSI 1995a
January 1995	Post-disposal	√*	√	√			OSI 1995b
May 1996	Monitoring	Site: 1000x1500 (approx) Ref: 1000x1500 (approx)	√	√	Site: 13 Ref: 39	Sediment sampling	CR Environmental, Inc. 1997
August 2001	Monitoring	Site: 2100x2200			Site: 38 Ref: 16		SAIC 2003
August 2003	Monitoring	Site: 1200x2100			Site: 26 Ref: 5		ENSR 2004

* Detailed data not available

Figure 1-1. Location of CCBDS with selected MWRA monitoring stations noted

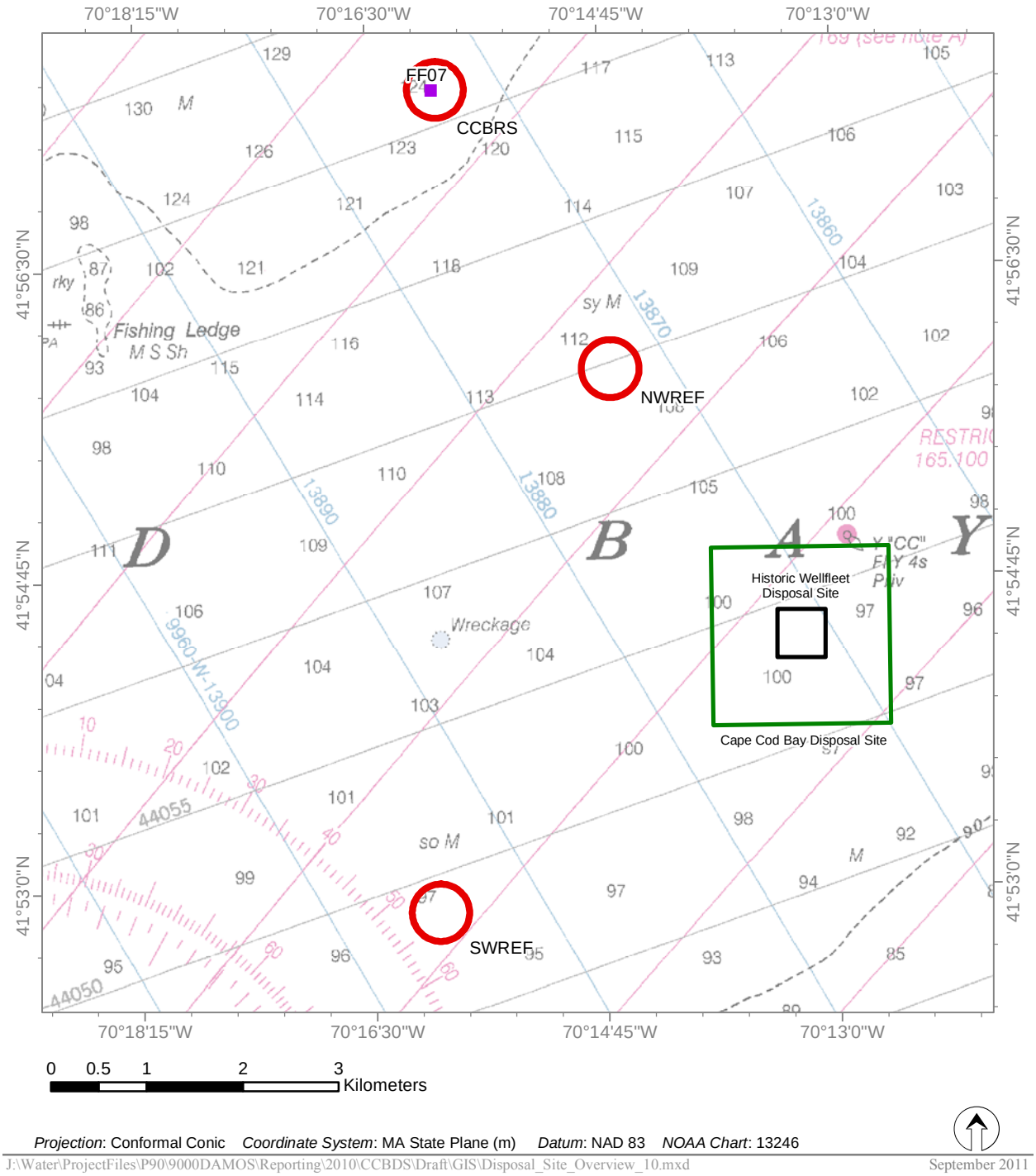


Figure 1-2. Location of CCBDS, the Historic Wellfleet Disposal Site, and reference areas

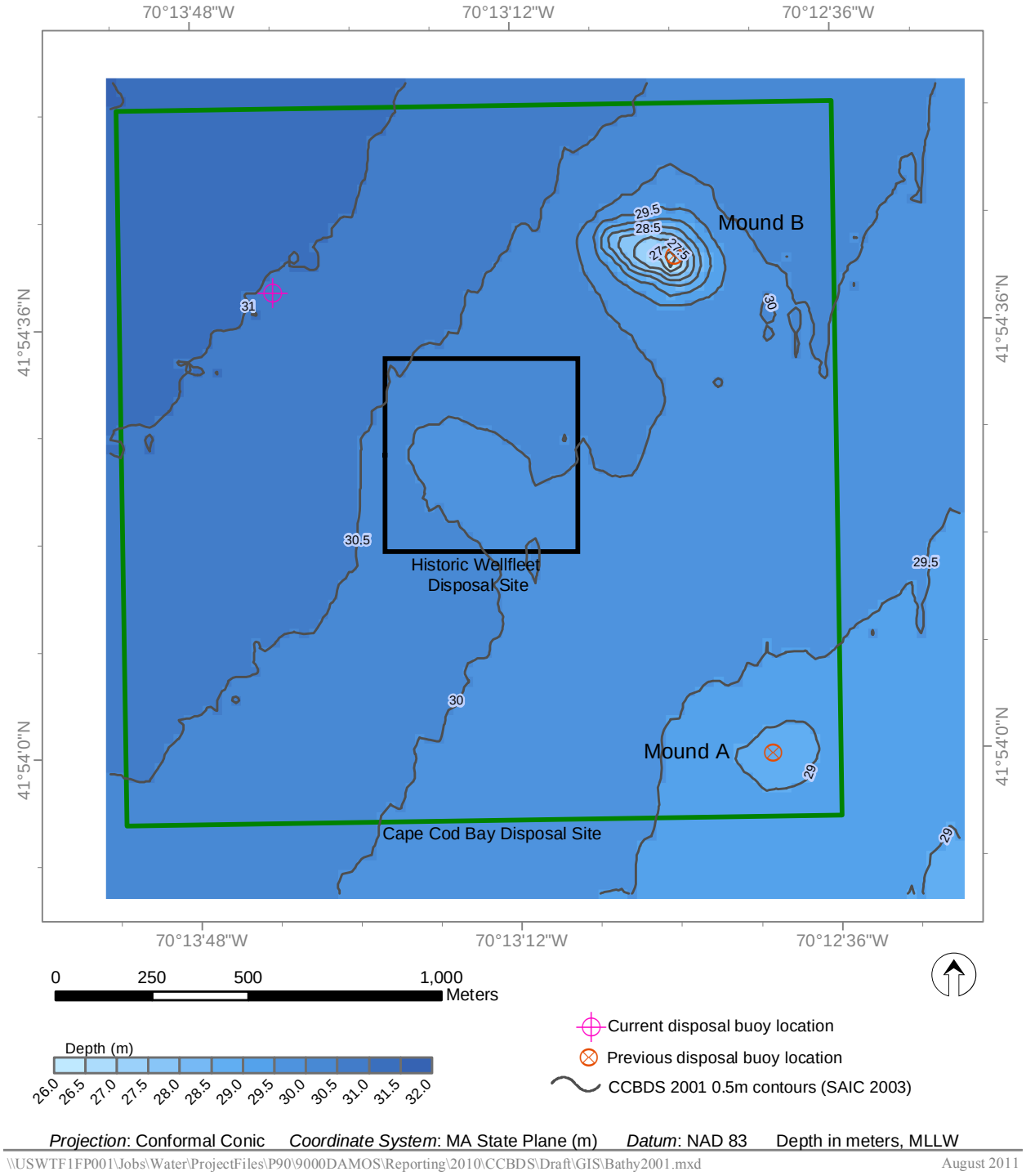


Figure 1-3. Bathymetry of CCBDS, August 2001

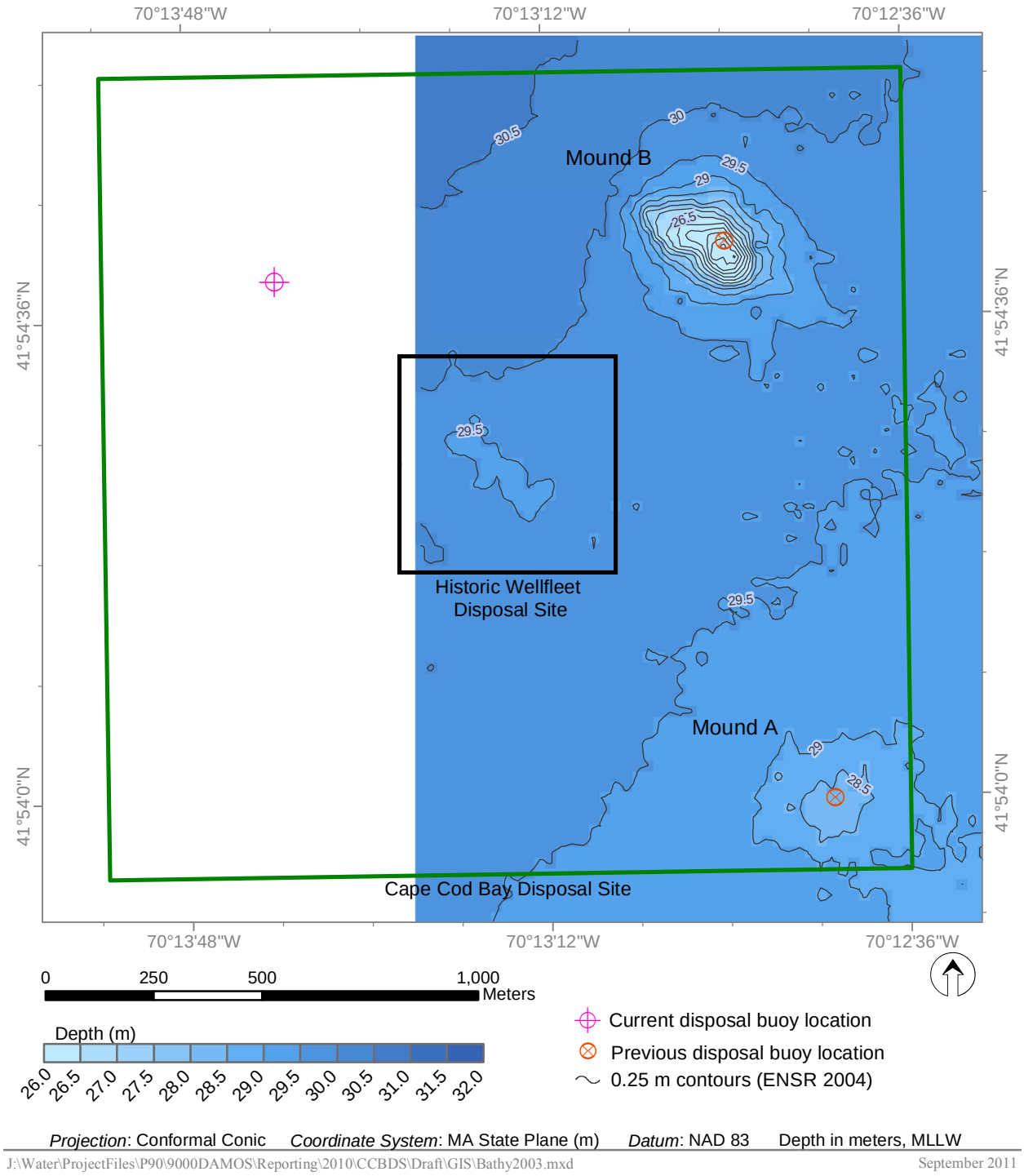


Figure 1-4. Bathymetry of the eastern portion of CCBDS, August 2003

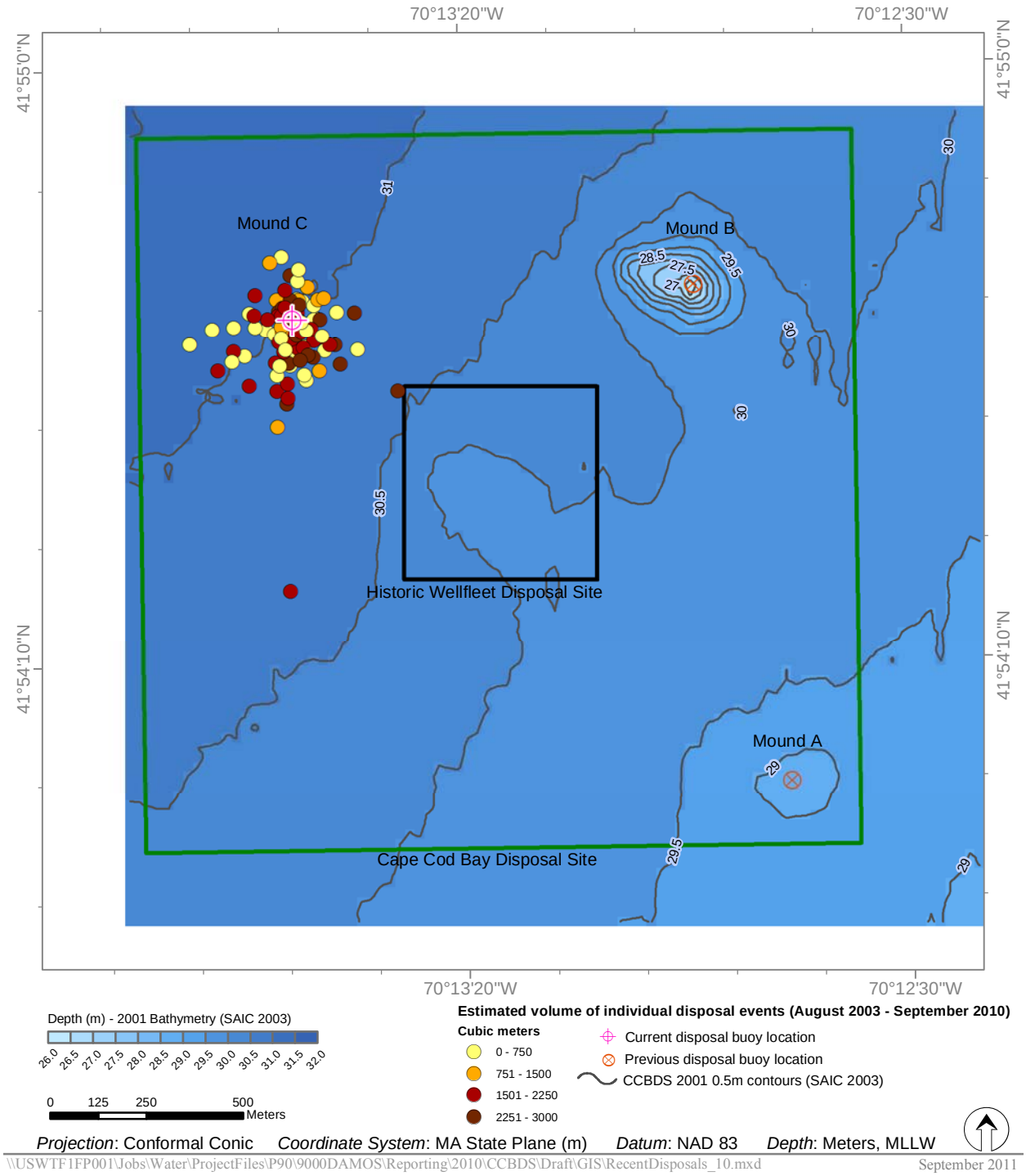


Figure 1-5. Recent disposals at CCBDS (2003–2010)

2.0 METHODS

The September 2010 surveys conducted at CCBDS were performed by AECOM, CR Environmental, Inc., and Germano & Associates. The bathymetric survey was conducted 16 September 2010 to document depths in and around the disposal site. The SPI and PUC survey was conducted 21–24 September 2010 to assess benthic recolonization within the disposal site compared to reference areas. Field activities are summarized in Table 2-1, and an overview of the methods used to collect and analyze the survey data is provided below.

2.1 Navigation and On-Board Data Acquisition

Navigation for the surveys was accomplished using a Trimble AgGPS 132 12-channel Differential Global Positioning System (DGPS) system capable of receiving U.S. Coast Guard (USCG) Beacon corrections as well as OmniStar subscription-based satellite differential corrections. The system is capable of sub-meter horizontal position accuracy. The DGPS system was interfaced to a laptop computer running HYPACK MAX® hydrographic survey software. HYPACK MAX® continually recorded vessel position and DGPS satellite quality and provided a steering display for the vessel captain to accurately maintain the position of the vessel along pre-established survey transects and targets.

Vessel heading measurements were acquired using a Hemisphere VS-100 Crescent Digital compass and DGPS system. This system produced vessel heading measurements accurate to within 0.05° 20 times per second. The Hemisphere system was interfaced to HYPACK ® acquisition software.

2.2 Bathymetry

Bathymetric surveys provide measurements of water depth that, when processed, can be used to map the seafloor topography. The processed data can also be compared with previous surveys to track changes in the size and location of seafloor features. This technique is the primary tool in the DAMOS Program for mapping the distribution of dredged material at disposal sites.

2.2.1 Bathymetric Data Collection

The 2010 multibeam bathymetric survey of CCBDS was conducted 16 September 2010 aboard the F/V First Light. The bathymetric survey was conducted over a 2000 x 2100 m (2200 x 2300 yd) area, capturing the entirety of the current disposal area including all three disposal mounds (Figure 2-1). Sediment acoustic backscatter data, in

the form of side-scan imagery and snippets, were also collected. The bathymetric survey included a total of 29 survey lines, spaced approximately 70 m (230 ft) apart and oriented in a north-south direction. Multiple cross-tie lines were completed to assess data quality and the accuracy of tidal corrections (Figure 2-1).

Bathymetric and acoustic backscatter data were collected using a Reson 8101 Multibeam Echo Sounder (MBES). This 240-kHz system forms 101 1.5° beams distributed equiangularly across a 150° swath. The MBES transducer was mounted amidships to the port rail of the survey vessel using a high strength adjustable boom, and the DGPS antenna was attached to the top of the transducer boom. The transducer depth below the water surface (draft) was recorded at the beginning and end of data acquisition.

The MBES topside processor was equipped with components necessary to export depth solutions, backscatter, and side scan sonar signals to the HYPACK MAX® acquisition computer via Ethernet communications. HYPACK MAX® also received and recorded navigation data from the DGPS, motion data from a serially interfaced TSS DMS 3-05 motion reference unit (MRU), and heading data from the Hemisphere compass system. Patch tests were conducted at the start and end of the survey day to allow computation of angular offsets between the MBES system components. The system was calibrated for local water mass speed of sound by performing conductivity-temperature-depth (CTD) casts at frequent intervals throughout the survey day with a Seabird SBE-19 Seacat CTD profiler. Additional confirmation of proper calibration was obtained using the "bar check" method, in which a metal plate was lowered beneath the MBES transducer to known distances (e.g., 5.0 and 10.0 m) below the water surface. "Bar-check" calibrations were accurate to within 0.05 m in tests conducted at the beginning and end of the survey.

Water depths over the survey area were recorded in meters and referenced to mean lower low water (MLLW) based on water levels recorded at a local tide gage established at the marina in Sandwich, MA. HYPACK MAX® software was used to manage data acquisition and storage of data from the echosounder and the navigation system. HYPACK MAX® also recorded depth, vessel heave, heading, position, and time along each survey transect line.

2.2.2 Bathymetric Data Processing

MBES bathymetric data were processed using HYSWEEP® software. Data for outer beams greater than 60° offset from nadir (vertical) were excluded from processing to minimize the impact of the rough sea states encountered during the survey. Preliminary steps of data processing included: application of tide corrections; adjustment of beam orientation using the results of patch test calibrations; correction of soundings for

minor variations in water column sound velocity; and removal of outlying sounding solutions associated with water column interference (e.g. marine mammals, fish, or suspended debris).

The cleaned and adjusted data were further processed to calculate seafloor elevations based on evaluation of overlapping swath data. Based on the estimated average acoustic footprint of the MBES system, the average sounding solutions present within 3 x 3 m grid cells were accepted as seafloor elevations and exported in delimited ASCII text format for mapping in the geographic information system software program ArcGIS®10.1 (GIS). The vertical uncertainty of soundings within each of these cells was calculated and exported in ASCII format to aid statistical assessment of data quality.

MBES backscatter data were processed using HYPACK®'s implementation of GeoCoder software developed by NOAA's Center for Coastal and Ocean Mapping Joint Hydrographic Center (CCOM/JHC). GeoCoder was used to create a mosaic best suited for substrate characterization through the use of innovative beam-angle correction algorithms.

Snippets backscatter data (beam-specific ping time-series records) were extracted from cleaned files and were converted to Generic Sensor Format (GSF) files. Mosaics of beam time-series (BTS) backscatter data were created from GSF data using GeoCoder, and were exported in grey-scale TIF raster format. BTS data were also exported in ASCII format with fields for Easting, Northing, and backscatter (dB). These data were gridded using kriging algorithms and filtered with a mild low-pass Gaussian filter to minimize nadir artifacts. The filtered grids were used to develop maps of backscatter values using 2 m (horizontal resolution) node intervals.

2.2.3 Bathymetric Data Analysis

Bathymetric data were analyzed to document the distribution of dredged material at CCBDS and to evaluate changes in seafloor topography in comparison with previous surveys. The processed bathymetric grids were converted to rasters and bathymetric contour lines were generated and displayed using GIS.

GIS was also used to calculate depth difference grids between previous surveys and the 2010 bathymetric dataset. Since the most recent bathymetric survey at CCBDS in 2003 only covered the eastern portion of the site (Figure 1-4), the 2001 bathymetric survey was used to generate a depth difference grid for the western portion of CCBDS. The depth difference grids were calculated by subtracting the 2001 or 2003 survey depth estimates from the 2010 survey depth estimates at each point throughout the grid. The resulting depth differences were contoured and displayed using GIS.

2.3 Sediment-Profile and Plan-View Imaging

2.3.1 Sediment-Profile Imaging

Sediment-profile imaging (SPI) is a monitoring technique used to provide data on the physical characteristics of the seafloor as well as the status of the benthic biological community. This technique involves deploying an underwater camera system to photograph a cross section of the sediment-water interface. Acquisition of high-resolution sediment-profile images was accomplished using a Nikon D100 digital single-lens reflex camera mounted inside an Ocean Imaging Model 3731 pressure housing system. The pressure housing sat atop a wedge-shaped prism with a front faceplate and back mirror. The mirror was mounted at a 45° angle to reflect the profile of the sediment-water interface. As the prism penetrated the seafloor, a trigger activated a time-delay circuit that fired an internal strobe to obtain a cross-sectional image of the upper 15–20 cm of the sediment column (Figure 2-2). The camera remained on the seafloor for approximately 20 seconds to ensure that a successful image had been obtained. Details of the camera settings for each digital image are available in the associated parameters file embedded in each electronic image file. For this survey, the ISO-equivalent was set at 640, shutter speed was 1/250, f8, and storage in compressed raw Nikon Electronic Format (NEF) files (approximately 10.5 MB each). Electronic files were converted to high-resolution jpeg (8-bit) format files (2600 x 3900 pixels) using Nikon Capture® NX2 software (Version 2.2.7).

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

Each image was assigned a unique time stamp in the digital file attributes by the camera's data logger and cross-checked with the time stamp in the navigational system's computer data file. In addition, the field crew kept redundant written sample logs. Images were downloaded periodically to verify successful sample acquisition and/or to

assess what type of sediment/depositional layer was present at a particular station. Digital image files were re-named with the appropriate station name immediately after downloading as a further quality assurance step.

2.3.2 Plan-View Imaging

Plan-view underwater images were also collected at each station sampled with the sediment-profile camera. An Ocean Imaging Model DSC6000 plan-view underwater camera (PUC) system with two Ocean Imaging Model 400-37 Deep Sea Scaling lasers was attached to the Model 3731 camera frame and used to collect plan-view photographs on the seafloor surface (Figure 2-2). The PUC system consisted of a Nikon D90 camera encased in titanium housing, a 24 VDC autonomous power pack, a 500W strobe, and a bounce trigger. A weight was attached to the bounce trigger with a stainless steel cable so that the weight hung below the camera frame. Scaling lasers projected two red dots that were separated by a constant distance (26 cm) regardless of the field of view of the PUC, which was varied by increasing or decreasing the length of the trigger wire. For this survey, the trigger wire length was constant (1.0 m), and the area of seafloor imaged was approximately 0.5 m^2 (Appendix D).

As the camera frame was lowered to the seafloor, the weight attached to the bounce trigger contacted the seafloor prior to the camera frame hitting the bottom and triggered the PUC. Details of the camera settings for each digital image are available in the associated parameters file embedded in each electronic image file. For this survey, the ISO-equivalent was set at 800, shutter speed was 1/30, f16, white balance set to flash, color mode to Adobe RGB, sharpening to none, noise reduction off, and storage in compressed raw Nikon Electronic Format (NEF) files (approximately 10.5 MB each). Electronic files were converted to high-resolution jpeg (8-bit) format files (2850 x 4300 pixels) using Nikon Capture® NX2 software (Version 2.2.7).

Prior to field operations, the internal clock in the digital PUC was synchronized with the GPS navigation system and the SPI camera. Each PUC image acquired was assigned a time stamp in the digital file, and redundant notations were made in the field and navigation logs. Throughout the survey, PUC images were downloaded at the same time as the sediment-profile images and evaluated for successful image acquisition and image clarity.

2.3.3 SPI and PUC Data Collection

The sediment-profile and plan-view imaging survey at CCBDS was initiated 21 September 2010 and completed 24 September aboard the F/V First Light. At each station, the vessel was positioned at the target coordinates and the camera was deployed within a defined station tolerance of 10 m (33 ft). Three replicate SPI and plan-view images were collected at each of the stations.

The 2010 imaging survey design included the collection of sediment-profile and plan-view images at 90 stations randomly distributed within preselected areas. To enhance the statistical power of the analysis the number of stations was increased from 26 disposal mound stations and five reference area stations in 2003 to 45 mound stations and 45 reference area stations in 2010 (Table 2-2, Figure 2-3). The 45 stations located within CCBDS were distributed as follows: 15 stations at Mound A, 15 stations at Mound B, and 15 stations at Mound C. The 45 reference stations were distributed among the three reference areas as follows: 15 stations at CCBRS, 15 stations at NWREF, and 15 stations at SWREF. The reference areas were surveyed to provide a basis of comparison between CCBDS sediment conditions and the ambient sediment conditions in Cape Cod Bay.

2.3.4 SPI and PUC Data Analysis

Computer-aided analysis of the resulting images provided a set of standard measurements that enabled comparison between different locations and different surveys. The DAMOS Program has successfully used this technique for over 25 years to map the distribution of disposed dredged material and to monitor benthic recolonization at disposal sites.

Following completion of data collection, the digital images were analyzed using Bersoft Image Measurement© software version 3.06 (Bersoft, Inc.). Images were first adjusted in Adobe Photoshop® to expand the available pixels to their maximum light and dark threshold range. Linear and areal measurements were recorded as number of pixels and converted to scientific units using the Kodak® Color Separation Guide for measurement calibration. Detailed records of all SPI and PUC results are included in Appendices C and D.

2.3.4.1 SPI Data Analysis

Analysis of each SPI image was performed to provide measurement of the following standard set of parameters:

- Sediment Type—The sediment grain size major mode and range were estimated visually from the images using a grain-size comparator at a similar scale. Results

were reported using the phi scale. Conversion to other grain-size scales is provided in Appendix B. The presence and thickness of disposed dredged material were also assessed by inspection of the images.

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

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

- Apparent Redox Potential Discontinuity (aRPD) Depth—aRPD provides a measure of the integrated time history of the balance between near-surface oxygen conditions and biological reworking of sediments. Sediment particles exposed to oxygenated waters oxidize and lighten in color to brown or light grey. As the particles are buried or moved down by biological activity, they are exposed to reduced oxygen concentrations in subsurface pore waters and their oxic coating slowly reduces, changing color to dark grey or black. When biological activity is high, the aRPD depth increases; when it is low or absent, the aRPD depth decreases. The aRPD depth was measured by assessing color and reflectance boundaries within the images.

- Infaunal Successional Stage—Infaunal successional stage is a measure of the biological community inhabiting the seafloor. Current theory holds that organism-sediment interactions in fine-grained sediments follow a predictable sequence of development after a major disturbance (such as dredged material disposal), and this sequence has been divided subjectively into three stages (Rhoads and Germano 1982, 1986). Successional stage was assigned by assessing which types of species or organism-related activities were apparent in the images.

Additional components of the SPI analysis included calculation of means and ranges for the parameters listed above and mapping of means of replicate values from each station.

2.3.4.2 PUC Image Data Analysis

Analysis of each PUC image was performed to provide additional information about large-scale sedimentary features, density and patch size of surface fauna, density of infaunal burrowers, and occurrences and density of epifaunal foraging patterns on the seafloor of the disposal site and reference areas.

2.3.5 Statistical Methods

The data used for statistical analysis were collected from three distinct reference areas (CCBRS, NWREF, and SWREF) and from each of the three disposal mounds (Mounds A, B, and C). Fifteen stations were sampled from each area, and three replicates were collected from each station. The arithmetic mean was calculated from three replicate observations per station.

The objective of the 2010 SPI survey at CCBDS was to assess the benthic recolonization status of the mounds relative to reference conditions. The two SPI parameters which are most indicative of recolonization status, and which also lend themselves to quantitative analysis, are the depth of the aRPD (an indirect measure of the degree of biological reworking of surface sediments) and the infaunal successional stage. For the statistical analysis, the mean value for aRPD (based on n=3 replicate images) was utilized, while the maximum value among the three replicates was used as the successional stage rank for each station. The successional stage ranks had possible values between 0 (no fauna present) and 3 (Stage 3); half ranks were also possible for the "in-between" stages (e.g., Stage 1 going to 2 had a value of 1.5).

Traditionally, the study objective has been addressed using point null hypotheses of the form "There is no difference in benthic conditions between the reference area and the disposal mound." An approach using bioequivalence or interval testing is considered to be more informative than the point null hypothesis test of "no difference". In the real world, there is always some small difference, and the statistical significance of this difference may or may not be ecologically meaningful. Without an associated power analysis, this type of point null hypothesis testing provides an incomplete picture of the results.

In this application of bioequivalence (interval) testing, the null hypothesis presumes the difference is great, i.e., an inequivalence hypothesis (e.g., McBride 1999). This is recognized as a 'proof of safety' approach because rejection of the inequivalence

null hypothesis requires sufficient proof that the difference is actually small. The null and alternative hypotheses to be tested were:

H0: $d \leq -\delta$ or $d \geq \delta$ (presumes the difference is great)

HA: $-\delta < d < \delta$ (requires proof that the difference is small)

where d is the difference between the reference site and disposal mound means.

If the null hypothesis is rejected, then we conclude that the two means are equivalent to one another within ± δ units. The size of δ should be determined from historical data and/or best professional judgment to identify a maximum difference that is within background variability/noise and is therefore not ecologically meaningful. Based on historical DAMOS data, δ values of 1 for aRPD and 0.5 for successional stage rank (on the 0–3 scale) have been established.

The test of the interval hypothesis can be broken down into two one-sided tests (TOST) (McBride 1999 after Schuirmann 1987) which are based on the normal distribution, or, more typically, on Student's t-distribution when sample sizes are small and variances must be estimated from the data. The statistics used to test the interval hypotheses shown here are based on such statistical foundations as the Central Limit Theorem (CLT) and basic statistical properties of random variables. A simplification of the CLT says that the mean of any random variable is normally distributed. Linear combinations of normal random variables are also normal, so a linear function of means is also normally distributed. When a linear function of means is divided by its standard error the ratio follows a t-distribution with degrees of freedom associated with the variance estimate. Hence, the t-distribution can be used to construct a confidence interval around any linear function of means.

In the sampling design utilized in the 2010 SPI survey at CCBDS, there were six distinct areas (three reference areas and three disposal mounds), and the difference equations of interest are the linear contrasts of each mound mean minus the average of the three reference means, or

[⅓(MeanCCBRS + MeanNWRef + MeanSWRef) – (MeanMound)]

where MeanMound was the mean for one of the disposal mounds (Mound = A, B, or C).

The three reference areas collectively represented ambient conditions, but if there were mean differences among these three areas then pooling them into a single reference group would have increased the variance beyond true background variability. The effect

of keeping the three reference areas separate had little effect on the grand reference mean (when n is equal among these areas), but it maintained the variance as a true background variance for each individual population with a constant mean.

The difference equation, $\hat{d}$, for the comparison of interest was:

[⅓(MeanCCBRS + MeanNWRef + MeanSWRef) – (MeanMound)] ……. [Eq.1]

and the standard error of each difference equation was calculated assuming that the variance of a sum is the sum of the variances for independent variables, or:

$$SE(\hat{d}) = \sqrt{\sum_j \left(S_j^2 c_j^2 / n_j\right)} \qquad \text{[Eq.2]}$$

where:

c_j = coefficients for the *j* means in the difference equation, $\hat{d}$ [Eq. 1] (i.e., for equation 1 shown above, the coefficients were 1/3 for each of the 3 reference areas, and -1 for the disposal mound).

S_j^2 = variance for the jth area. If equal variances are assumed, a single pooled residual variance estimate can be substituted for each group, equal to the mean square error from an ANOVA based on all six groups.

nj = number of replicate observations for the j^{th} area.

The inequivalence null hypothesis was rejected (and equivalence is concluded) if the confidence interval on the difference of means, $\hat{d}$, was fully contained within the interval [–□ , + □]. Thus the decision rule was to reject H0 if:

$$D_L = \hat{d} - t_{\alpha,\upsilon} se(\hat{d}) > -\delta \quad \text{and} \quad D_U = \hat{d} + t_{\alpha,\upsilon} se(\hat{d}) < \delta \qquad \text{[Eq. 3]}$$

where:

$\hat{d}$ = observed difference in means between the Reference and Mound

$t_{\alpha,\upsilon}$ = upper 100th percentile of a Student's t-distribution with υ degrees of freedom

$SE(\hat{d})$ = standard error of the difference.

υ = degrees of freedom for the standard error. If a pooled residual variance estimate was used, it was the residual degrees of freedom from an ANOVA on all groups (total number of stations minus the number of groups); if separate variance estimates were used, degrees of freedom were calculated based on the Brown and Forsythe estimation (Zar 1996).

The normality and equal variance assumptions were tested using Shapiro-Wilk's test for normality on the area residuals ($\alpha = 0.05$) and Levene's test for equality of variances ($\alpha = 0.05$) for each of the six areas. If normality for each group was not rejected but equality of variances was, then the variance for the difference equation was based on separate variances for each group. If the three reference areas were determined to have equal variances, then the reference data were combined and a pooled variance estimate was used for the difference equations. If systematic deviations from normality were identified, then a non-parametric bootstrapped interval was used.

Table 2-1.

Summary of Field Activities at CCBDS

Survey Type	Date	Summary
Bathymetry	16 September 2010	Area: 2000 x 2100 m Lines: 29 Spacing: 70 m
Sediment-Profile and Plan-View Imaging	21, 23–24 September 2010	Stations: 90 Disposal Site: 45 Reference Area: 45

Table 2-2.

CCBDS and Reference Area SPI and Plan-View Image Target Locations

Station	Latitude (N)	Longitude (W)	Station	Latitude (N)	Longitude (W)
Disposal Site			**Reference Areas**		
Mound A			Cape Cod Bay Reference Area		
DIS-A1	41° 54.037'	70° 12.713'	REF-CCB-1	41° 57.598'	70° 15.831'
DIS-A2	41° 53.955'	70° 12.651'	REF-CCB-2	41° 57.411'	70° 15.998'
DIS-A3	41° 54.038'	70° 12.802'	REF-CCB-3	41° 57.527'	70° 16.084'
DIS-A4	41° 54.039'	70° 12.840'	REF-CCB-4	41° 57.637'	70° 15.985'
DIS-A5	41° 53.982'	70° 12.891'	REF-CCB-5	41° 57.603'	70° 16.064'
DIS-A6	41° 53.984'	70° 12.700'	REF-CCB-6	41° 57.453'	70° 15.912'
DIS-A7	41° 53.947'	70° 12.818'	REF-CCB-7	41° 57.463'	70° 16.034'
DIS-A8	41° 53.997'	70° 12.752'	REF-CCB-8	41° 57.503'	70° 15.797'
DIS-A9	41° 54.090'	70° 12.797'	REF-CCB-9	41° 57.442'	70° 16.115'
DIS-A10	41° 54.032'	70° 12.666'	REF-CCB-10	41° 57.524'	70° 15.867'
DIS-A11	41° 54.084'	70° 12.707'	REF-CCB-11	41° 57.482'	70° 15.925'
DIS-A12	41° 54.102'	70° 12.650'	REF-CCB-12	41° 57.384'	70° 15.879'
DIS-A13	41° 53.946'	70° 12.721'	REF-CCB-13	41° 57.600'	70° 15.924'
DIS-A14	41° 54.139'	70° 12.739'	REF-CCB-14	41° 57.521'	70° 15.950'
DIS-A15	41° 54.080'	70° 12.881'	REF-CCB-15	41° 57.526'	70° 16.137'
Mound B			Northwest Reference Area		
DIS-B1	41° 54.577'	70° 12.931'	REF-NW-1	41° 55.787'	70° 14.725'
DIS-B2	41° 54.713'	70° 12.939'	REF-NW-2	41° 56.064'	70° 14.653'
DIS-B3	41° 54.543'	70° 12.900'	REF-NW-3	41° 55.854'	70° 14.607'
DIS-B4	41° 54.553'	70° 12.831'	REF-NW-4	41° 55.961'	70° 14.825'
DIS-B5	41° 54.666'	70° 12.911'	REF-NW-5	41° 55.909'	70° 14.655'
DIS-B6	41° 54.785'	70° 12.851'	REF-NW-6	41° 55.795'	70° 14.622'
DIS-B7	41° 54.712'	70° 13.001'	REF-NW-7	41° 55.956'	70° 14.575'
DIS-B8	41° 54.794'	70° 12.959'	REF-NW-8	41° 55.987'	70° 14.696'
DIS-B9	41° 54.666'	70° 12.967'	REF-NW-9	41° 55.833'	70° 14.792'
DIS-B10	41° 54.683'	70° 12.853'	REF-NW-10	41° 55.864'	70° 14.536'
DIS-B11	41° 54.669'	70° 12.761'	REF-NW-11	41° 55.887'	70° 14.843'
DIS-B12	41° 54.690'	70° 13.095'	REF-NW-12	41° 55.857'	70° 14.706'
DIS-B13	41° 54.592'	70° 12.772'	REF-NW-13	41° 56.001'	70° 14.587'
DIS-B14	41° 54.630'	70° 13.055'	REF-NW-14	41° 55.953'	70° 14.520'
DIS-B15	41° 54.598'	70° 12.981'	REF-NW-15	41° 56.002'	70° 14.754'

Table 2-2. (continued)

CCBDS and Reference Area SPI and Plan-View Image Target Locations

Station	Latitude (N)	Longitude (W)	Station	Latitude (N)	Longitude (W)
	Disposal Site			**Reference Areas**	
	Mound C			Southwest Reference Area	
DIS-C1	41° 54.599'	70° 13.653'	REF-SW-1	41° 52.881'	70° 16.095'
DIS-C2	41° 54.752'	70° 13.746'	REF-SW-2	41° 53.008'	70° 15.940'
DIS-C3	41° 54.634'	70° 13.572'	REF-SW-3	41° 52.745'	70° 15.927'
DIS-C4	41° 54.629'	70° 13.729'	REF-SW-4	41° 52.784'	70° 16.087'
DIS-C5	41° 54.567'	70° 13.509'	REF-SW-5	41° 52.875'	70° 16.205'
DIS-C6	41° 54.668'	70° 13.630'	REF-SW-6	41° 52.839'	70° 16.140'
DIS-C7	41° 54.658'	70° 13.783'	REF-SW-7	41° 52.799'	70° 15.866'
DIS-C8	41° 54.693'	70° 13.663'	REF-SW-8	41° 52.953'	70° 15.935'
DIS-C9	41° 54.742'	70° 13.589'	REF-SW-9	41° 52.853'	70° 16.070'
DIS-C10	41° 54.501'	70° 13.646'	REF-SW-10	41° 52.973'	70° 16.114'
DIS-C11	41° 54.706'	70° 13.813'	REF-SW-11	41° 52.930'	70° 16.160'
DIS-C12	41° 54.602'	70° 13.826'	REF-SW-12	41° 52.787'	70° 15.977'
DIS-C13	41° 54.544'	70° 13.710'	REF-SW-13	41° 52.999'	70° 16.034'
DIS-C14	41° 54.573'	70° 13.601'	REF-SW-14	41° 52.937'	70° 16.005'
DIS-C15	41° 54.697'	70° 13.500'	REF-SW-15	41° 52.870'	70° 15.916'

Notes: Coordinate system NAD83

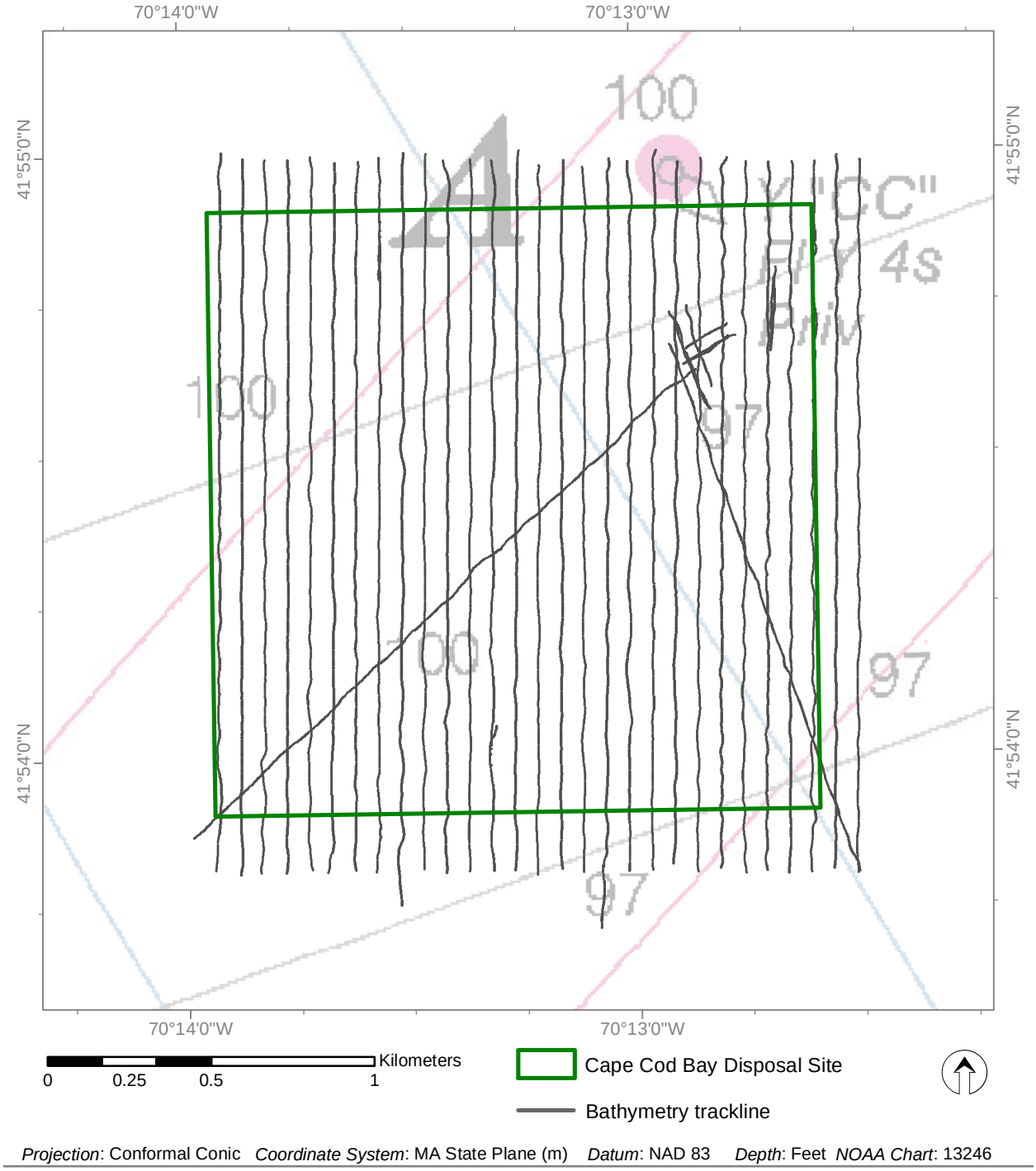


Figure 2-1. CCBDS bathymetry survey boundary and tracklines

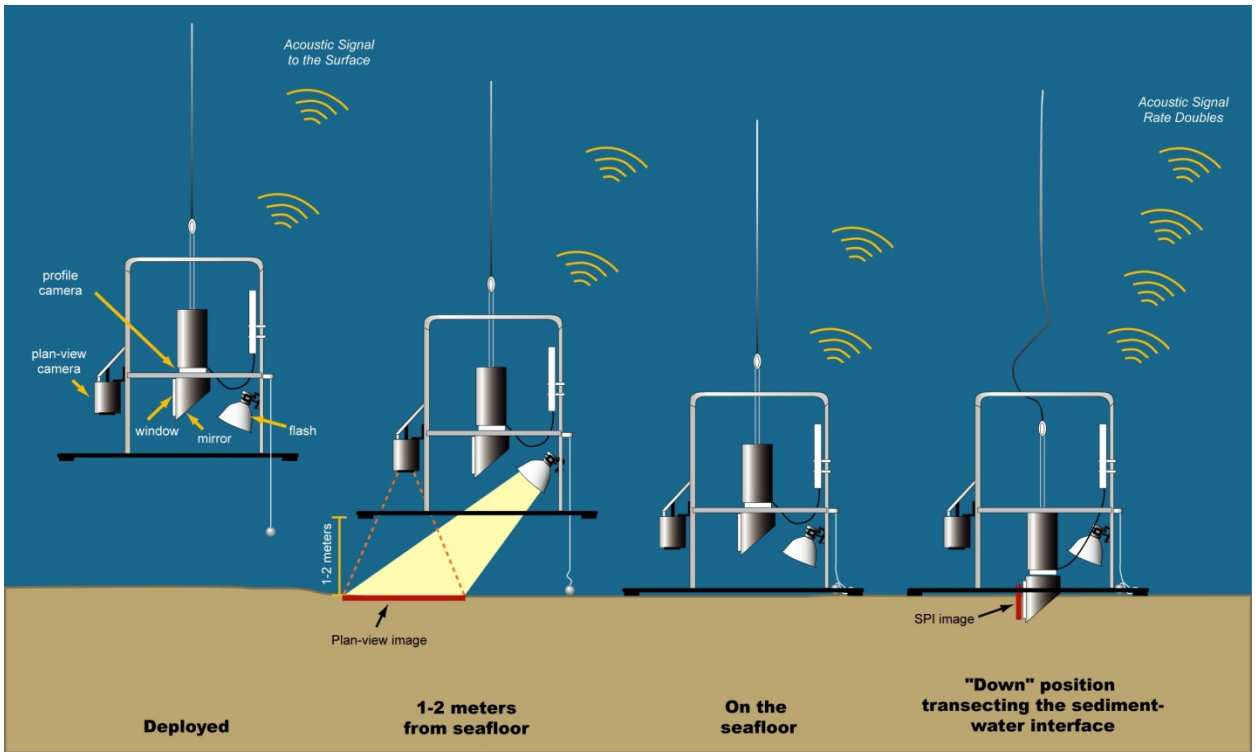


Figure 2-2. Operation of the combined Ocean Imaging Model 3731 sediment-profile and Model DSC-6000 plan view cameras

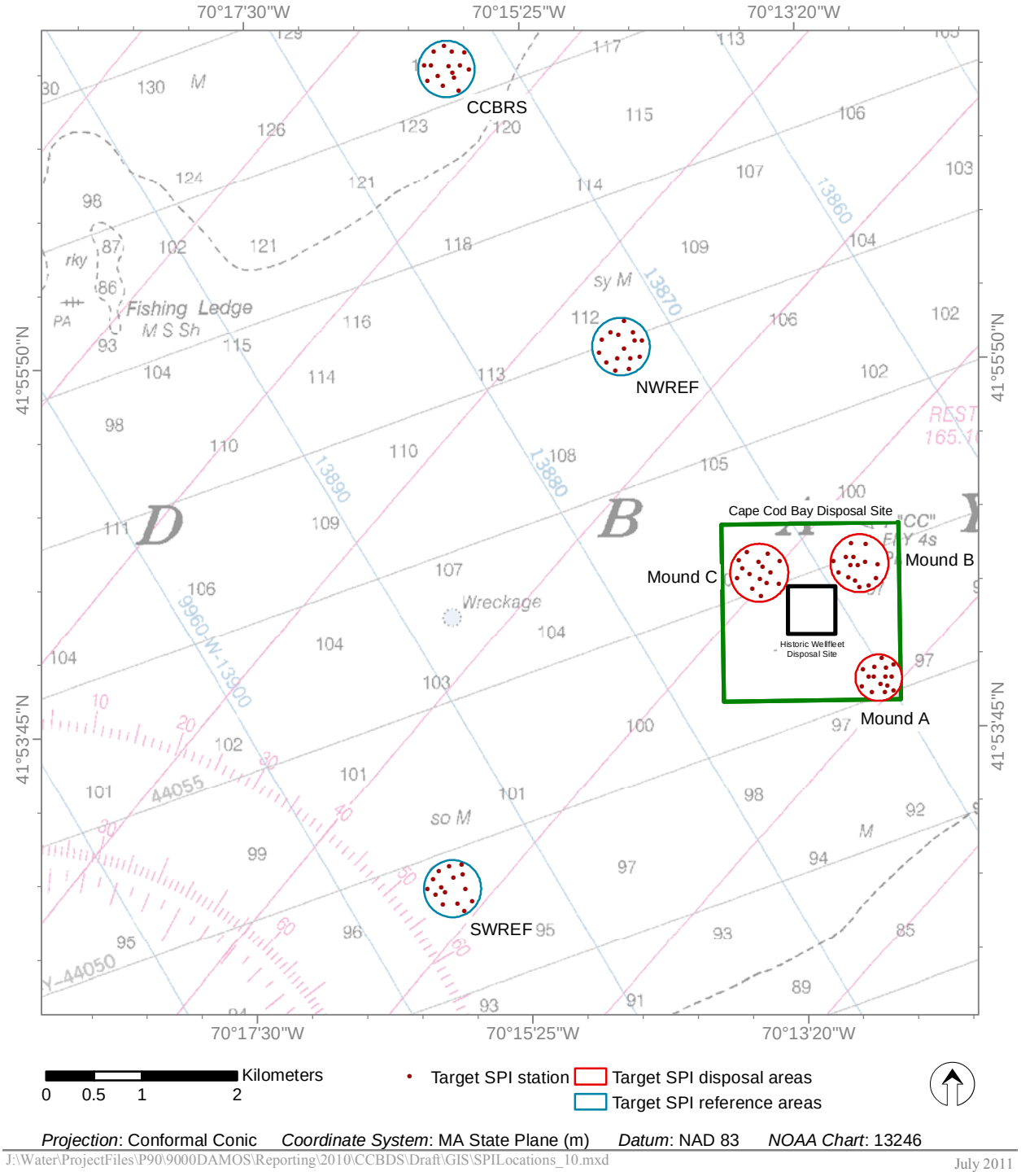


Figure 2-3. CCBDS and reference area SPI and plan-view target locations

3.0 RESULTS

3.1 Bathymetry and Backscatter

The 2010 bathymetric survey of CCBDS was completed on 15 September despite adverse weather conditions that developed through the day, including strong winds (approximately 15–20 knots) and breaking waves which approached 2 m heights by the completion of the survey. An underlying storm swell was irregular and ranged from approximately 0.1 to 0.5 m during the survey.

3.1.1 Bathymetric Data Quality

In order to assess data quality across the MBES swath, cell depth variations were mapped and statistically evaluated. The average error within bathymetric grid cells for the CCBDS survey was 0.07 m (95th % Confidence Interval [C.I.]). USACE Guidance for Hydrographic Surveying (EM 1110-2-1003) provides performance standards for data acquired in depths up to 80 feet (24.4 meters). The performance standard for data accuracy in this depth range was 0.61 m at the 95th % C.I.. Despite the adverse survey conditions, the data from the 2010 CCBDS survey exceeded the USACE performance standard.

3.1.2 Bathymetric Results

The seafloor within CCBDS sloped gently and evenly from the southeast to the northwest with an average slope of approximately 0.75 m/km. (Figure 3-1). Water depths at the site ranged from over 31 m (101 ft) in the northwest corner to less than 24 m (79 ft) over Mound B.

The Historic Wellfleet Disposal Site remained evident as an irregularly shaped 0.5 m rise in the center of CCBDS. Mound A, in the southeastern corner of CCBDS, had a diameter of approximately 250 m and rose 1 m above the surrounding seafloor. The most prominent feature at the site was Mound B in the northeastern quadrant, with a footprint of 400 m and a height of 6 m over the ambient seafloor.

The new mound in the northwestern quadrant of the site, identified as Mound C, was barely discernable in the bathymetry but showed a slight rise of about 0.5 m from the surrounding seafloor with several small 1 m high areas (Figure 3-2). There were numerous individual depressions, approximately 0–1 m deep, throughout the northwest quadrant of CCBDS, likely associated with individual disposal events.

Depth difference calculations between the 2003 and 2010 bathymetric datasets were limited to the extent of the 2003 survey which did not include the western portion of CCBDS (Figure 3-3). Results from this comparison showed isolated areas of less than a meter of depth increase on Mound A and areas of both depth increase and decrease on the surface of Mound B. Surficial sediments of Mound B appear to have been scoured from the northwestern side of the mound apex and redeposited on the southeastern side of the peak with some depth changes of as much as 1.5 m since the 2003 survey. The extents of these depth changes were limited in comparison to the overall size of this large mound.

The last complete bathymetric survey of CCBDS (2001) was used to evaluate depth changes over the western portion of the site and the formation of Mound C since disposal activities began in that area in 2003. This analysis suggested that Mound C exists as a wide, irregular formation on the seafloor with a diameter of over 400 m (Figure 3-4). The majority of the mound rises only 0.5–0.75 m with small pockets extending up to 1.0 meter above the 2001 survey depths. Small-scale survey artifacts (0.1–0.5 m) were apparent in the depth differencing calculations (Figure 3-4) and were likely the result of adverse sea conditions encountered during data collection.

3.1.3 Backscatter Results

Sonar imagery and modeled backscatter (in dB) suggested an ambient seafloor backscatter signal of approximately -37.4 dB. Portions of the seafloor which appeared to consist of dredged material, based on sonar imagery and relief models, possessed higher backscatter values ranging from approximately -36.5 dB to -24 dB (Figure 3-5). Backscatter imagery also suggested the widespread presence of low relief disposal artifacts across the survey area, with a higher concentration of these artifacts in the northwestern quadrant of the survey area. Dominant artifacts included isolated and clustered relatively small (10–40 m diameter) points of high backscatter associated with individual disposal events and a narrow linear feature greater than 1 km long that stretched across Mound C and appeared to extend to the southern boundary of CCBDS (Figure 3-5). The point features were generally associated with seafloor depressions approximately 0–1 m deep. The major linear feature may be associated with an underway disposal event or be evidence of trawling activity at CCBDS.

3.2 Sediment-Profile and Plan-View Imaging

Detailed image analysis results are provided in Appendices C (SPI) and D (PUC). The following sections summarize the results for the reference areas and for each of the three disposal mounds. Statistical comparisons between the reference area and disposal mound SPI results for 2010 are also presented.

3.2.1 Reference Areas

Physical Sediment Characteristics

All three of the reference areas were characterized by soft muddy sediment having a grain size major mode of >4 phi (silt-clay; Table 3-1). Sediment texture and color were uniform across all three reference areas, and no dredged material was detected in any of the images. Penetration of the camera prism into the soft mud was consistently deep; mean penetration depths at most stations ranged from 15 to 20 cm (Table 3-1; Figures 3-6 and 3-7). Mean small-scale boundary roughness values at most stations were between 1 and 2 cm, and almost all of this roughness was related to biological activity (Table 3-1 and Figure 3-8).

Biological Conditions

Mean aRPD depths ranged from 3 to 5 cm at the majority of the reference area stations (Table 3-1 and Figure 3-9). These relatively deep values were indicative of a high degree of sediment aeration from biological reworking. In contrast to the deep aRPD depths measured at CCBRS and NWREF, five stations in the SWREF area had replicate aRPD depths that ranged from 1.6 to 3.0 cm (Figure 3-9). However, the mean values at these five stations were relatively deep (2.7 to 2.9 cm; Table 3-1) and indicative of extensive, biologically-mediated sediment aeration.

All of the reference area stations were characterized by an advanced infaunal successional status of Stage 1 on 3 or Stage 2 on 3 (Table 3-1 and Figure 3-10). A Stage 1 on 3 designation was based on the presence of small, tube-dwelling polychaetes at the sediment surface together with Stage 3 evidence such as subsurface feeding voids, burrows, tubes, and/or larger-bodied infauna (Figures 3-11 and 3-12). Stage 2 on 3 was characterized by the presence of small, light-colored bivalves (most likely Nucula sp.) at or just below the sediment surface, together with feeding voids, burrows, or larger-bodied organisms at depth (Figure 3-13).

Brittle stars (Ophiuroids) were highly abundant at the CCBRS and NWREF reference areas but were not visible in any of the images from SWREF. Specifically, dense aggregations of these organisms were visible in all of the plan-view images from CCBRS and 87% of the images from NWREF (Figure 3-14). Brittle star arms extending above the sediment surface were seen in some of the profile images from these two reference areas (Figure 3-15). Numerous burrow openings and organism tracks also were visible in many of the plan-view images from all three reference areas, providing additional evidence of extensive biological activity taking place at and beneath the sediment surface.

3.2.2 Disposal Mounds A, B, and C

Dredged Material Distribution and Physical Sediment Characteristics

Dredged material was observed in the SPI images at all fifteen of the stations at each of the three disposal mounds. At each station, the dredged material extended from the sediment-water interface to the bottom of the profile image, indicating that the actual dredged material thickness was greater than the prism penetration depth (Table 3-2).

At the majority of stations over Mounds A and B, the dredged material consisted of soft mud with a characteristic signature: light-colored sediment comprising the surface redox layer overlying very dark or black, highly reduced sediment at depth (Figure 3-16). At Mound B, Station 2 had a small patch of wood fibers at depth, Stations 5 and 10 had sandy dredged material, and Station 9 had a distinct mud-over-sand stratigraphy (Figure 3-17).

The dredged material comprising the surface of Mound C consisted primarily of silt/clay, similar to the sediment at Mounds A and B. Compared to these latter two mounds, however, the dredged material observed at the majority of Mound C stations was lighter in color, particularly at depth below the surficial oxidized layer (Figure 3-18). The lighter color of the underlying sediment suggests lesser reducing conditions within the surface sediments of Mound C stations compared to those over Mounds A and B (compare Figures 3-16 and 3-18).

In further contrast to Mounds A and B, there was distinct layering of dredged material visible in the profile images at 14 of the 15 Mound C stations (Figure 3-19). This is attributed to the more recent disposal activity at Mound C compared to the older Mounds A and B. Small patches of wood fibers with a distinct reddish-brown color were also observed at depth in the profile images from Stations 4, 7, and 13 (Figure 3-20).

Surface sediments over all three mounds consisted of silt/clay with a grain size major mode of >4 phi (Table 3-2 and Figure 3-21). Mound B was the largest of the three features, with a distinct central mound. Two stations (Stations 5 and 10) located at the apex of Mound B and on one of its more steeply sloping sides, were characterized by fine sand overlying finer-grained sediment at depth. The surface sand might be a lag deposit resulting from selective winnowing of finer-grained sediment by tidal currents that are enhanced as they flow over the mound apex, or there may have been individual loads of dredged material containing coarser sediment that were placed at this location (Figure 3-22). There also was some evidence of isolated layers of coarse sediment below the surface at Mound B (Figure 3-21).

Mean prism penetration depths were relatively deep over all three of the mounds (7.0–20.9 cm with a mean of 15.6 cm), reflecting the widespread presence of primarily soft, muddy dredged material (Table 3-2 and Figure 3-23). Lower penetration at Stations 5 (7.0 cm) and 10 (8.1 cm) on Mound B reflected the presence of compact, sandy sediment near the mound apex. Penetration values at the Mound C stations were lower, on average, than at the two older mounds (Figure 3-23), possibly due to relatively firm, cohesive clay comprising the subsurface sediment at a number of the Mound C stations.

Most of the mean boundary roughness values were between 1 and 2 cm and showed very little variation across the three mounds (Table 3-2). This moderate boundary roughness was attributed both to physical and biological factors at each of the mounds (Figure 3-24).

Biological Conditions

Mean aRPD depths ranged between 2 and 4 cm at the majority of stations over the three disposal mounds (Table 3-2 and Figure 3-25). As noted for the reference sites, such values indicate a relatively high degree of sediment aeration from biological reworking. There was a strong color contrast between the oxidized surface layer and the underlying black, reduced sediment at many of the Mound A and B stations (Figure 3-16). The color contrast marking the aRPD was less pronounced at most of the Mound C stations (Figure 3-18). Methane gas vesicles, resulting from anaerobic decomposition of organic matter at depth, were present in only one replicate image (Station 7 on Mound B, Figure 3-26). None of the other stations over the three disposal mounds showed any evidence of low dissolved oxygen conditions or subsurface methane production.

Similar to the reference area, advanced successional conditions were widespread across all three of the disposal mounds. Specifically, there was evidence of Stage 3 infauna at all of the stations over each of the three mounds and almost all replicates (Table 3-2 and Figure 3-27). The only non-Stage 3 replicates were located on Mound A: Station 13 had one replicate showing only Stage 1, and Station 8 had one replicate where the successional stage could not be determined.

Evidence of Stage 3 succession included burrows, feeding voids, and larger-bodied organisms present below the sediment surface (Figure 3-28). The evidence of Stage 3 succession was typically accompanied by small Stage 1 tubes at the sediment-water interface (Stage 1 on 3) or small Stage 2 bivalves (probably Nucula sp.) occurring at or just below the sediment surface (Stage 2 on 3) (Table 3-2). The small, light-colored Stage 2 bivalves were relatively rare at Mounds A and B, occurring in only 11% and 2% of the replicate images, respectively. In contrast, these bivalves were relatively abundant at Mound C where they were visible in 47% of the images (Figure 3-29).

Approximately 85% of the replicate PUC images from the three mounds showed burrow openings at the sediment surface, providing additional evidence of the presence of Stage 3 infauna (Figure 3-30). In contrast to their abundance at the CCBRS and NWREF reference areas, brittle stars were rarely observed at the sediment surface in the PUC images from the three disposal mounds, occurring only at Mound A Station 1 and Mound B Stations 3, 12, and 13 (Figure 3-31). Organism tracks, most likely from crabs, were visible in 87% of the replicate PUC images from the three disposal mounds (Figure 3-32). In a small number of the PUC images, crabs, seastars and juvenile flatfish were also visible (Figure 3-33).

3.3 Statistical Comparisons of Mound and Reference Stations

A summary of the mean aRPD and successional stage rank values by sampling location are shown in Table 3-3 and Figure 3-34. The statistical comparison results for each variable follow.

Mean aRPD Variable

The data from all six groups (three reference areas and three disposal mounds) were combined to assess normality and estimate pooled variance. Results for the normality test indicated that the area residuals (i.e., each observation minus the area mean) were normally distributed (Shapiro-Wilk's test p-value = 0.47). Group standard deviations ranged from 0.35 to 0.7 (Table 3-3). Levene's test for equality of variances was not rejected ($p = 0.26$), so a single pooled variance estimate was used for all groups.

When the confidence region for the difference between the mean of the reference areas and each mound is fully contained within the interval [-1, +1], it can be concluded the two means were significantly equivalent. Although all three disposal mounds had slightly lower RPD values than reference, with differences in means ranging from 0.22 to 0.74 cm, these differences were not statistically significant (Table 3-4). The mean aRPD depths over each of the three disposal mounds were assessed as significantly similar to those at the reference areas.

Successional Stage Rank Variable

All mounds and reference areas were characterized by an advanced successional status of Stage 3 or equivalent. With identical means and zero variance, no statistics were needed for comparisons between reference and mounds to conclude statistical equivalence in the successional stage variable.

Table 3-1.

Summary SPI Results (station means) at the Cape Cod Bay Reference Areas

Reference Area	Station	Grain Size Major Mode (phi)	Mean Prism Penetration Depth (cm)	Mean Boundary Roughness (cm)	Mean aRPD Depth (cm)	Mean Dredged Material Thickness (cm)	Successional Stages Present (no. of replicates)
CCBRS	REF1-1	>4	15.9	1.5	4.2	0	1 on 3 (3)
	REF1-2	>4	15.4	2.0	3.6	0	1 on 3 (3)
	REF1-3	>4	15.8	1.2	4.3	0	1 on 3 (3)
	REF1-4	>4	19.1	1.2	4.7	0	1 on 3 (3)
	REF1-5	>4	14.6	1.6	3.2	0	1 on 3 (3)
	REF1-6	>4	13.6	2.4	3.8	0	1 on 3 (3)
	REF1-7	>4	14.3	2.4	3.5	0	1 on 3 (3)
	REF1-8	>4	15.7	1.3	3.1	0	1 on 3 (3)
	REF1-9	>4	15.4	1.7	3.6	0	1 on 3 (3)
	REF1-10	>4	15.8	0.6	3.7	0	1 on 3 (3)
	REF1-11	>4	16.6	1.4	3.8	0	1 on 3 (2); 2 on 3 (1)
	REF1-12	>4	14.7	1.0	3.0	0	1 on 3 (3)
	REF1-13	>4	16.1	1.0	4.2	0	1 on 3 (3)
	REF1-14	>4	17.1	1.1	3.6	0	1 on 3 (3)
	REF1-15	>4	16.6	2.7	3.1	0	1 on 3 (3)
	Mean		**15.8**	**1.5**	**3.7**		
NWREF	REF2-1	>4	18.2	1.3	3.5	0	1 on 3 (2); 2 on 3 (1)
	REF2-2	>4	19.4	1.4	3.1	0	1 on 3 (1); 3 (1); 2 on 3 (1)
	REF2-3	>4	17.0	1.7	3.8	0	2 on 3 (2); ind (1)
	REF2-4	>4	16.7	2.6	4.0	0	1 on 3 (3)
	REF2-5	>4	15.4	0.8	4.2	0	1 on 3 (3)
	REF2-6	>4	19.8	1.1	1.7	0	1 on 3 (3)
	REF2-7	>4	20.1	0.4	3.3	0	1 on 3 (2); 3 (1)
	REF2-8	>4	18.1	1.6	3.7	0	1 on 3 (3)
	REF2-9	>4	19.6	1.0	4.5	0	1 on 3 (3)
	REF2-10	>4	20.8	1.3	3.7	0	1 on 3 (2); 2 on 3 (1)
	REF2-11	>4	19.7	1.4	3.8	0	1 on 3 (3)
	REF2-12	>4	19.7	0.9	3.6	0	1 on 3 (3)
	REF2-13	>4	19.0	1.9	2.5	0	1 on 3 (3)
	REF2-14	>4	18.2	1.6	4.1	0	1 on 3 (2); 2 on 3 (1)
	REF2-15	>4	20.9	1.8	3.5	0	1 on 3 (3)
	Mean		**18.8**	**1.4**	**3.5**		

Table 3-1. (continued)

Reference Area	Station	Grain Size Major Mode (phi)	Mean Prism Penetration Depth (cm)	Mean Boundary Roughness (cm)	Mean RPD Depth (cm)	Mean Dredged Material Thickness (cm)	Successional Stages Present (no. of replicates)
SWREF	REF3-1	>4	19.8	1.0	3.2	0	1 on 3 (3)
	REF3-2	>4	17.9	1.4	3.2	0	1 on 3 (3)
	REF3-3	>4	17.1	1.4	3.1	0	1 on 3 (3)
	REF3-4	>4	15.9	1.6	2.8	0	2 on 3 (2); 1 on 3 (1)
	REF3-5	>4	15.5	2.0	3.9	0	2 on 3 (2); 1 on 3 (1)
	REF3-6	>4	17.7	1.4	2.7	0	1 on 3 (2); 2 on 3 (1)
	REF3-7	>4	18.2	0.9	2.7	0	1 on 3 (3)
	REF3-8	>4	16.5	1.0	3.4	0	1 on 3 (3)
	REF3-9	>4	16.1	1.2	3.7	0	1 on 3 (3)
	REF3-10	>4	17.0	2.1	3.3	0	1 on 3 (3)
	REF3-11	>4	15.7	1.0	3.1	0	1 on 3 (2); 2 on 3 (1)
	REF3-12	>4	14.8	1.3	3.1	0	1 on 3 (3)
	REF3-13	>4	15.6	1.6	2.9	0	2 on 3 (3)
	REF3-14	>4	17.7	1.2	3.4	0	2 on 3 (2); 1 on 3 (1)
	REF3-15	>4	16.5	1.3	2.9	0	1 on 3 (3)
	Mean		**16.8**	**1.4**	**3.2**		

Table 3-2.

Summary SPI Results (station means) at Disposal Mounds A, B, and C within CCBDS

Mound	Station	Grain Size Major Mode (phi)	Mean Prism Penetration Depth (cm)	Mean Boundary Roughness (cm)	Mean aRPD Depth (cm)	Mean Dredged Material Thickness (cm)	Successional Stages Present (no. of replicates)
Mound	A-1	>4	17.7	1.0	3.9	>17.7	1 on 3 (2); 2 - 3 (1)
A	A-2	>4	19.0	0.9	3.2	>19.0	1 on 3 (3)
	A-3	>4	10.2	1.6	2.8	>10.2	2 - 3 (2); 1 on 3 (1)
	A-4	>4	18.0	1.0	2.2	>18	1 on 3 (3)
	A-5	>4	15.8	0.7	3.3	>15.8	1 on 3 (3)
	A-6	>4	16.4	1.6	3.0	>16.4	1 on 3 (3)
	A-7	>4	17.4	1.3	2.5	>17.4	1 on 3 (3)
	A-8	>4	16.8	2.3	2.9	>16.8	1 on 3 (2); ind (1)
	A-9	>4	16.9	0.7	3.2	>16.9	1 on 3 (3)
	A-10	>4	17.4	1.6	3.9	>17.4	1 on 3 (3)
	A-11	>4	18.1	1.6	2.5	>18.1	1 on 3 (3)
	A-12	>4	16.2	1.5	3.6	>16.2	1 on 3 (3)
	A-13	>4	19.0	1.1	2.4	>19.0	2 - 3 (1); 1 on 3 (1); 1 (1)
	A-14	>4	18.5	0.8	3.0	>18.5	1 on 3 (2); 2 on 3 (1)
	A-15	>4	14.9	1.7	2.8	>14.9	1 on 3 (3)
	Mean		**16.8**	**1.3**	**3.0**		
Mound	B-1	>4	18.6	1.4	2.2	>18.6	1 on 3 (3)
B	B-2	>4	18.5	1.0	3.5	>18.5	1 on 3 (3)
	B-3	>4	18.4	0.9	2.0	>18.4	1 on 3 (3)
	B-4	>4	18.6	1.7	1.5	>18.6	1 on 3 (3)
	B-5	>4 to 3	7.0	1.4	2.1	>7.0	1 on 3 (2); 2 - 3 (1)
	B-6	>4	17.9	1.5	3.1	>17.9	1 on 3 (3)
	B-7	>4	14.9	0.7	2.5	>14.9	1 on 3 (3)
	B-8	>4	16.7	0.9	2.8	>16.7	1 on 3 (3)
	B-9	>4/3–2	19.4	1.1	3.0	>19.4	1 on 3 (3)
	B-10	>4 to 3	8.1	1.0	2.8	>8.1	1 on 3 (3)
	B-11	>4	15.7	1.4	3.2	>15.7	1 on 3 (3)
	B-12	>4	15.9	1.6	2.5	>15.9	1 on 3 (3)
	B-13	>4	16.3	1.8	4.0	>16.3	1 on 3 (3)
	B-14	>4	20.9	1.2	3.4	>20.9	1 on 3 (3)
	B-15	>4	18.9	1.6	2.3	>18.9	1 on 3 (3)
	Mean		**16.4**	**19.3**	**2.7**		

Table 3-2. (continued)

Mound	Station	Grain Size Major Mode (phi)	Mean Prism Penetration Depth (cm)	Mean Boundary Roughness (cm)	Mean RPD Depth (cm)	Mean Dredged Material Thickness (cm)	Successional Stages Present (no. of replicates)
Mound C	C-1	>4	11.2	1.6	3.7	>11.2	1 on 3 (3)
	C-2	>4	13.6	1.2	3.1	>13.6	1 on 3 (2); 2 on 3 (1)
	C-3	>4	14.6	1.4	3.0	>14.6	1 on 3 (2); 2 on 3 (1)
	C-4	>4	16.0	0.9	4.4	>16.0	2 on 3 (3)
	C-5	>4	11.5	0.9	2.9	>11.5	1 on 3 (2); 2 - 3 (1)
	C-6	>4	15.9	1.2	3.2	>15.9	1 on 3 (3)
	C-7	>4	13.3	1.5	3.2	>13.3	2 on 3 (3)
	C-8	>4	13.8	1.0	3.0	>13.8	2 on 3 (2); 1 on 3 (1)
	C-9	>4	10.9	1.6	2.8	>10.9	2 on 3 (3)
	C-10	>4	12.3	1.2	2.4	>12.3	1 on 3 (2); 2 on 3 (1)
	C-11	>4	10.7	1.3	3.4	>10.7	2 on 3 (2); 1 on 3 (1)
	C-12	>4	12.8	1.7	3.5	>12.8	2 on 3 (2); 1 on 3 (1)
	C-13	>4	15.5	0.9	2.9	>15.5	1 on 3 (2); 2 on 3 (1)
	C-14	>4	15.2	1.1	3.6	>15.2	1 on 3 (2); 2 on 3 (1)
	C-15	>4	15.0	1.1	3.5	>15.0	1 on 3 (3)
	Mean		**13.5**	**1.2**	**3.2**		

Table 3-3.

Summary of Station Means by Sampling Location

		Mean aRPD (cm)		Successional Stage Rank	
Site	**N**	**Mean**	**Standard Deviation**	**Mean**	**Standard Deviation**
Reference Areas					
CCBRS	15	3.7	0.49	3	0
NWREF	15	3.5	0.7	3	0
SWREF	15	3.2	0.35	3	0
Mean		3.5		3	
Disposal Mounds					
A	15	3.0	0.52	3	0
B	15	2.7	0.66	3	0
C	15	3.2	0.47	3	0

Table 3-4.

Summary Statistics and Results of Inequivalence Hypothesis Testing for aRPD Values

Difference Equation	Observed Difference ($\hat{d}$)	SE ($\hat{d}$)	df for SE ($\hat{d}$)	95% Confidence Bounds (lower–upper)	Results
$Mean_{REF} - Mean_{MoundA}$	0.45	0.16	84	0.18–0.72	s
$Mean_{REF} - Mean_{MoundB}$	0.74	0.16	84	0.47–1	s
$Mean_{REF} - Mean_{MoundC}$	0.22	0.16	84	-0.05–0.49	s

d = Fail to reject the inequivalence hypothesis: the two group means are significantly different

s = Reject the inequivalence hypothesis: the two group means are significantly similar

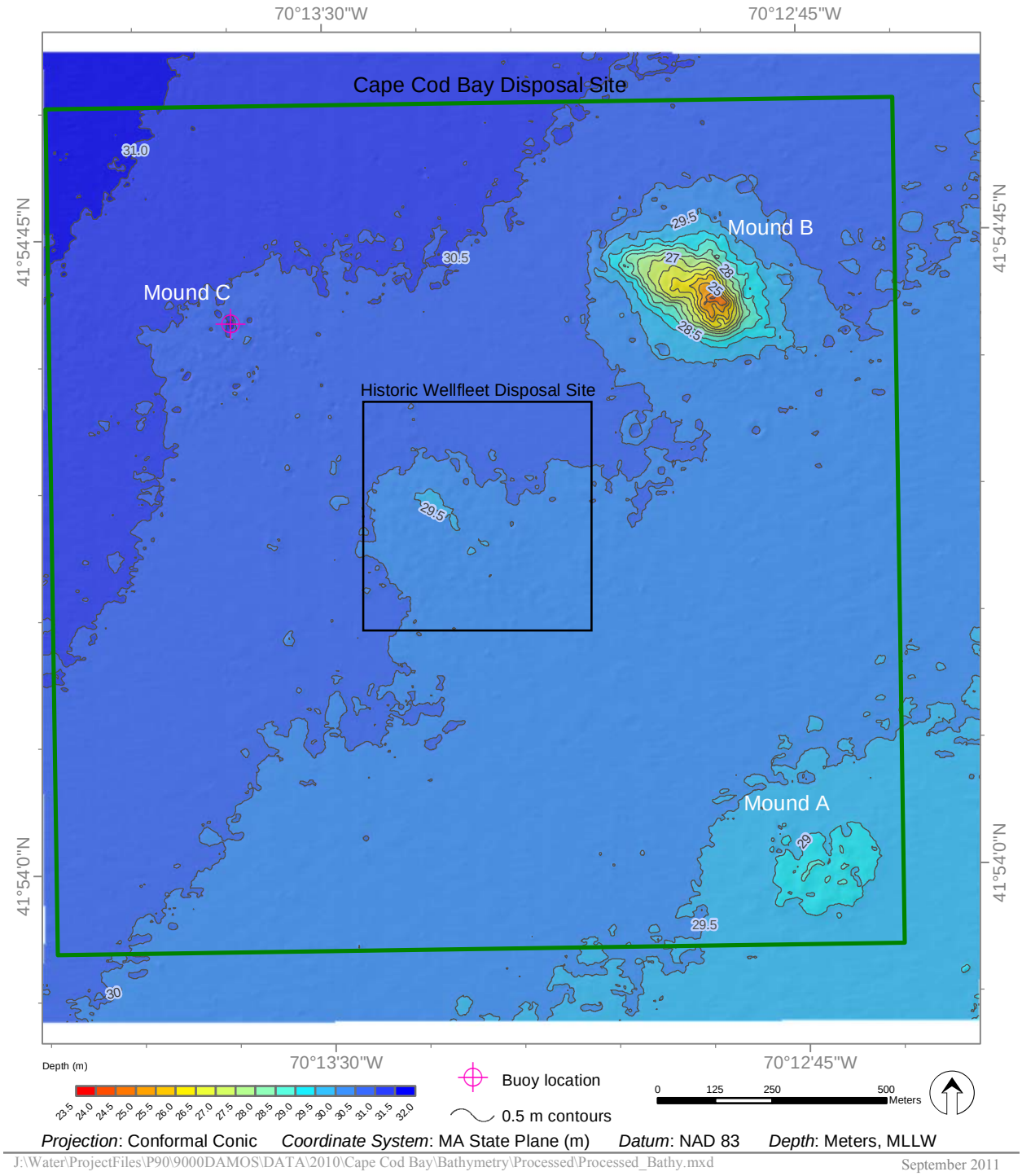


Figure 3-1. Bathymetry of CCBDS, September 2010

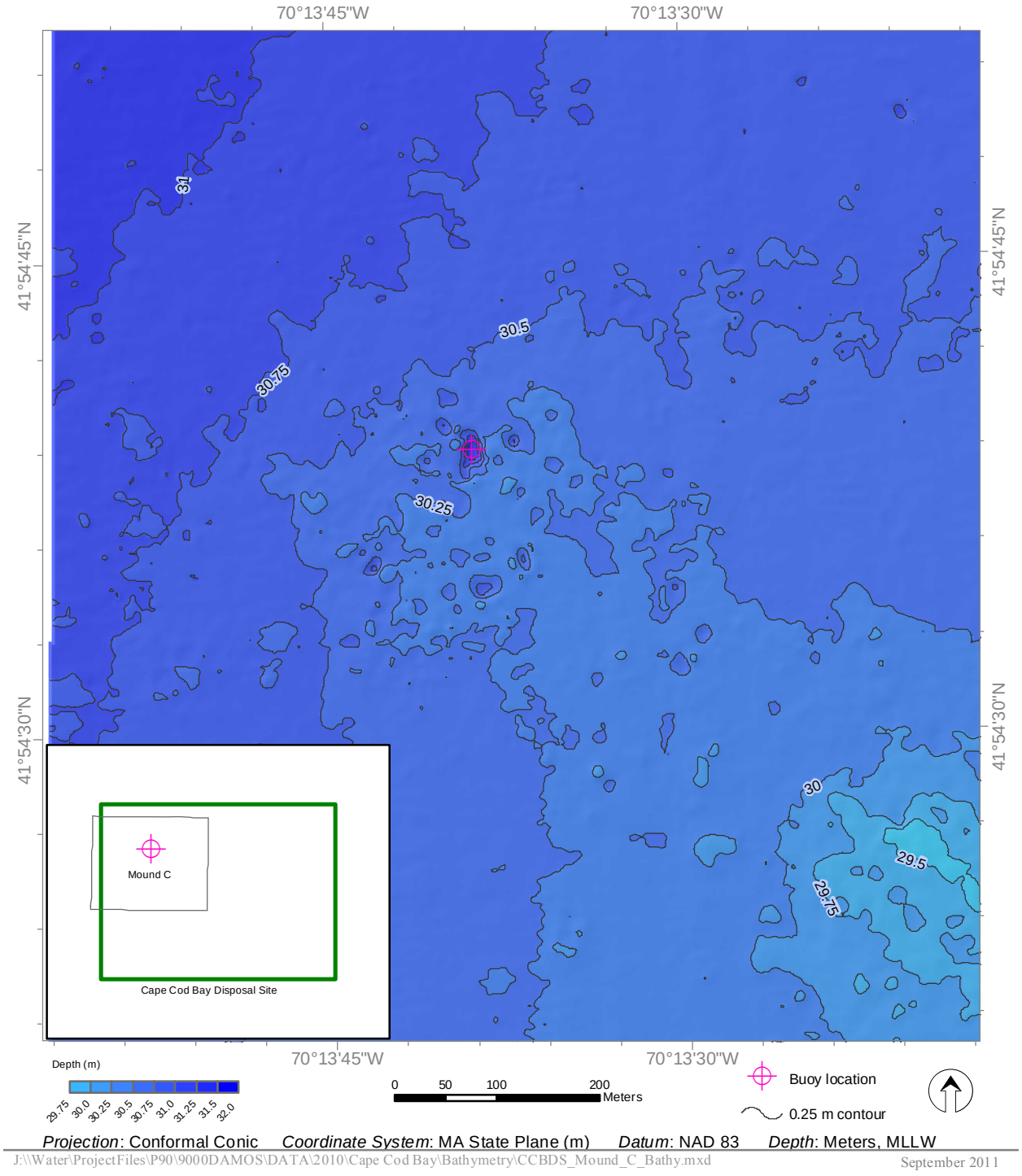


Figure 3-2. Bathymetry of Mound C at CCBDS, September 2010

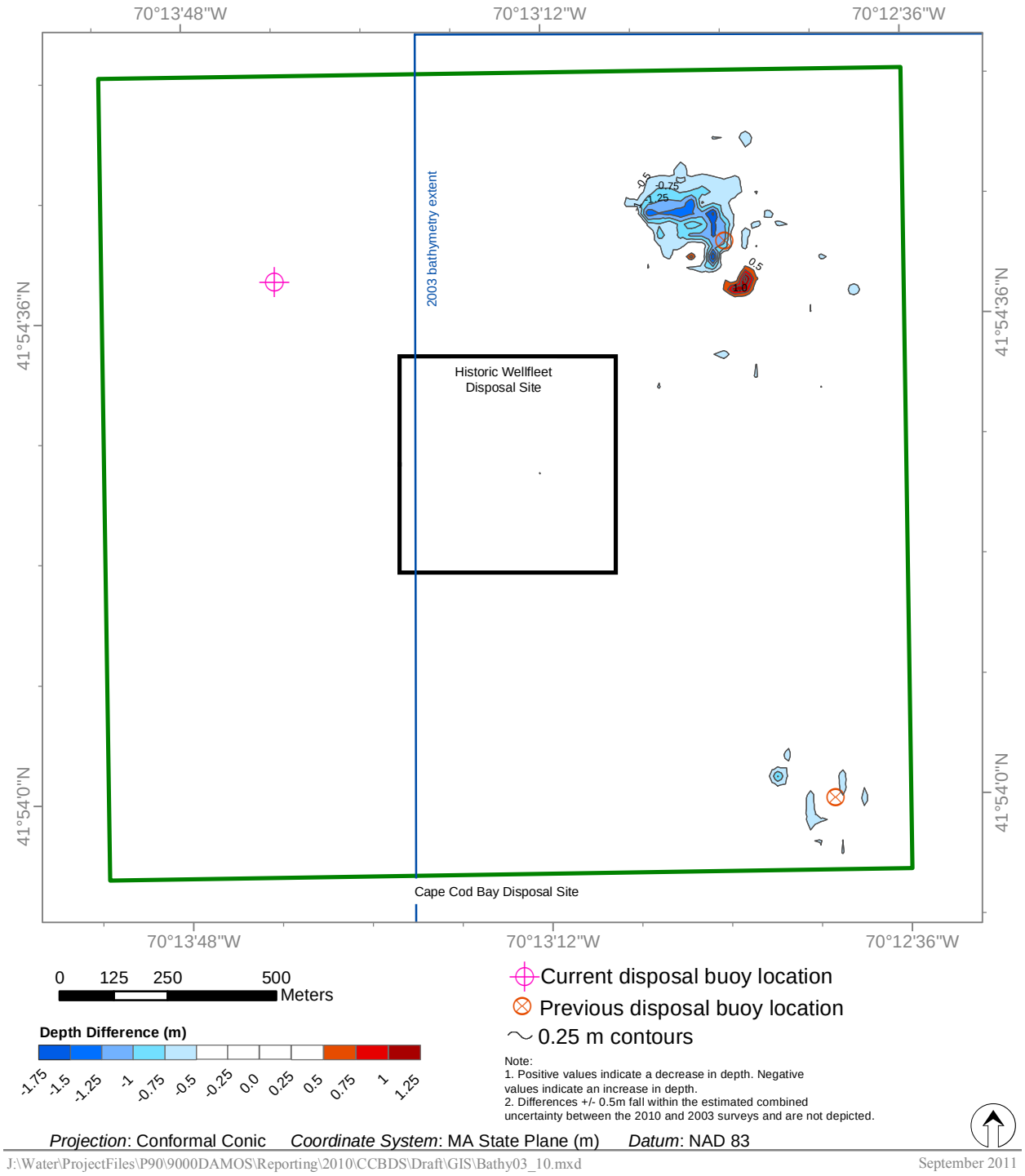


Figure 3-3. Depth difference contour map of eastern portion of CCBDS, 2010–2003 (0.25 m contour interval)

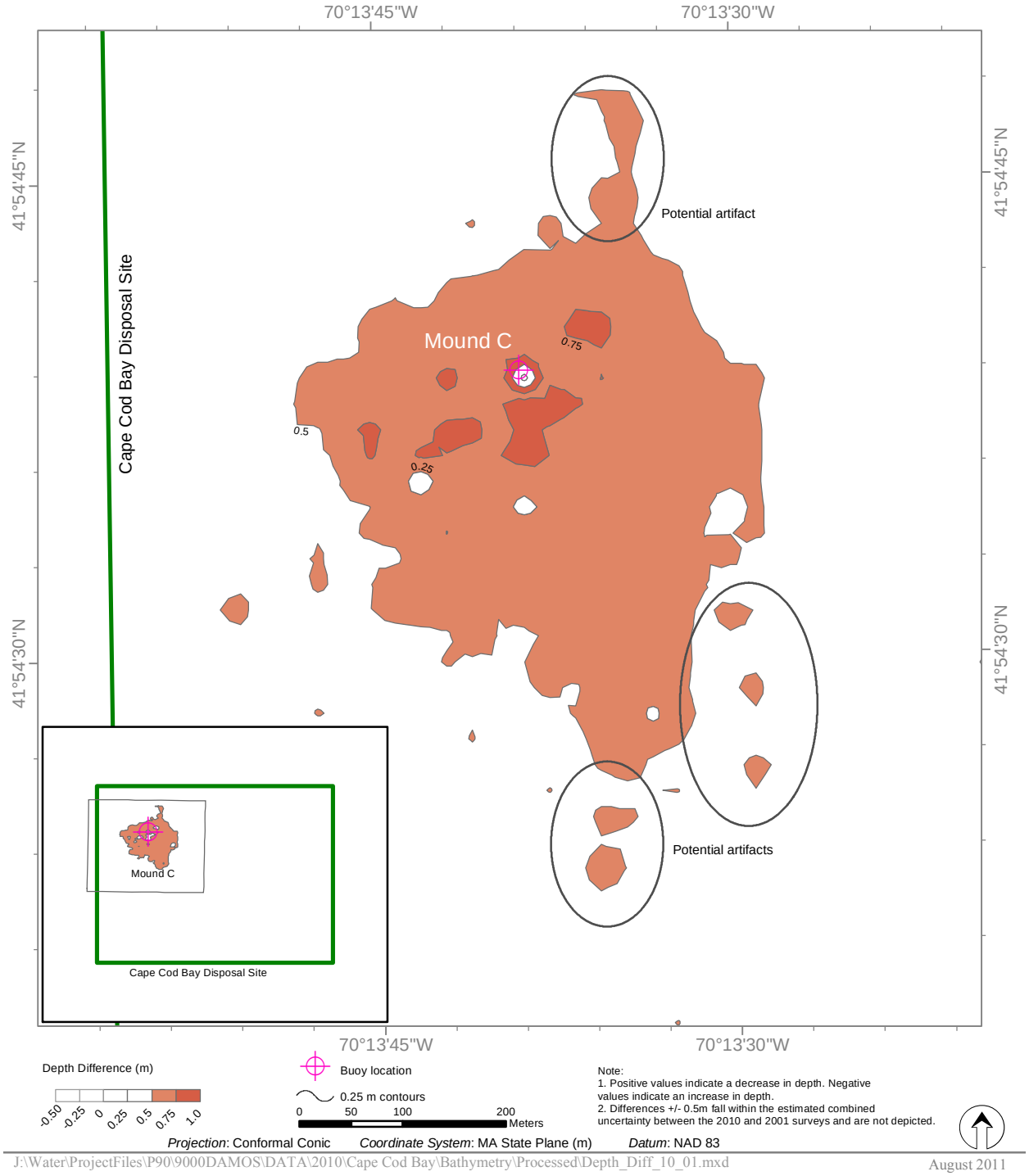


Figure 3-4. Depth difference contour map of Mound C at CCBDS, 2010–2001 (0.25 m contour interval)

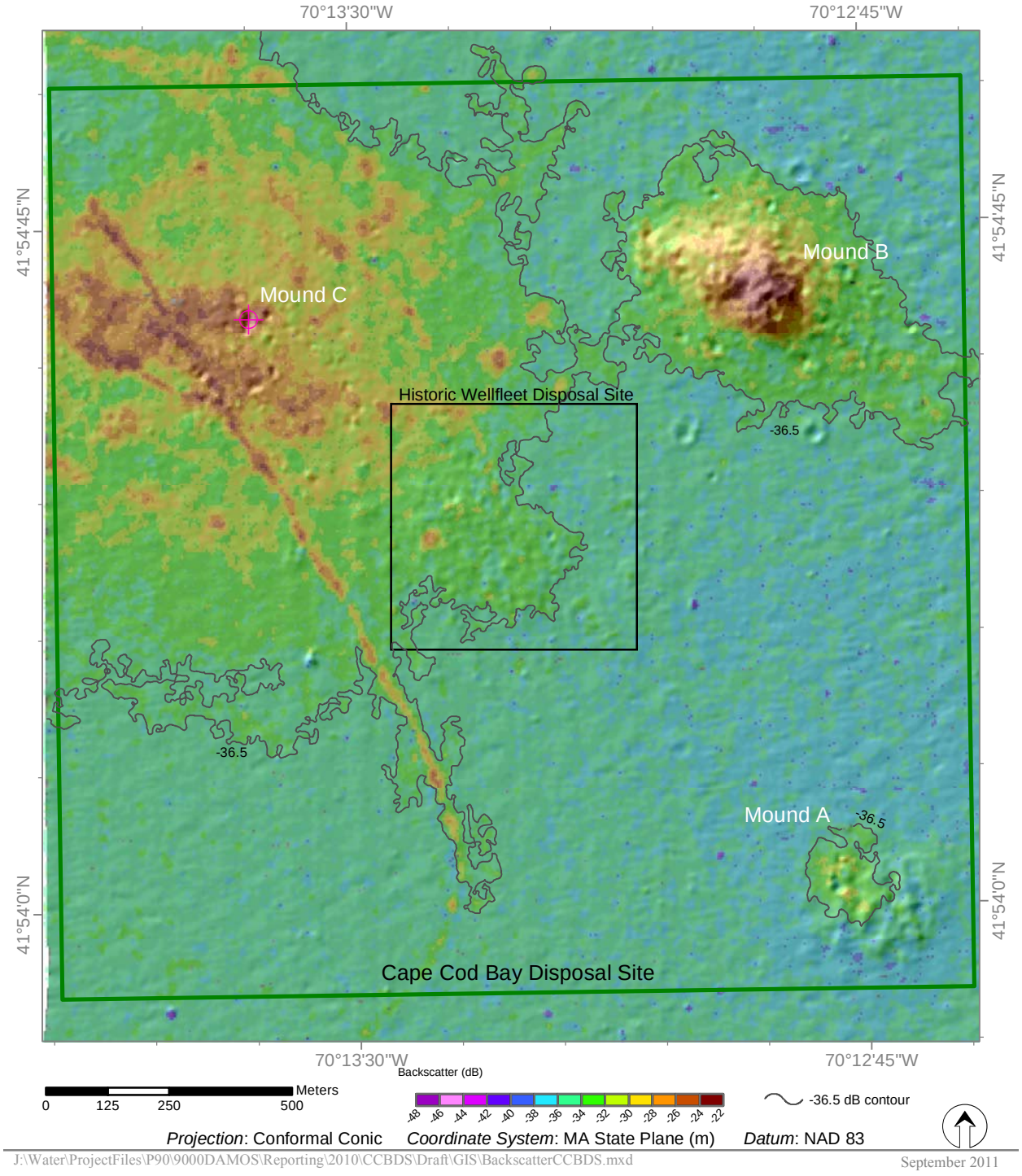


Figure 3-5. Backscatter intensity (dB) at CCBDS, September 2010 (-36.5 dB contour line)

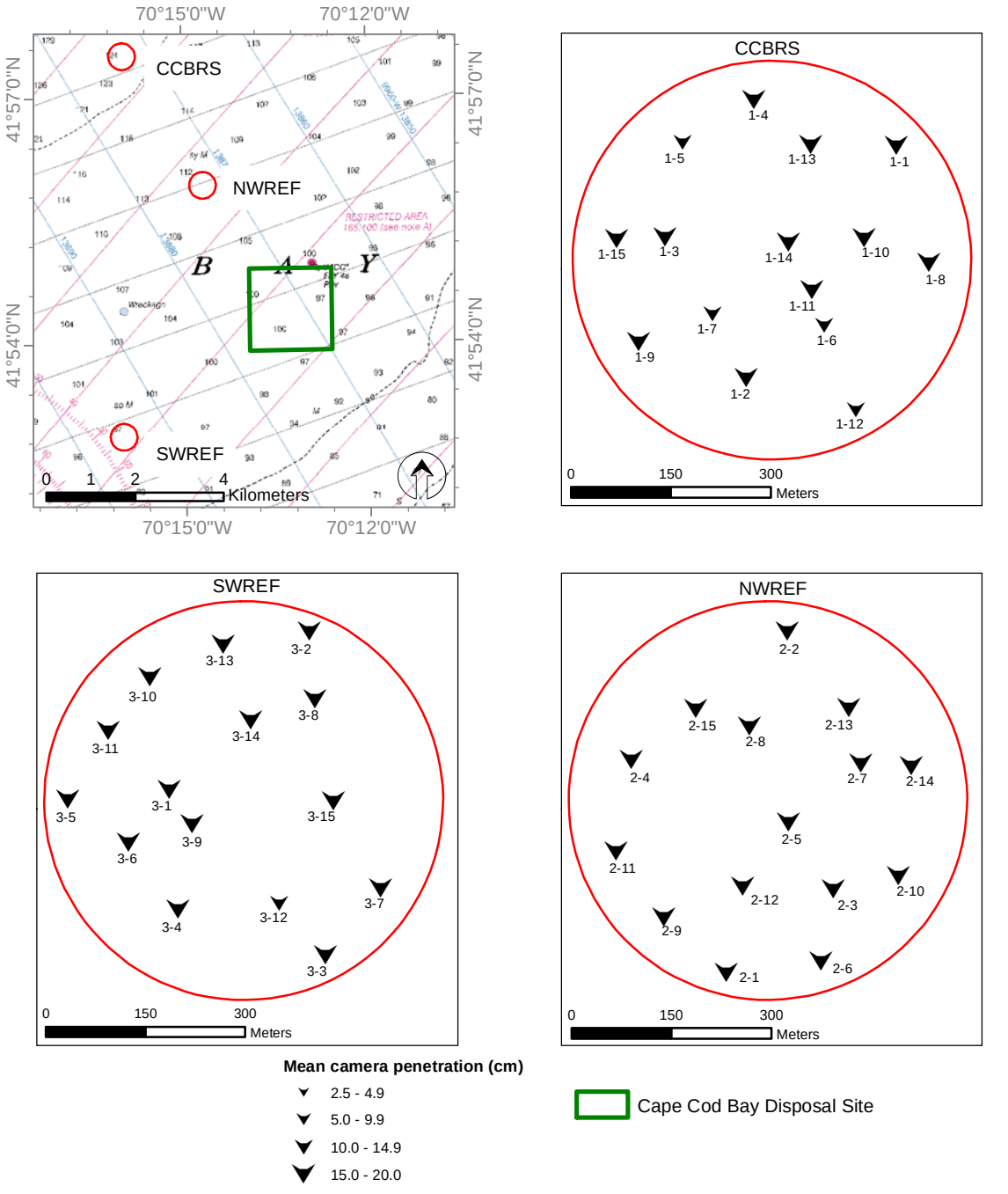


Figure 3-6. Map of means of replicate prism penetration depths (cm) at the CCBDS reference areas

Figure 3-7. Profile image from CCBRS Station 4 showing relatively deep prism penetration in the soft, homogenous silt-clay that typified all three of the reference areas.

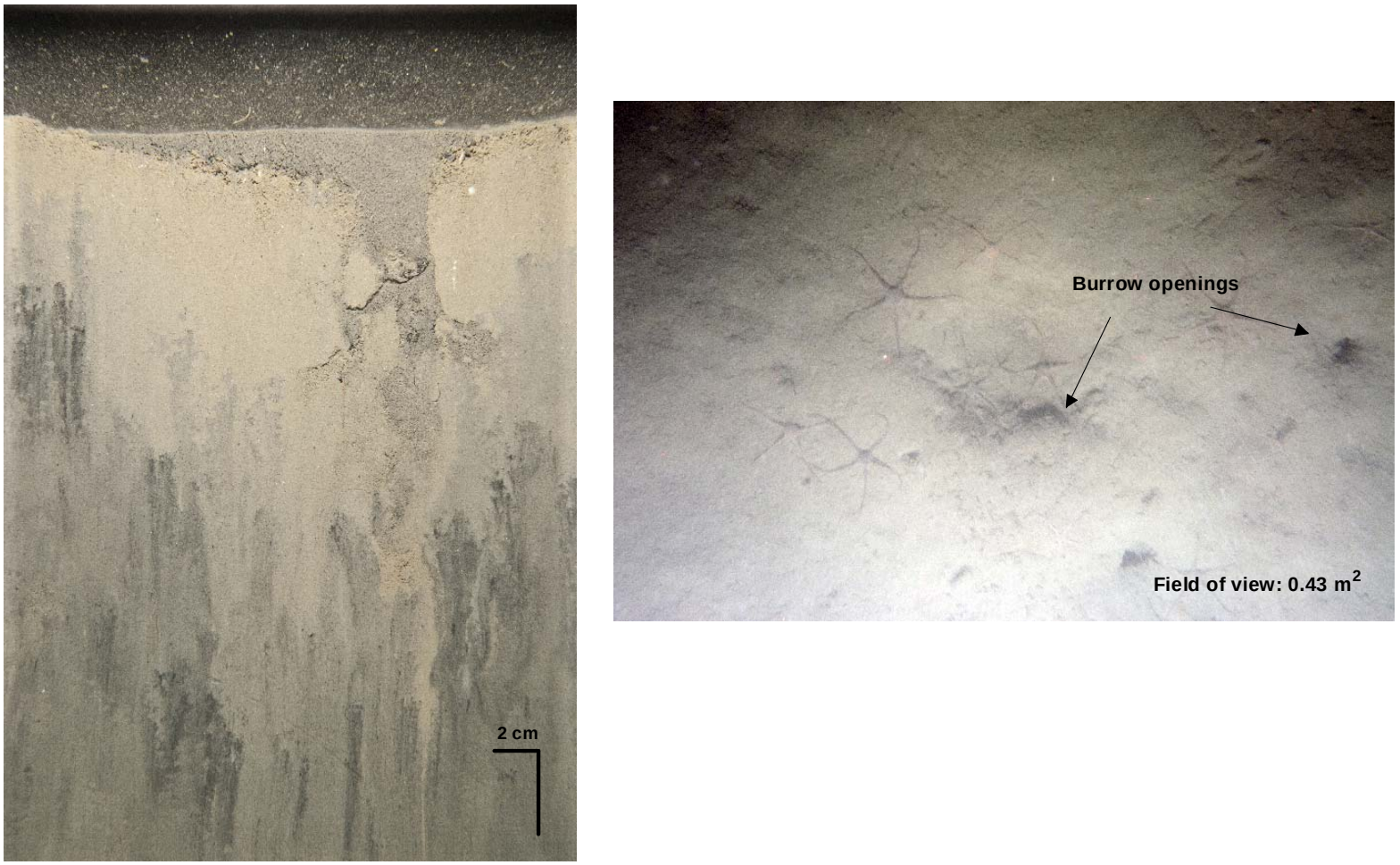


Figure 3-8. Profile and plan-view images from NWREF Station 12 illustrating biogenic surface roughness associated with burrowing activity.

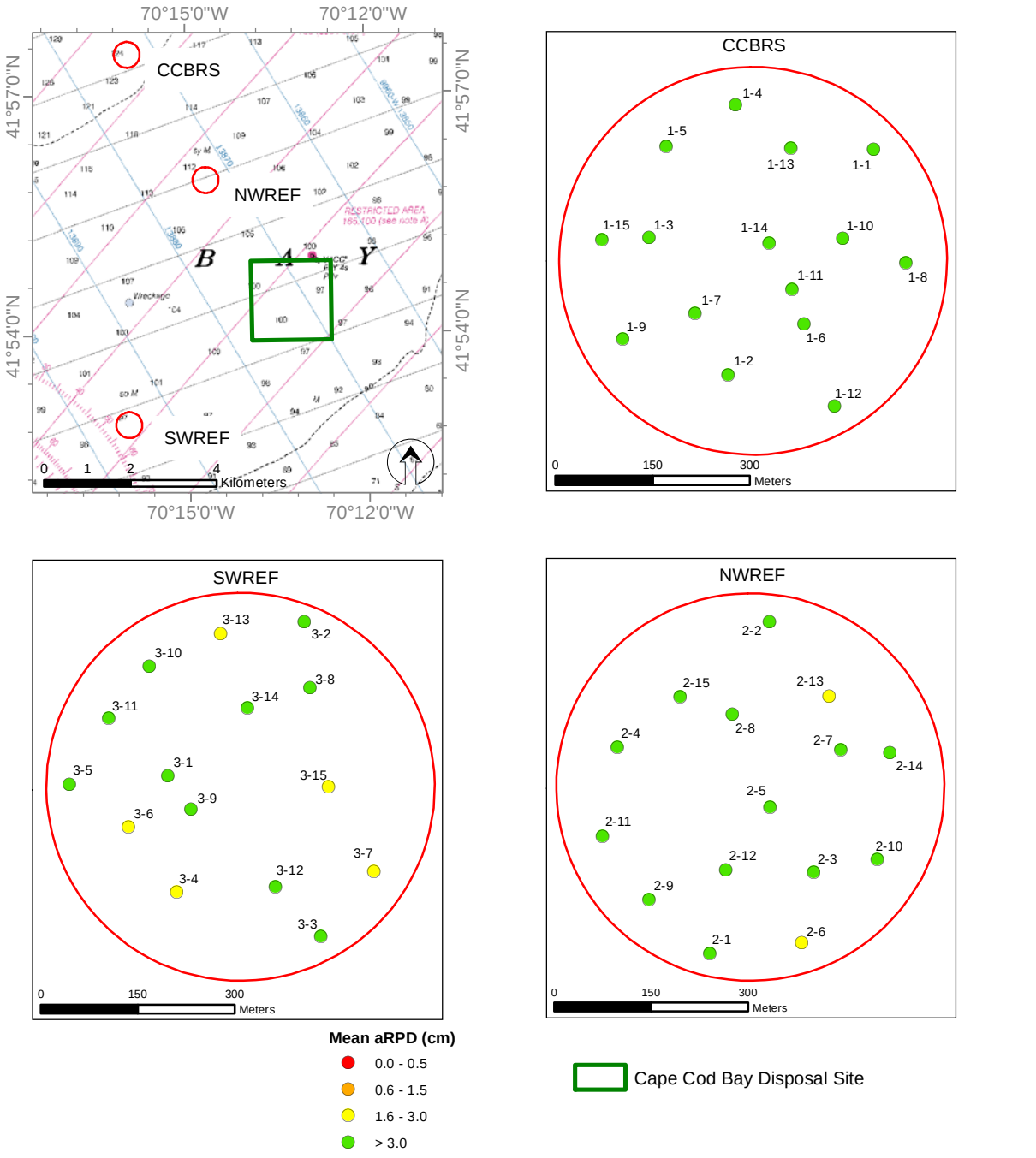
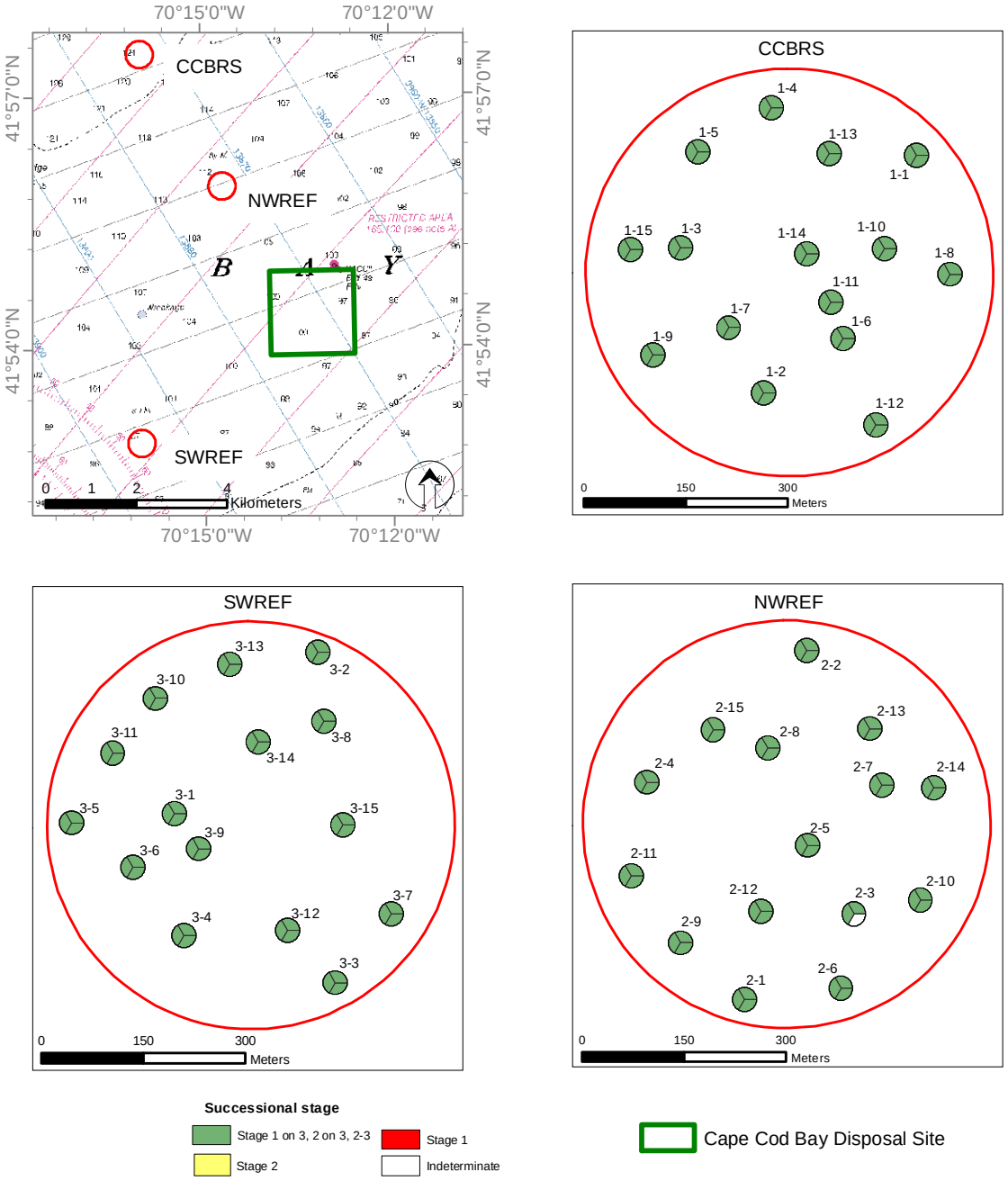


Figure 3-9. Map of means of replicate aRPD depths (cm) at the CCBDS reference areas



Projection: Conformal Conic *Coordinate System*: MA State Plane (m) *Datum*: NAD 83

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Figure 3-10. Map showing the infaunal successional stage observed in each replicate profile image at each reference area station.

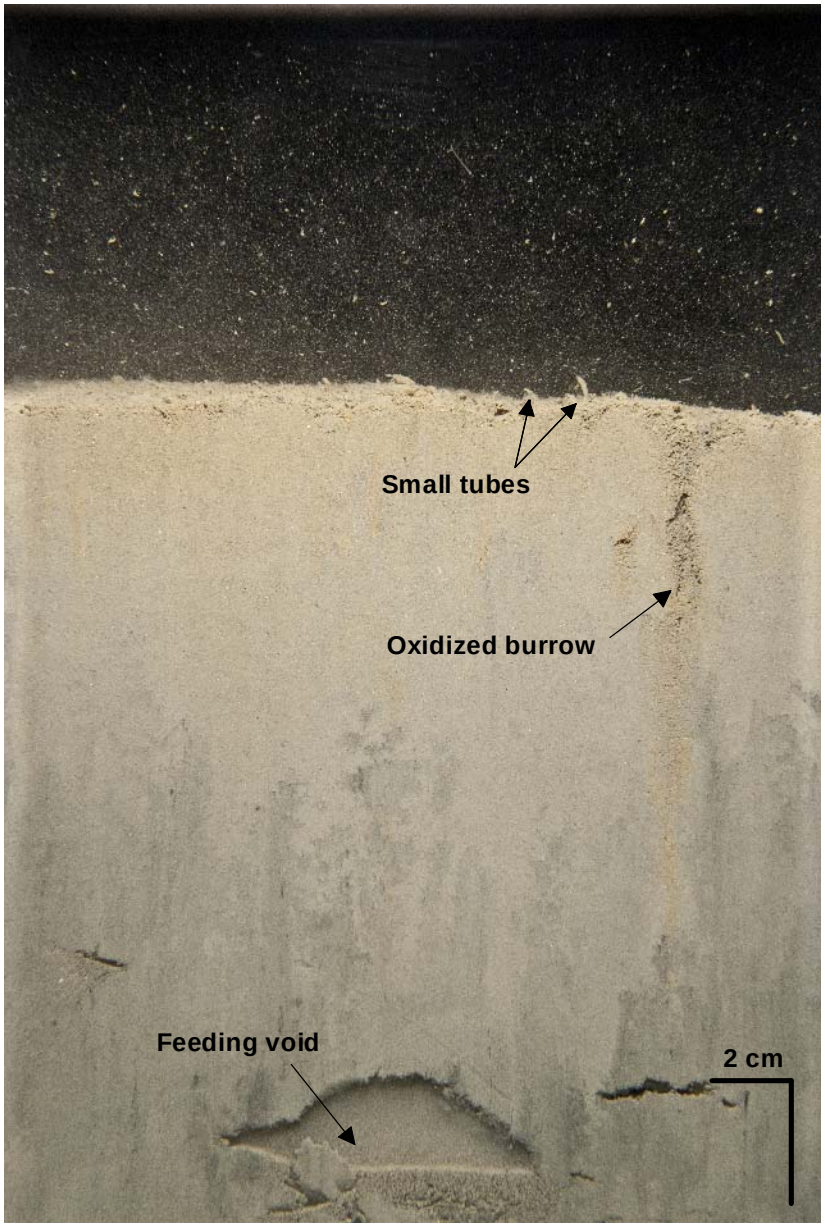


Figure 3-11. Profile image from CCBRS Station 11 showing extensive biological activity at and below the sediment surface. Small tubes at the sediment surface (Stage 1) overlie several active Stage 3 feeding voids and a vertical oxidized burrow at depth.

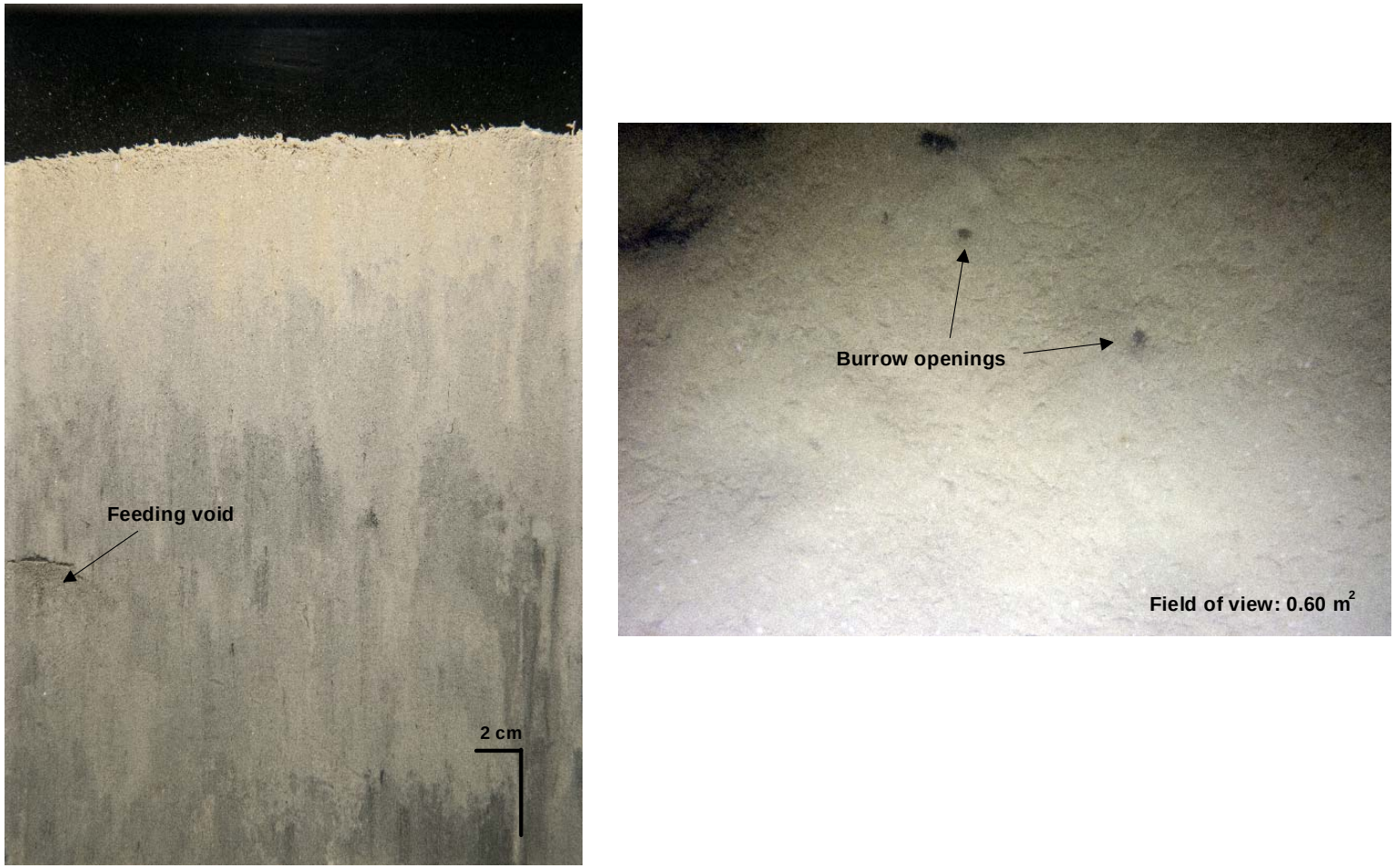


Figure 3-12. Profile and plan-view images from SWREF Station 2. Numerous small Stage 1 surface tubes and a subsurface Stage 3 feeding void are visible in the profile image. Several burrow openings visible in the plan-view image confirm that larger-bodied Stage 3 organisms were present at this station.

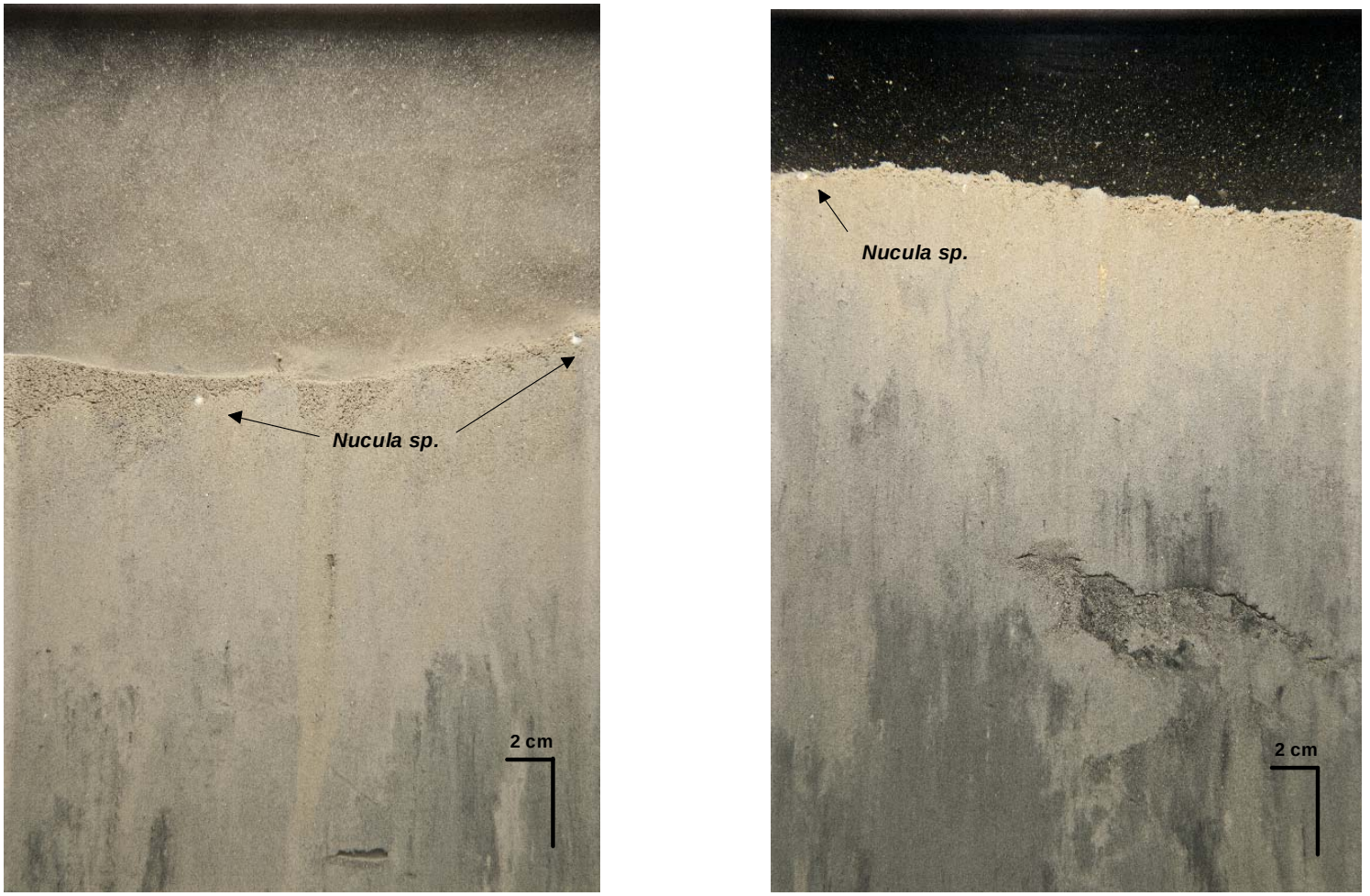
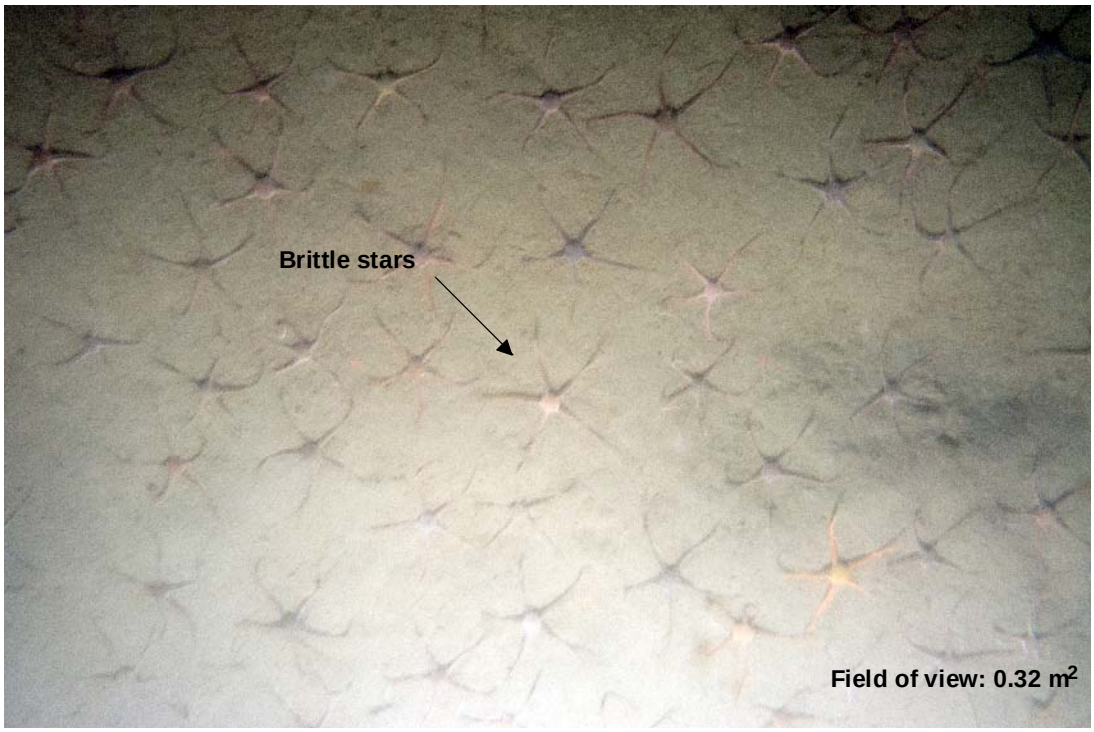


Figure 3-13. Profile images from NWREF Station 2 (left) and SWREF Station 14 (right) illustrating Stage 2 on 3. In both images, small white bivalves (*Nucula* sp.) are visible near the sediment surface (arrows), and Stage 3 feeding voids occur at depth.



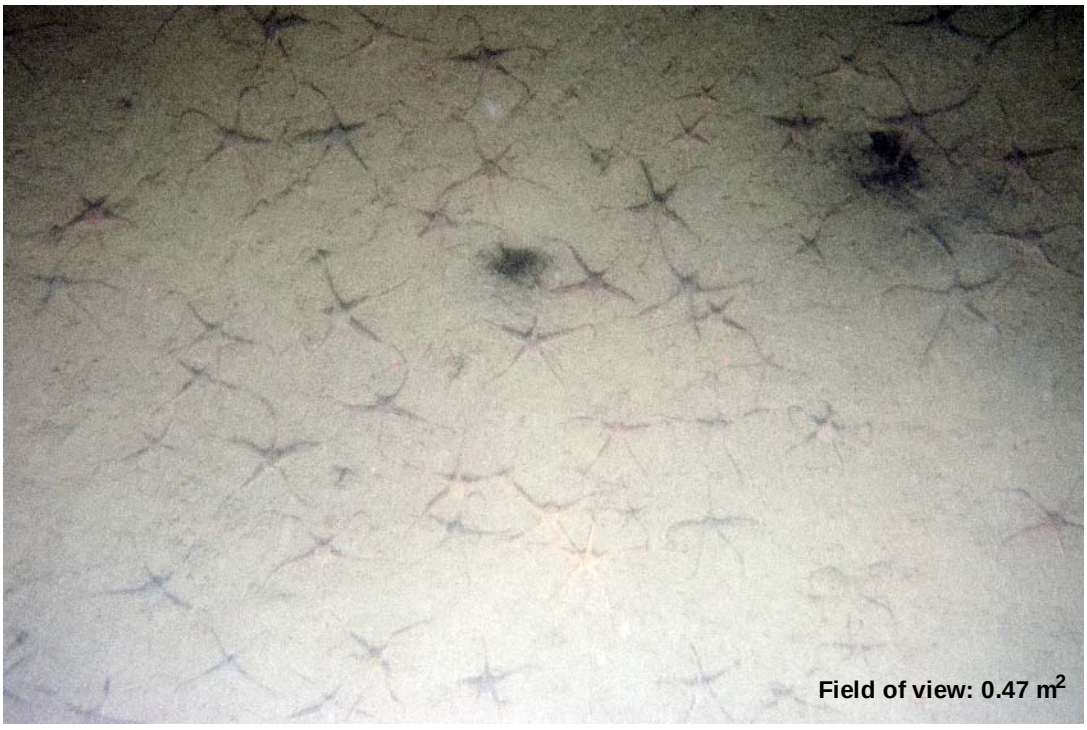


Figure 3-14. Numerous brittle stars are visible at the sediment surface in these plan-view images from CCBRS Station 5 and NWREF Station 9.

Figure 3-15. In this profile image from CCBRS Station 7, several brittle star arms are visible above the sediment surface. The body of a brittle star that has burrowed into the sediment is also visible.

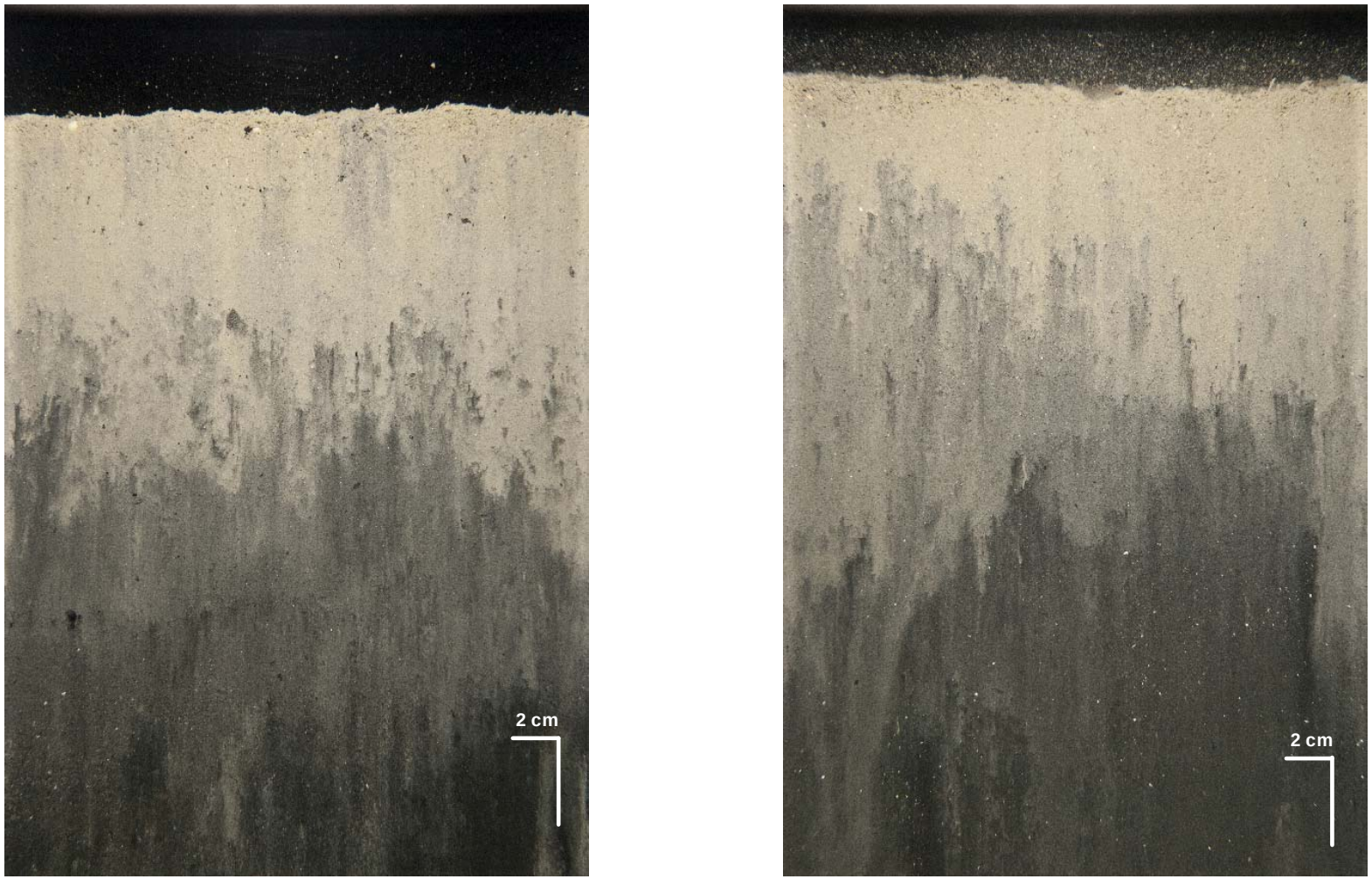


Figure 3-16. Profile images from Mound A Station 1 (left) and Mound B Station 15 (right) illustrating a typical dredged material signature for CCBDS where mottled, poorly sorted sediments have developed an oxidized layer at the surface over highly reduced (i.e., sulfidic) sediment at depth.

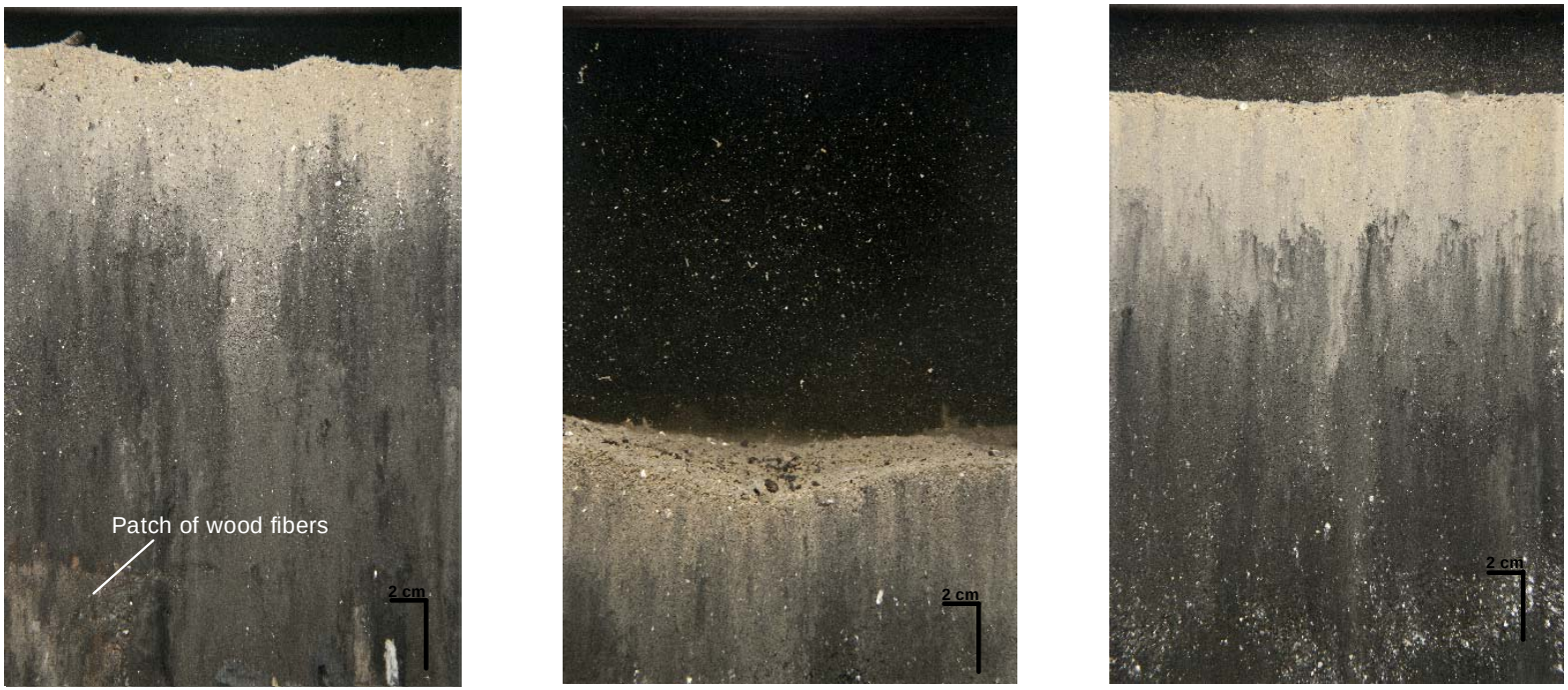


Figure 3-17. Profile images showing a patch of wood fibers at Mound B Station 2 (left), sandy dredged material at Station 5 (center), and mud-over-sand stratigraphy at Station 9 (right).

Figure 3-18. Profile image from Mound C Station 2 showing silt/clay dredged material with an oxidized surface layer (i.e., redox layer) overlying relatively light-colored, mottled grey sediment at depth. Clasts on surface are camera artifacts.

Figure 3-19. Profile images showing distinct layering of dredged material at Mound C stations.

Figure 3-20. Profile image from Mound C Station 4 showing distinct sediment layering and reddish-brown patches of wood fibers at depth.

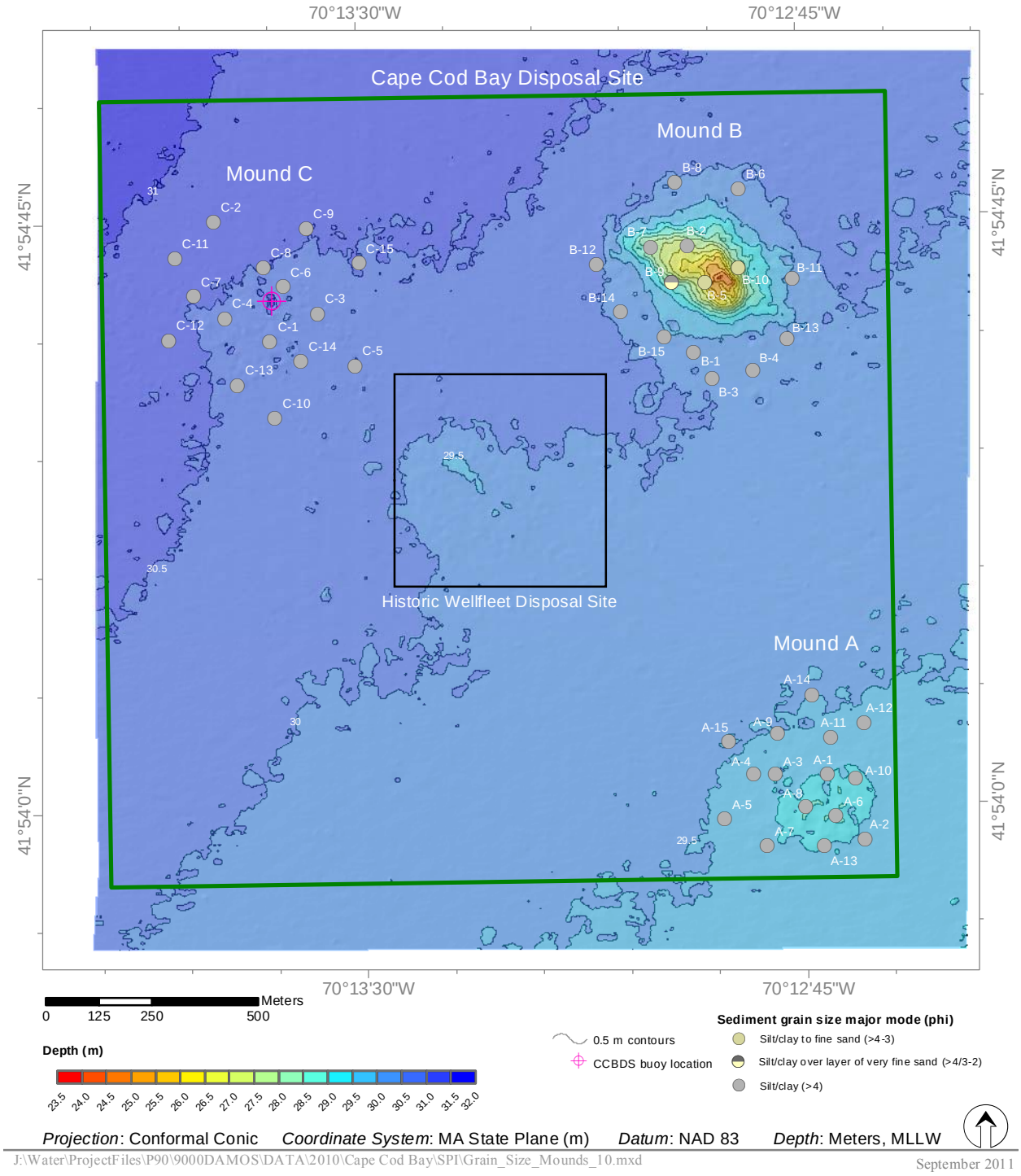


Figure 3-21. Map of grain size major mode at the CCBDS stations

Figure 3-22. Profile image from Station 5 at the apex of Mound C showing a lag deposit of fine sand at the sediment surface overlying reduced, finer-grained sediment at depth.

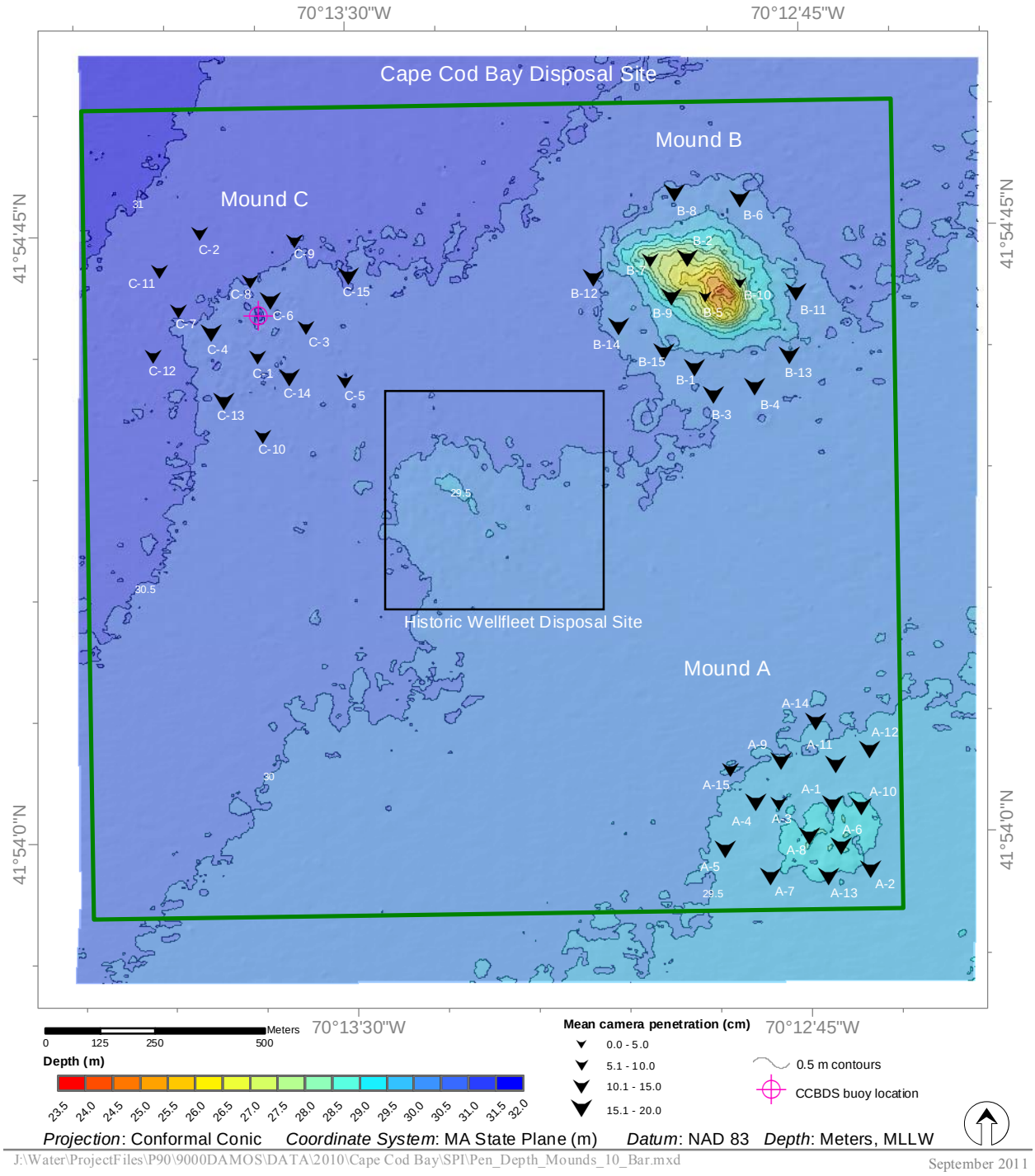


Figure 3-23. Map of means of replicate prism penetration depths at the CCBDS stations

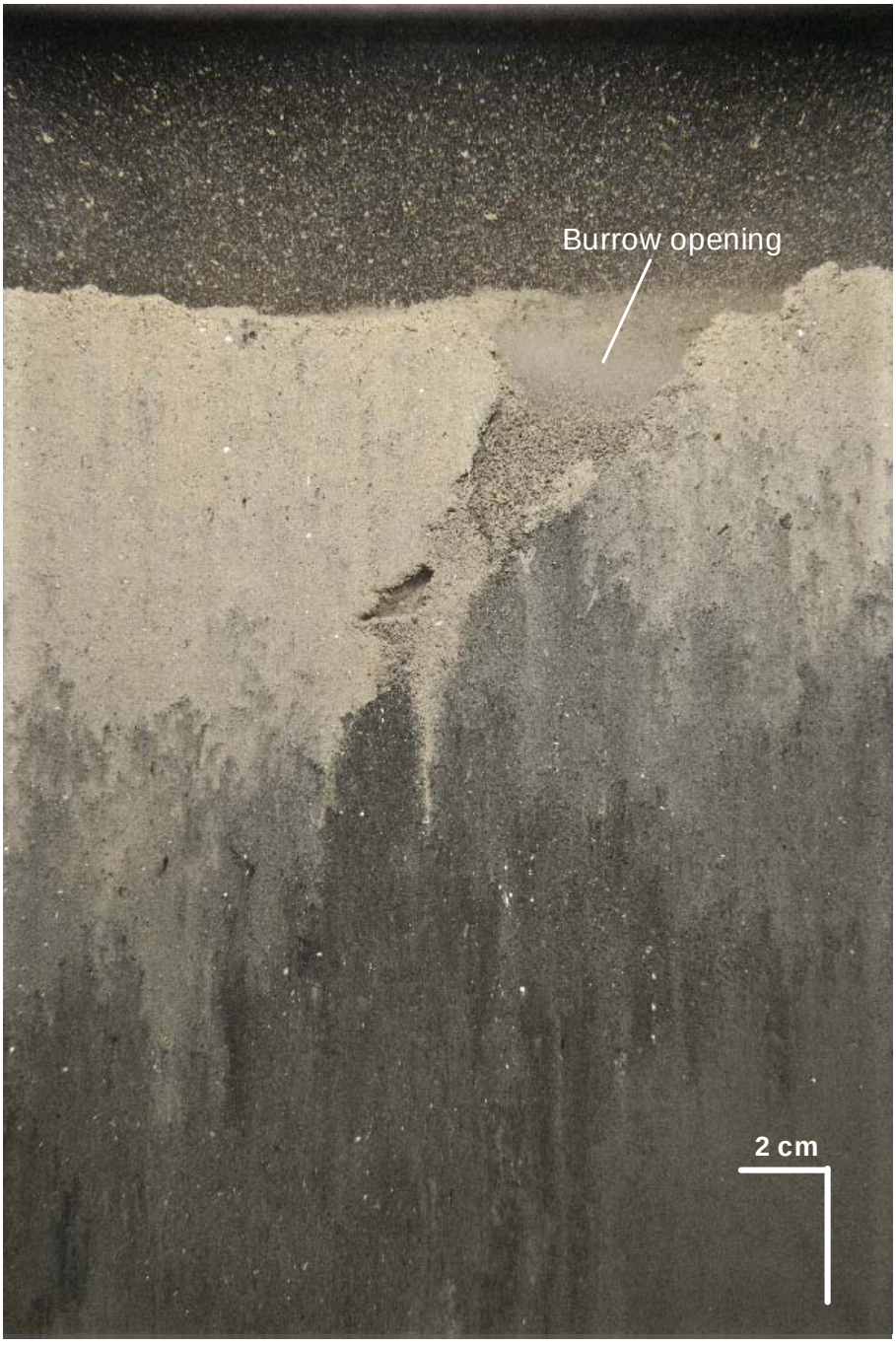


Figure 3-24. A burrow opening at the sediment surface contributes to small scale boundary roughness in this profile image from Mound B Station 13.

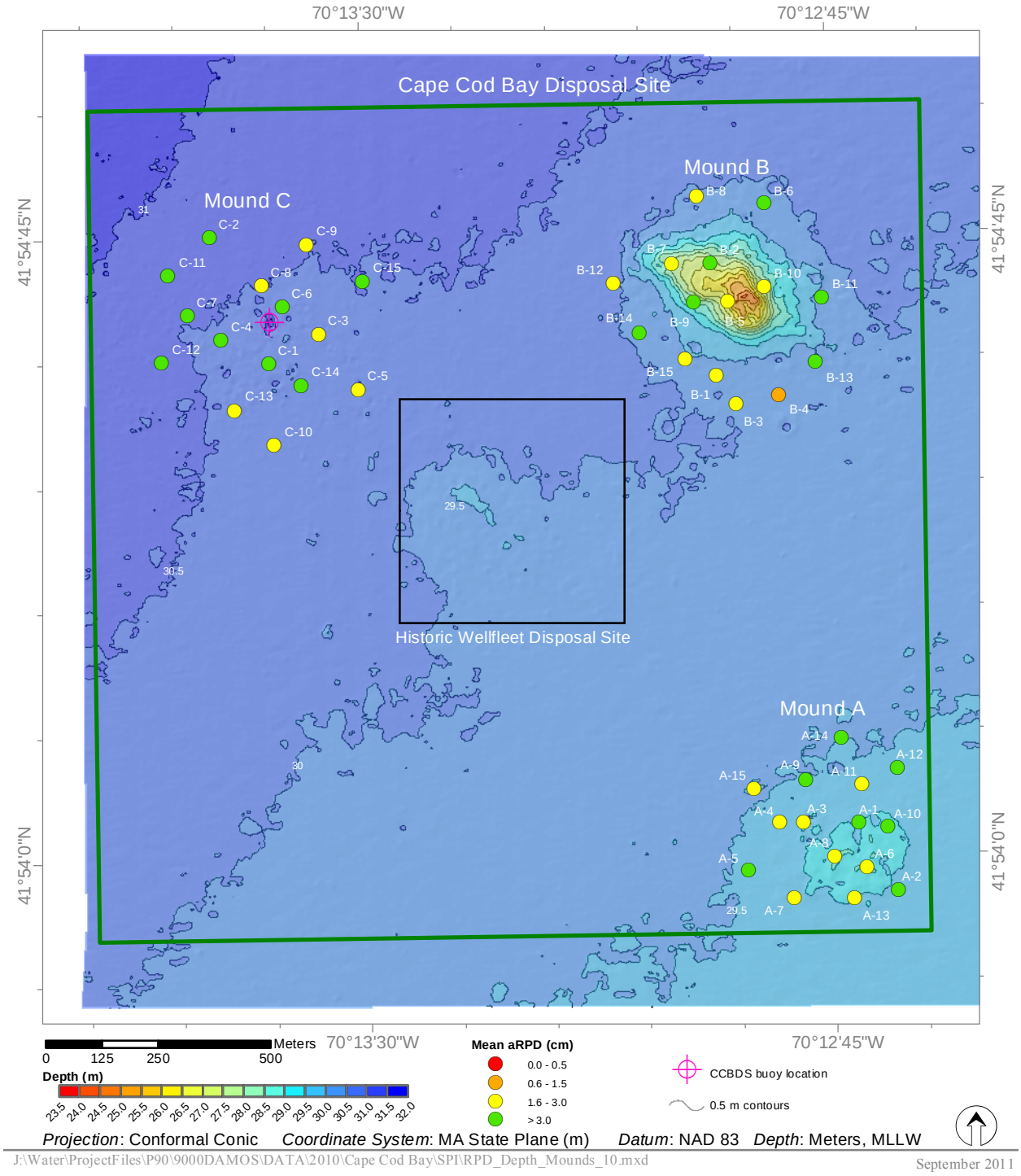


Figure 3-25. Map of mean of replicate aRPD depths at the CCBDS stations

Figure 3-26. Profile image showing methane gas bubbles within the sediment column at Mound B Station 7.

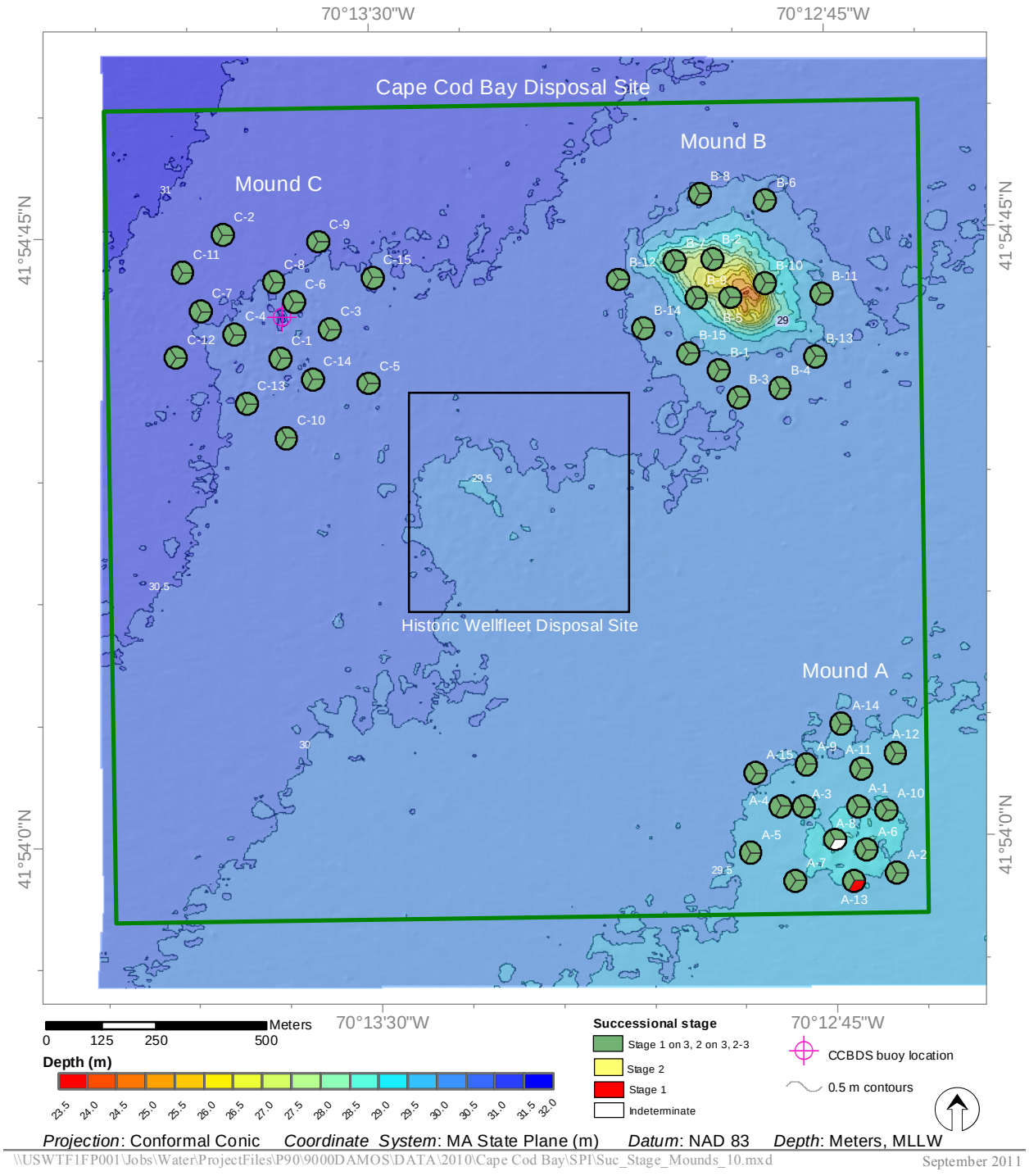


Figure 3-27. Pie charts showing the infaunal successional stage determined for each of the three replicate SPI images at each of the CCBDS stations

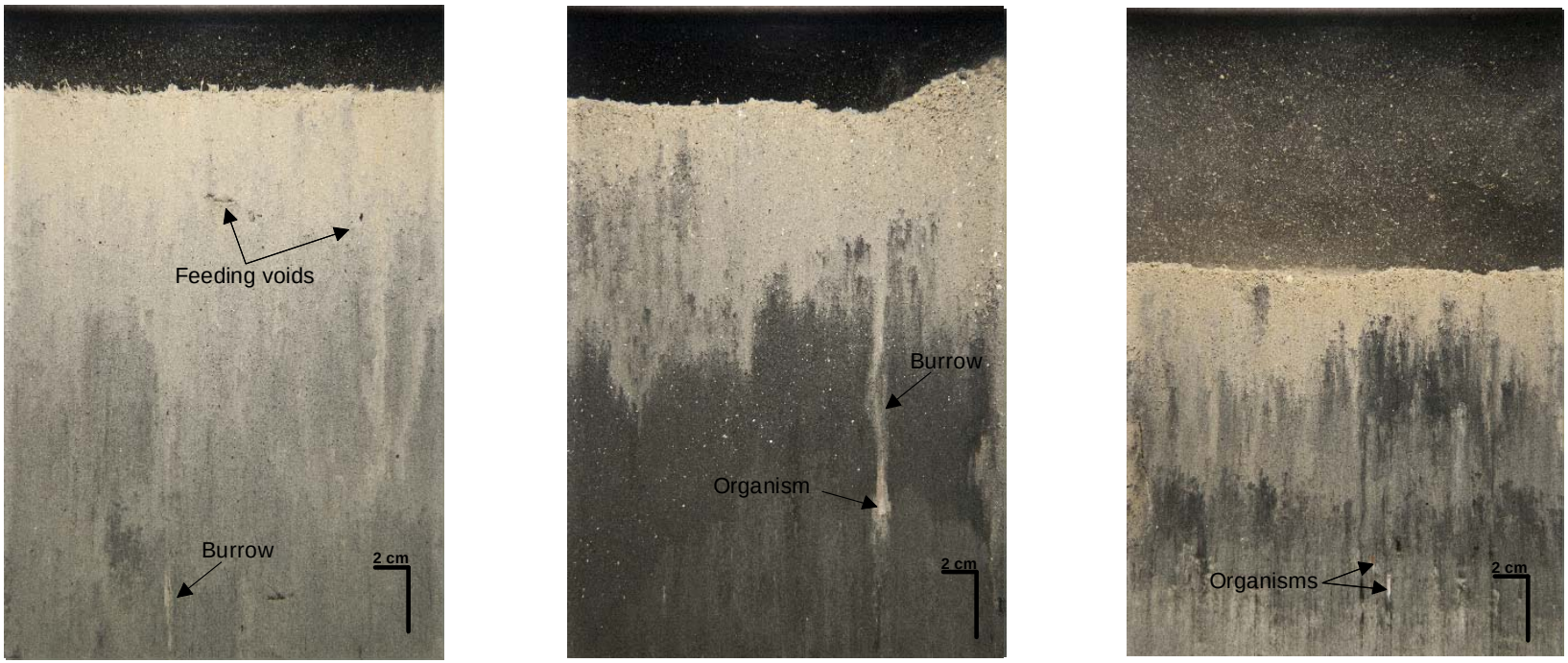


Figure 3-28. Profile images from each disposal mound illustrating evidence of advanced successional stages. Mound A Station 14 (left) shows dense Stage 1 surface tubes overlying two Stage 3 feeding voids and a deep oxidized burrow. Mound B Station 1 (center) shows a large-bodied Stage 3 organism with associated oxidized burrow within the reduced dredged material at depth. Mound C Station 10 (right) shows dredged material layering with several larger-bodied organisms in the subsurface layers.

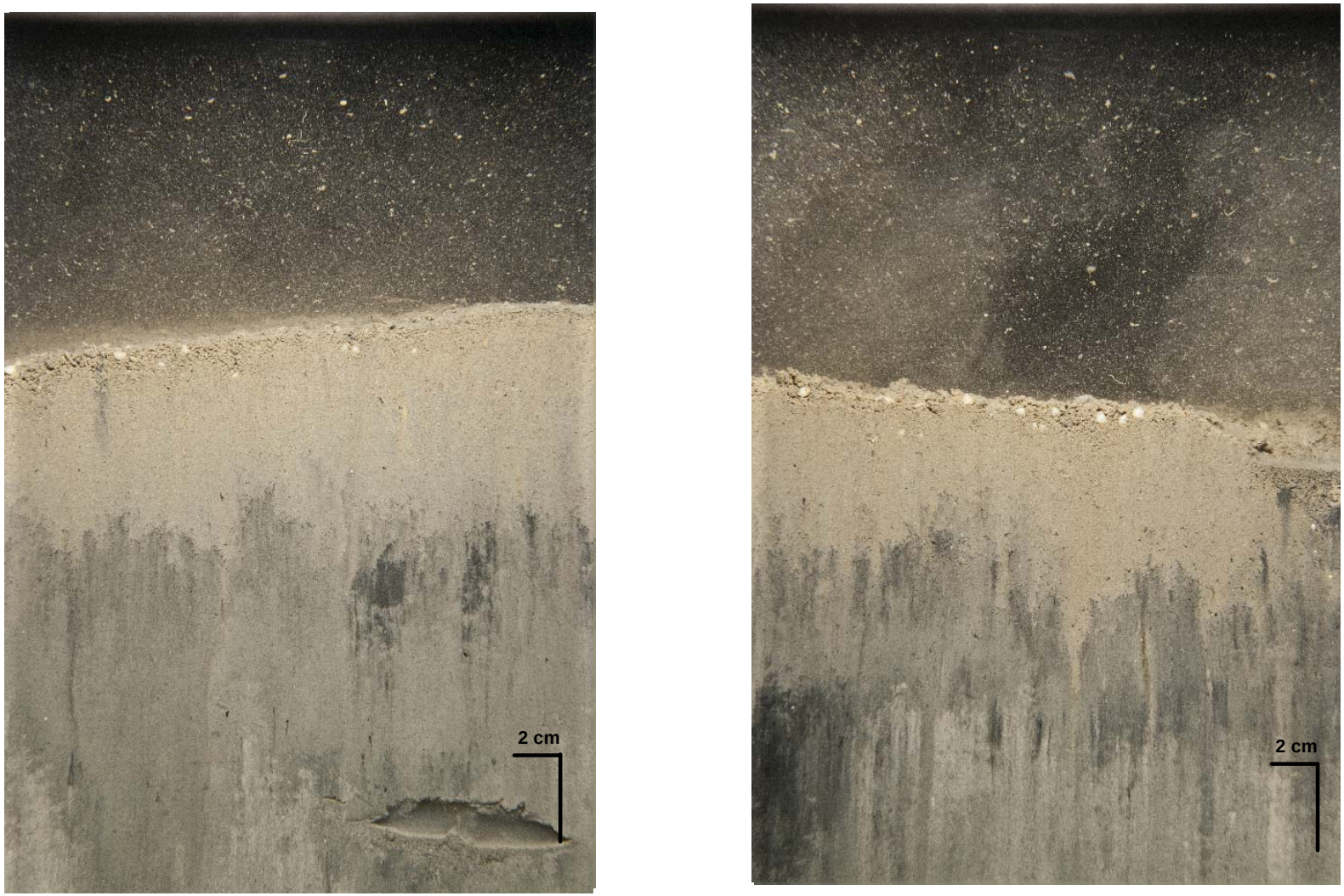


Figure 3-29. Profile images from Mound C Stations 2 and 11 showing numerous small white bivalves (*Nucula* sp.) at and just below the sediment surface.

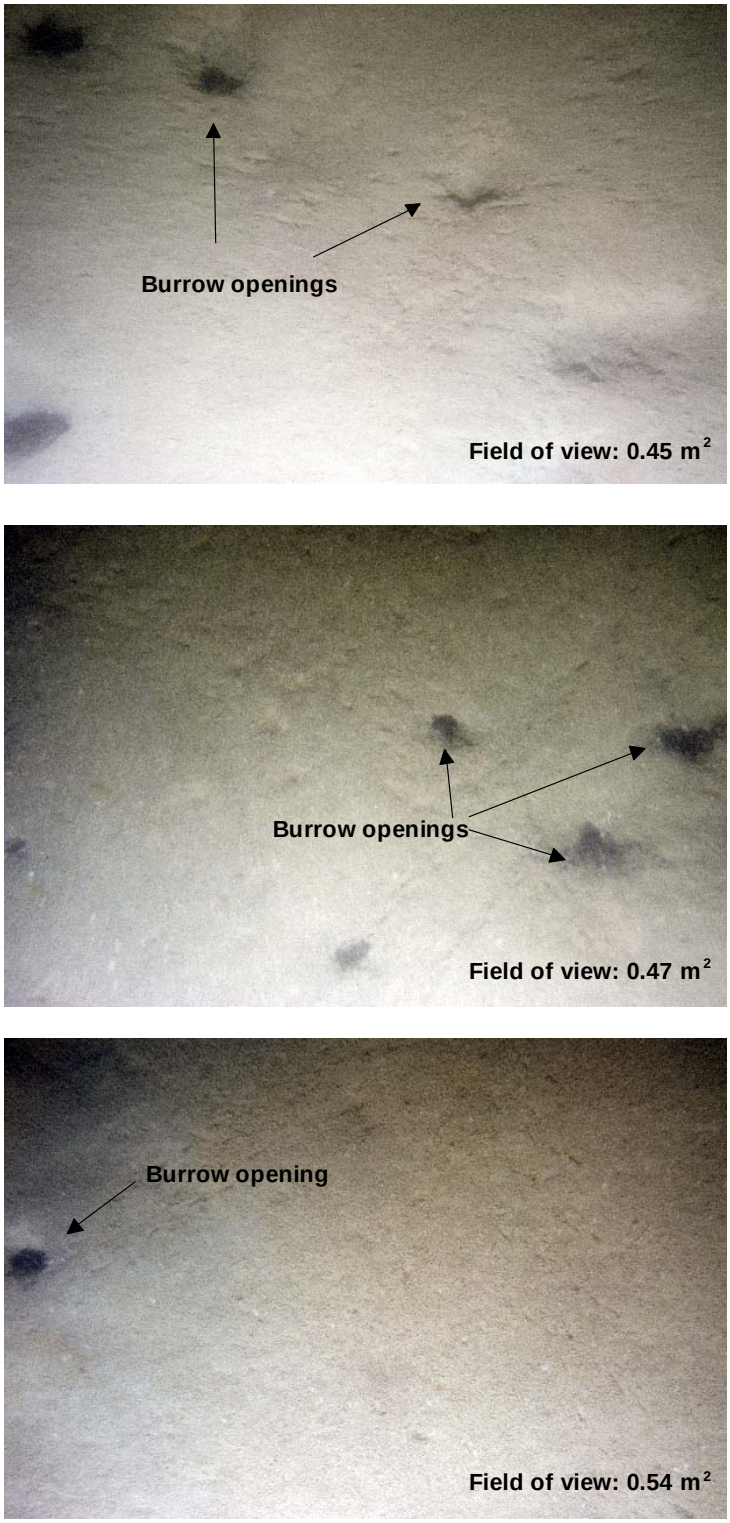


Figure 3-30. Plan-view images of burrow openings at the sediment surface at various disposal mound stations (top: Mound A Station 7; center: Mound B Station 8; bottom: Mound C Station 2).

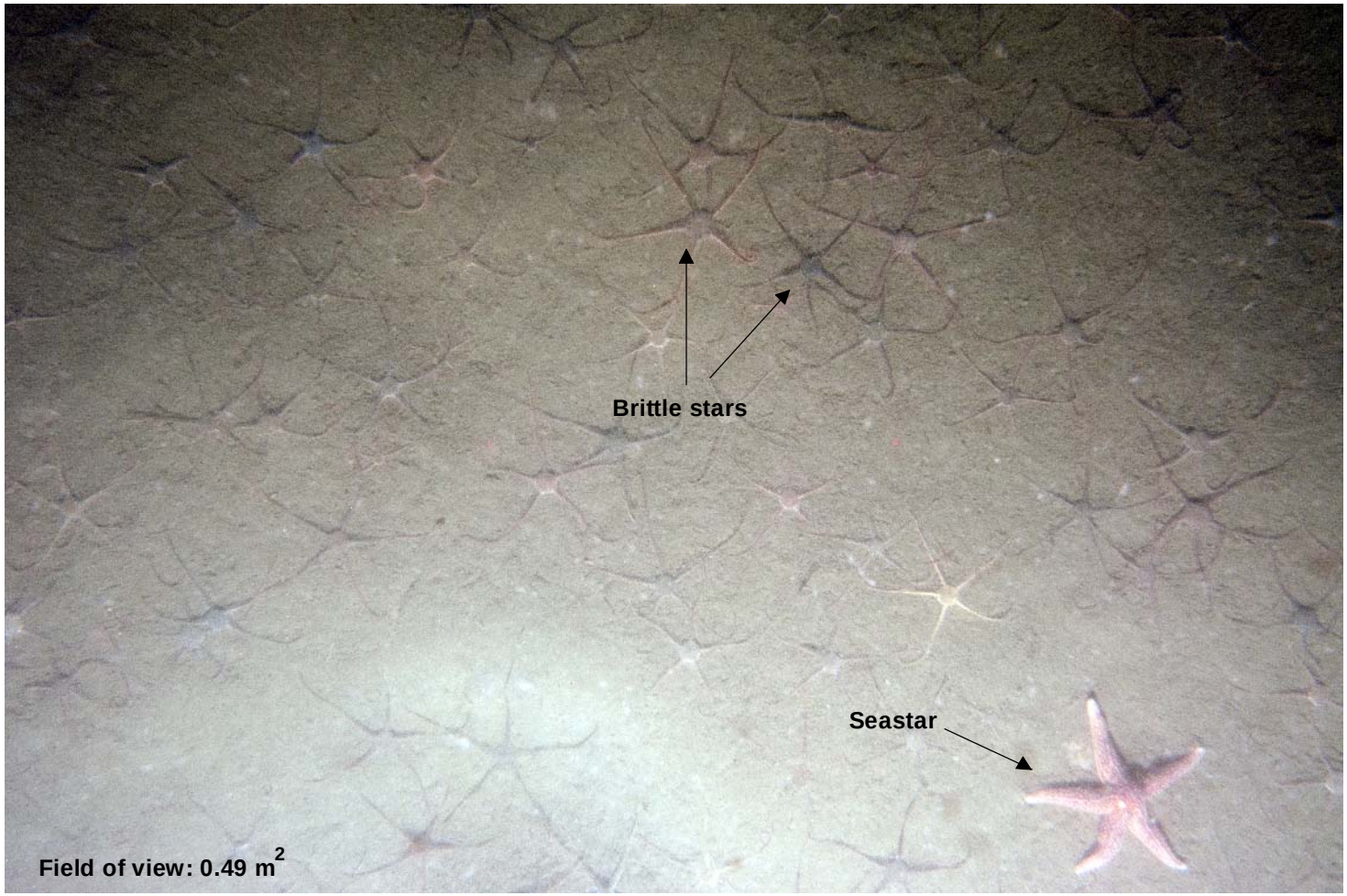


Figure 3-31. Numerous brittlestars and one seastar at Mound B Station 3.

Figure 3-32. The plan-view image on top shows tracks among burrow openings at Mound A Station 9. Note the darker sediment that has been excavated from within the center burrow and expelled onto the sediment surface. Distinct tracks are also visible in the bottom image from Mound B Station 5.

Figure 3-33. Plan-view image from Mound C Station 14 showing a crab, a juvenile flatfish, one burrow opening, and extensive organism tracks.

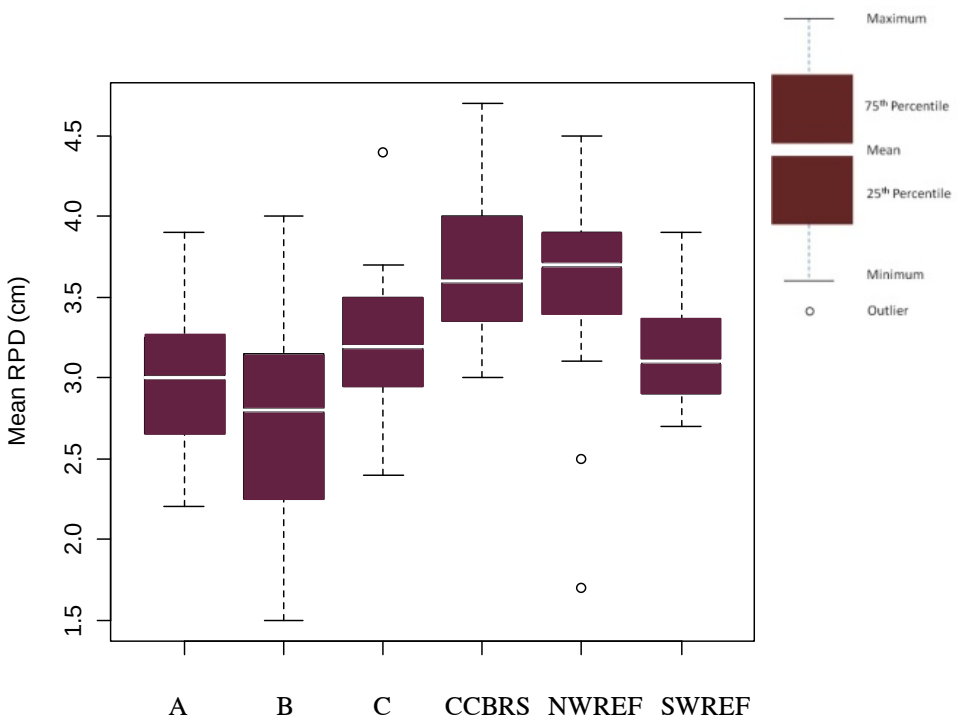


Figure 3-34. Boxplots showing the distribution of mean aRPD depths at the reference areas and disposal mound stations.

4.0 DISCUSSION

The objectives of the 2010 survey of the Cape Cod Bay Disposal Site (CCBDS) were to document the distribution of dredged material and evaluate the recovery of benthic communities after the placement of 137,000 m^3 (179,000 yd^3) of material at the site since 2003. The 2010 survey was designed to document the changes in seafloor topography over the entire disposal site using multibeam bathymetry and to perform an assessment of benthic conditions at Mound A, Mound B, and the newly created Mound C through sediment-profile imaging (SPI).

4.1 Dredged Material Distribution

Dredged material was generally limited to four distinct areas of CCBDS; the Historic Wellfleet Disposal Site at the center of the site, Mound A in the southeast quadrant, Mound B in the northeast quadrant, and the newly formed Mound C in the northwest quadrant.

The Historic Wellfleet Disposal Site and Mound A remained as stable features on the seafloor with little change in height or diameter since the 2003 bathymetric survey. Mound B also exhibited a stable footprint since 2003 with the exception of limited sediment redistribution around the mound apex. There appears to have been transport of surficial material from the northwestern side of the mound peak to the southeastern side of the mound peak in the seven years between the 2003 and 2010 surveys (Figure 4-1). The northwestern slope experienced an area of sediment loss approximately 200 m across and up to 1.5 m deep; conversely the southeastern slope experienced a more concentrated area of sediment deposition (75 m wide, 1.25 m deep).

This sediment transport may have been due to resuspension of fine grain dredged material caused by enhanced tidal or storm currents over the steep mound peak. Currents generated from major northeaster storms (winds speeds greater than 14 m/s) could produce bottom currents in excess of 10 cm/sec in a northwest to southeast direction at CCBDS (USGS 1998). The weather station at the Barnstable Airport (25 km from CCBDS) recorded winds of this magnitude at least six times since 2003, suggesting that multiple storm events could have produced bottom currents capable of redistributing fine grain material in the pattern observed at Mound B. While a complete mass balance assessment was not possible, there was no indication of dredged material dispersal outside of the CCBDS boundary, or the Mound B formation, in the 2010 bathymetric or backscatter datasets. Hence, the overall topography of Mound B is considered stable.

Mound C bathymetery was not as prominent as the other three features and was only clearly discernable through depth difference calculations using the 2001 and 2010

bathymetric surveys. The wide, low relief of the new mound was consistent with the broad spread of dredged material disposal locations, as supported by the disposal logs for the period (2003–2010) and the scattered individual craters apparent in the bathymetric data. Based on the 2010 topography of Mound C, there is substantial capacity remaining for future dredged material disposal in that quadrant of CCBDS. In order to avoid sediment redistribution, as seen around the steep apex of Mound B, it is recommended to continue the current pattern of broad distribution of disposals around Mound C rather than focus placement at one point.

4.2 Benthic Recovery

The recovery of the benthic community at CCBDS was primarily evaluated through apparent redox potential discontinuity (aRPD) depths and successional stage status observations from SPI and plan-view underwater camera (PUC) images.

aRPD

All three mounds showed well developed aRPD depths (2–4 cm) that were indicative of a high degree of sediment aeration through biological reworking; localized sediment transport processes may also have contributed to the aRPDs at select Mound B stations. While disposal mound aRPD measurements were slightly lower than reference area values, the difference was not considered to be statistically significant. This suggests that SPI stations on all three mounds showed a similar degree of sediment reworking as nearby reference area stations.

Successional Stage Status

Advanced successional stages were observed throughout the disposal site and reference areas. Every disposal mound SPI station exhibited at least one replicate with a Stage 3 successional status in the form of burrows, feeding voids, or large-bodied organisms. PUC images also documented the presence of extensive burrow openings on the surface of all three mounds. This advanced successional status of the three mounds (Stage 1 on 3 or Stage 2 on 3) was identical to reference areas and further indicates the recovery of the benthic community at CCBDS.

Dense aggregations of brittle stars were observed at two of the reference areas (CCBRS and NWREF) but were not seen at the third reference area (SWREF). The patchy distribution of brittle stars was further reflected in the occurrence of brittle stars at only four disposal mound stations. The lack of brittle stars at one reference area suggests that natural variation in the population distribution, not a disposal related effect, limited their presence at disposal mound stations.

4.2.1 Comparison to Previous Surveys

The 2010 survey results suggest that there has been a reversal of the apparent downward trend in benthic conditions that was identified in the 2001 and 2003 surveys and that benthic conditions at the three mounds are now comparable to the reference areas.

While the aRPD at Mound A has not returned to the 1996 survey depths, it has rebounded since the 2001 and 2003 surveys and is now within a range that is characteristic of extensive biogenic reworking and healthy benthic conditions and similar to that observed at the reference stations (Figure 4-2 & Table 4-1). The extraordinarily deep aRPD measured at Mound A in 1996 may reflect a seasonal elevation in aRPD; the 1996 survey was conducted in May while all three subsequent surveys were conducted at the end of the summer (Table 1-2). While the highest bioturbation rates would be expected in mid to late summer (ENSR 2004) the late spring timing of the 1996 survey hinders accurate inter-annual comparison of this dataset with the later surveys.

The aRPD at Mound B also recovered to healthy values since the 2003 survey. This mound exhibited a similar pattern to Mound A with a healthy aRPD immediately after dredged material placement followed by a period of shallower measurements before finally returning to deeper aRPD depths several years after cessation of disposal activity (Figure 4-2 & Table 4-1).

Successional stage status of the two mounds also showed an initial spike in recovery followed by a period of decline in Stage 3 organisms (Table 4-2). This delayed recovery of aRPD and successional stage may be due to the sulfidic sediment apparent at depth in SPI images from both mounds or this recovery pattern may be characteristic of benthic recolonization of Cape Cod Bay.

MWRA Studies

Monitoring of eastern Cape Cod Bay as part of the Massachusetts Water Resource Authority's (MWRA) Harbor and Outfall Monitoring (HOM) Program has shown stable benthic habitat conditions since 1991 (Maciolek et al. 2010). Abundance of individual organisms fluctuated between 2002 and 2009, but long-term patterns have remained within expected ranges and are consistent with the natural cycle observed over this 20 year monitoring effort. The most recent MWRA benthic data available showed that the dominant species collected at Cape Cod Bay stations in 2009 were similar to those seen in previous years. The results of the MWRA HOM Program further support the 2010 SPI and PUC results that benthic conditions within CCBRS (MWRA Station FF07) are healthy and similar to surrounding areas in Cape Cod Bay.

Also, while biliary proliferation in liver tissues of Cape Cod Bay winter flounder reached a high in 2009 (Moore et al. 2010a), recent MWRA findings showed a decrease in this condition at the ECCB trawl to the lowest occurrence among the four MWRA flounder stations (Moore et al. 2010a, Moore et al. 2011).

Table 4-1.

Summary of Mean aRPD Depths (cm) Since 1996

Site	1996	2001	2003	2010
Mound A	5.5	1.9	1.2	3.0
Mound B	N/A	2.2	1.3	2.7
Mound C	N/A	N/A	N/A	3.2
Reference Areas	3.6	2.5	2.3	3.5

N/A = Mound not formed at time of survey

Table 4-2.

Percent of SPI Stations with Stage 3 Successional Status since 1996 (# of Stations)

Site	1996	2001	2003	2010
Mound A	85 (13)	69 (13)	92 (13)	100 (15)
Mound B	N/A	92 (25)	69 (13)	100 (15)
Mound C	N/A	N/A	N/A	100 (15)
Reference Areas	97 (39)	92 (13)	100 (5)	100 (45)

N/A = Mound not formed at time of survey

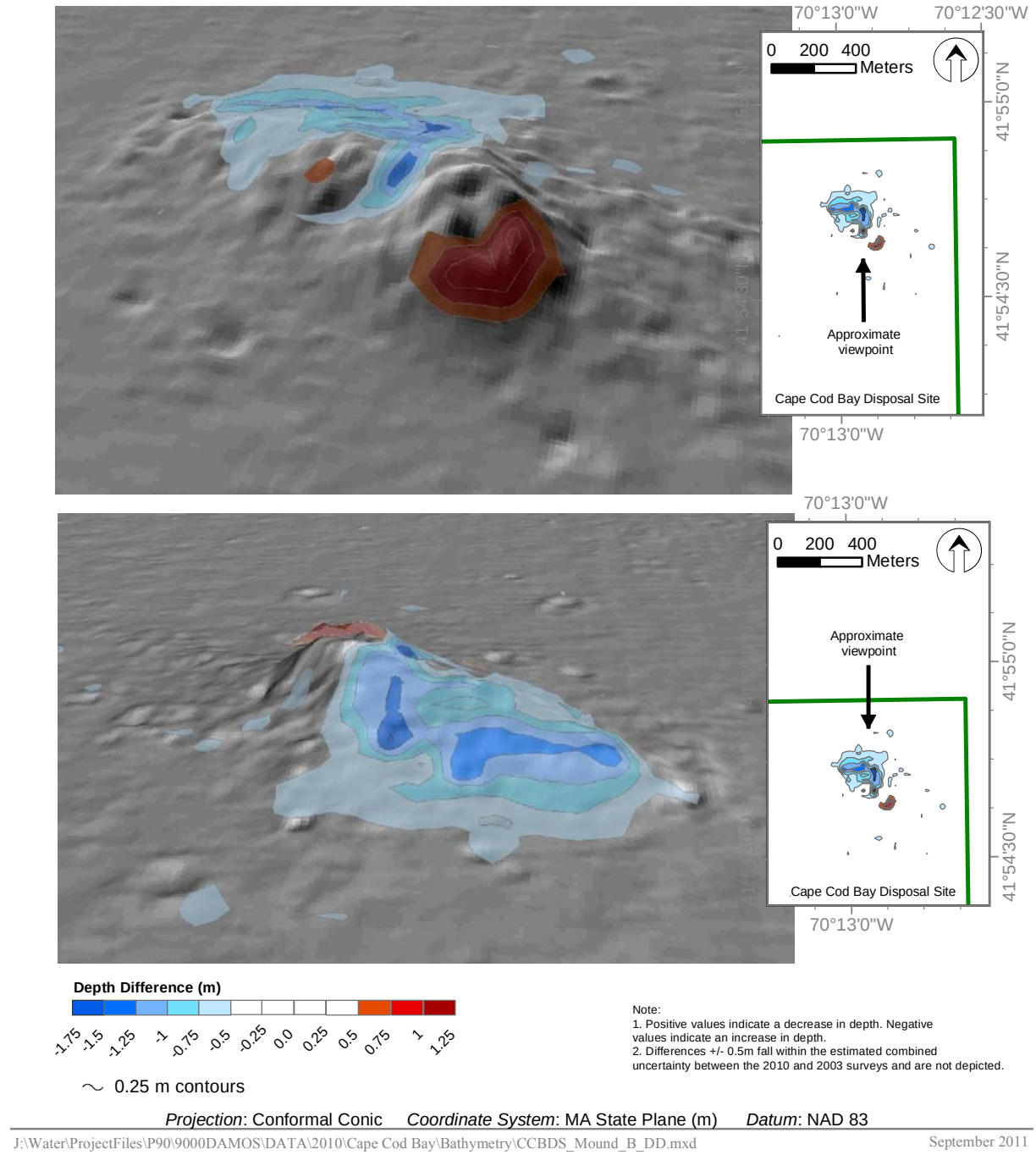


Figure 4-1. Oblique view of possible sediment transport at Mound B between 2003 and 2010

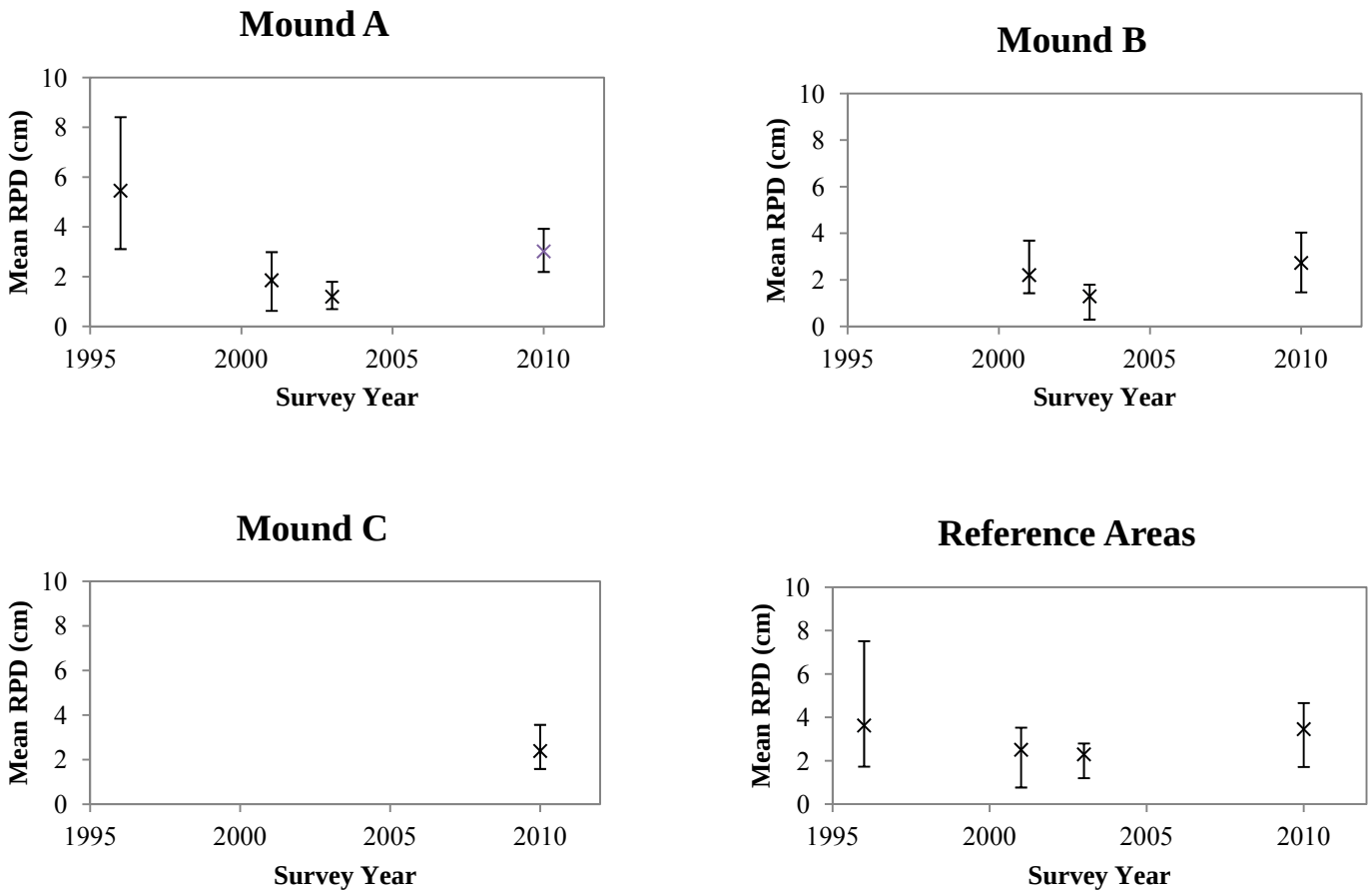


Figure 4-2. Mean (x) and range (error bars) of aRPD depths at CCBDS since 1996

5.0 CONCLUSIONS

The September 2010 survey at CCBDS was performed to collect bathymetric and backscatter data over the entire disposal site along with SPI and PUC images at three disposal mounds and three reference areas. The survey was designed to assess changes in seafloor topography since the placement of 137,000 m^3 (179,000 yd^3) material in the northwest quadrant of the site and to determine the benthic recovery status of all three mounds.

The Historic Wellfleet Disposal Site at the center of CCBDS had not received dredged material in over 20 years and remained as an irregularly shaped feature with a height of approximately 0.5 m. Mound A had not received dredged material in 15 years and had not experienced a change in height or footprint since the previous survey in 2003. Mound B was the largest feature at CCBDS and while it had not received dredged material in seven years at the time of the 2010 survey, it had experienced localized sediment transport around the mound apex. This redistribution was likely due to the effects of storm related tidal currents and waves, but it did not result in the dispersal of dredged material beyond the original mound footprint and the overall mound topography remains stable.

A new mound, Mound C, was formed in the northwest quadrant of CCBDS after the disposal of approximately 137,000 m^3 (179,000 yd^3) of material since 2003. Due to a wide spatial distribution of disposal events, Mound C was evident as a broad feature rising less than 1 m over the surrounding bottom. Substantial capacity remains at Mound C, but it is recommended that future dredged material placement continue to be directed to create a low relief mound to avoid the potential for the sediment transport seen at Mound B.

Benthic recolonization of all three mounds has returned to expected levels. All disposal mound SPI stations exhibited a high degree of sediment reworking and advanced successional stage status, indicating that the benthic conditions at the disposal mounds were comparable to reference conditions. Any decline in benthic recolonization that was previously noted at Mounds A and B has reversed, and both mounds supported advanced Stage 3 infauna and relatively deep aRPDs throughout their extent.

Based on the findings of the 2010 CCBDS survey, the following recommendations are proposed:

1. Future dredged material should be directed to Mound C in a wide dispersal pattern to promote the formation of a low relief mound;

2. Periodic bathymetric surveys should be conducted over Mound B to confirm the continued stability of the mound and to monitor the sediment transport processes around the mound apex;

3. Periodic bathymetric surveys should be conducted over Mound C to monitor the continued development and stability of the mound; and

4. Periodic SPI surveys should be conducted following periods of dredged material placement at the active mound. Monitoring of older mounds can be reduced to a limited number of confirmatory stations.

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Appendix A

Disposal Barge Logs for CCBDS
August 2003 to September 2010

APPENDIX A
Disposal Barge Logs for CCBDS
August 2003 to September 2010

Project Name	Permittee	Permit Number	Disposal Date	Volume (y^3)	Volume (m^3)	Latitude	Longitude	Distance	Direction
JAMES LANDING/MARINA BASIN/SCITUATE MA	ROLLING LAKES II	NAE20041721	11/19/2004	850	649.91	41.9112333	-70.2274	50 ft	
JAMES LANDING/MARINA BASIN/SCITUATE MA	ROLLING LAKES II	NAE20041721	11/21/2004	650	496.99	41.9109833	-70.2278	50 ft	
JAMES LANDING/MARINA BASIN/SCITUATE MA	ROLLING LAKES II	NAE20041721	11/22/2004	800	611.68	41.9107167	-70.22768333	60 ft	
JAMES LANDING/MARINA BASIN/SCITUATE MA	ROLLING LAKES II	NAE20041721	11/23/2004	800	611.68	41.9107167	-70.22768333	50 ft	
JAMES LANDING/MARINA BASIN/SCITUATE MA	ROLLING LAKES II	NAE20041721	11/24/2004	700	535.22	41.9108	-70.2278		
JAMES LANDING/MARINA BASIN/SCITUATE MA	ROLLING LAKES II	NAE20041721	11/29/2004	850	649.91	41.9104333	-70.22743333	50 ft	
JAMES LANDING/MARINA BASIN/SCITUATE MA	ROLLING LAKES II	NAE20041721	11/30/2004	1000	764.6	41.9113	-70.22798333	50 ft	
JAMES LANDING/MARINA BASIN/SCITUATE MA	ROLLING LAKES II	NAE20041721	12/3/2004	1100	841.06	41.9113	-70.22728333	75 ft	
JAMES LANDING/MARINA BASIN/SCITUATE MA	ROLLING LAKES II	NAE20041721	12/4/2004	700	535.22	41.91085	-70.22758333	50 ft	
JAMES LANDING/MARINA BASIN/SCITUATE MA	ROLLING LAKES II	NAE20041721	12/5/2004	750	573.45	41.9112667	-70.22718333	40 ft	
JAMES LANDING/MARINA BASIN/SCITUATE MA	ROLLING LAKES II	NAE20041721	12/10/2004	1000	764.6	41.9105833	-70.22788333	50 ft	
JAMES LANDING/MARINA BASIN/SCITUATE MA	ROLLING LAKES II	NAE20041721	12/11/2004	1150	879.29	41.9113	-70.22668333	25 ft	
JAMES LANDING/MARINA BASIN/SCITUATE MA	ROLLING LAKES II	NAE20041721	12/12/2004	1150	879.29	41.9116	-70.227	40 ft	
JAMES LANDING/MARINA BASIN/SCITUATE MA	ROLLING LAKES II	NAE20041721	12/14/2004	950	726.37	41.9108167	-70.22736667	40 ft	
JAMES LANDING/MARINA BASIN/SCITUATE MA	ROLLING LAKES II	NAE20041721	12/15/2004	800	611.68	41.9107333	-70.22761667	40 ft	
JAMES LANDING/MARINA BASIN/SCITUATE MA	ROLLING LAKES II	NAE20041721	12/17/2004	1050	802.83	41.9107833	-70.22775	75 ft	

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Project Name	Permittee	Permit Number	Disposal Date	Volume (y^3)	Volume (m^3)	Latitude	Longitude	Distance	Direction
JAMES LANDING/MARINA BASIN/SCITUATE MA	ROLLING LAKES II	NAE20041721	12/18/2004	1000	764.6	41.9102667	-70.22766667	40 ft	
JAMES LANDING/MARINA BASIN/SCITUATE MA	ROLLING LAKES II	NAE20041721	12/30/2004	700	535.22	41.9113167	-70.22733333	50 ft	
JAMES LANDING/MARINA BASIN/SCITUATE MA	ROLLING LAKES II	NAE20041721	12/31/2004	700	535.22	41.9111667	-70.22681667	50 ft	
GREEN HARBOR YACHT CLUB/GREEN HARBOR RIVER	GREEN HARBOR YACHT CLUB	NAE20072709	8/28/2008	2000	1529.2	41.9093	-70.22886667	200 ft	SE
GREEN HARBOR YACHT CLUB/GREEN HARBOR RIVER	GREEN HARBOR YACHT CLUB	NAE20072709	8/29/2008	2000	1529.2	41.9102333	-70.22633333	200 ft	NE
GREEN HARBOR YACHT CLUB/GREEN HARBOR RIVER	GREEN HARBOR YACHT CLUB	NAE20072709	8/30/2008	2000	1529.2	41.9104167	-70.2266	100 ft	ESE
GREEN HARBOR YACHT CLUB/GREEN HARBOR RIVER	GREEN HARBOR YACHT CLUB	NAE20072709	8/30/2008	2000	1529.2	41.9105167	-70.2274	70 ft	
GREEN HARBOR YACHT CLUB/GREEN HARBOR RIVER	GREEN HARBOR YACHT CLUB	NAE20072709	8/30/2008	1200	917.52	41.9106833	-70.22785	30 ft	
GREEN HARBOR YACHT CLUB/GREEN HARBOR RIVER	GREEN HARBOR YACHT CLUB	NAE20072709	8/31/2008	1200	917.52	41.9105667	-70.22781667	100 ft	
GREEN HARBOR YACHT CLUB/GREEN HARBOR RIVER	GREEN HARBOR YACHT CLUB	NAE20072709	9/1/2008	3000	2293.8	41.9091333	-70.22423333	175 ft	SE
GREEN HARBOR YACHT CLUB/GREEN HARBOR RIVER	GREEN HARBOR YACHT CLUB	NAE20072709	9/1/2008	800	611.68	41.9103833	-70.22751667	20 ft	
WESTPORT HARBOR	TOWN OF WESTPORT	NAE20072709	9/2/2008	3000	2293.8	41.9097833	-70.22601667	250 ft	E
WESTPORT HARBOR	TOWN OF WESTPORT	NAE20072709	9/3/2008	2000	1529.2	41.9103833	-70.22751667	100 ft	
WESTPORT HARBOR	TOWN OF WESTPORT	NAE20072709	9/3/2008	3000	2293.8	41.9109833	-70.22555	150 ft	NE
WESTPORT HARBOR	TOWN OF WESTPORT	NAE20072709	9/4/2008	3500	2676.1	41.91055	-70.22726667	50 ft	SE
WESTPORT HARBOR	TOWN OF WESTPORT	NAE20072709	9/5/2008	1500	1146.9	41.9103833	-70.22778333	160 ft	

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WESTPORT HARBOR	TOWN OF WESTPORT	NAE20072709	9/5/2008	3500	2676.1	41.9110333	-70.22791667	20-200 ft	NW
WESTPORT HARBOR	TOWN OF WESTPORT	NAE20072709	9/7/2008	3250	2484.95	41.9108	-70.22775	50 ft	SE
WESTPORT HARBOR	TOWN OF WESTPORT	NAE20072709	9/7/2008	3000	2293.8	41.9108333	-70.22663333	100 ft	E
WESTPORT HARBOR	TOWN OF WESTPORT	NAE20072709	9/8/2008	2000	1529.2	41.9045	-70.22766667	Unknown	
WESTPORT HARBOR	TOWN OF WESTPORT	NAE20072709	9/8/2008	2500	1911.5	41.9098333	-70.22803333	150 ft	ESE
WESTPORT HARBOR	TOWN OF WESTPORT	NAE20072709	9/9/2008	2100	1605.66	41.9101667	-70.22733333	25 ft	
WESTPORT HARBOR	TOWN OF WESTPORT	NAE20072709	9/9/2008	2684	2052.186	41.9101167	-70.22933333	125 ft	
WESTPORT HARBOR	TOWN OF WESTPORT	NAE20072709	9/11/2008	2798	2139.351	41.9103333	-70.22683333	100 ft	
WESTPORT HARBOR	TOWN OF WESTPORT	NAE20072709	9/12/2008	3000	2293.8	41.9088667	-70.2277	100 ft	SSW
WESTPORT HARBOR	TOWN OF WESTPORT	NAE20072709	9/12/2008	1904	1455.798	41.9113333	-70.2265	75 ft	SE
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE20072709	9/13/2008	2500	1911.5	41.9115333	-70.22771667	100 ft	NW
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE20072709	9/13/2008	2125	1624.775	41.9101667	-70.22716667	25 ft	
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE20072709	9/14/2008	2250	1720.35	41.9105333	-70.22721667	100 ft	E
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE20072709	9/14/2008	1685	1288.351	41.9121667	-70.22816667	175 ft	
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE20072709	9/15/2008	2000	1529.2	41.9109333	-70.22783333	50 ft	N
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE20072709	9/15/2008	1900	1452.74	41.9096333	-70.22666667	50 ft	

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POPE'S ISLAND	CITY OF NEW BEDFORD	NAE20072709	9/16/2008	2000	1529.2	41.91085	-70.22826667	75 ft	N
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE20072709	9/16/2008	1740	1330.404	41.9083333	-70.228	125 ft	
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE20072709	9/17/2008	2000	1529.2	41.9109333	-70.22793333	30 ft	W
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE20072709	9/17/2008	2071	1583.487	41.9093333	-70.22766667	25 ft	
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE20072709	9/18/2008	2000	1529.2	41.9103167	-70.22791667	50 ft	NNW
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE20072709	9/19/2008	2525	1930.615	41.9096667	-70.22983333	125 ft	
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE20072709	9/20/2008	3500	2676.1	41.91	-70.22701667	100 ft	SSE
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE20072709	9/20/2008	2367	1809.808	41.9091667	-70.228	75 ft	S
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE20072709	9/21/2008	3500	2676.1	41.9098167	-70.22763333	100 ft	SW
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE20072709	9/22/2008	2259	1727.231	41.909	-70.22766667	50 ft	SE
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE20072709	9/22/2008	2500	1911.5	41.9111333	-70.22771667	50-75 ft	N
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE20072709	9/23/2008	2206	1686.708	41.911	-70.22733333	25 ft	SE
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE20072709	9/23/2008	2500	1911.5	41.9108333	-70.2273	30-50 ft	E
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE20072709	9/24/2008	2798	2139.351	41.9098333	-70.90216667	100 ft	S
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE20072709	9/24/2008	2500	1911.5	41.91095	-70.22868333	100 ft	W
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE20072709	9/25/2008	2000	1529.2	41.9100833	-70.22776667	50 ft	S

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POPE'S ISLAND	CITY OF NEW BEDFORD	NAE20072709	9/27/2008	3500	2676.1	41.9111833	-70.22728333	100 ft	N
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE20072709	9/27/2008	3500	2676.1	41.9098833	-70.22726667	75 ft	E
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE20072709	9/29/2008	3500	2676.1	41.9102333	-70.22616667	100 ft	ESE
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE20072709	9/30/2008	3000	2293.8	41.9104667	-70.22736667	50 ft	SW
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE20072709	10/1/2008	3500	2676.1	41.9118667	-70.22753333	125 ft	N
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE20072709	10/2/2008	3500	2676.1	41.90995	-70.22686667	75 ft	E
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE20072709	10/4/2008	2500	1911.5	41.9106167	-70.22691667	50-70 ft	SE
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE20072709	10/5/2008	3000	2293.8	41.9111167	-70.2278	75 ft	WNW
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE20072709	10/6/2008	2750	2102.65	41.9114167	-70.22865	150 ft	NW
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE20072709	10/8/2008	3200	2446.72	41.9113	-70.22755	50 ft	N
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE20064296	11/24/2008	700	535.22	41.9108333	-70.22683333	150 ft	
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE20064296	11/28/2008	750	573.45	41.9106167	-70.22751667	150 ft	E
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE20064296	12/6/2008	800	611.68	41.91055	-70.2275	100 ft	SW
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE20064296	12/9/2008	800	611.68	41.91	-70.22751667	100 ft	SW
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE20064296	12/9/2008	800	611.68	41.9105	-70.22745	180 ft	SW
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE20064296	12/14/2008	800	611.68	41.91055	-70.22753333	250 ft	W

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POPE'S ISLAND	CITY OF NEW BEDFORD	NAE20064296	12/26/2008	800	611.68	41.91005	-70.22741667	300 ft	SW
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE20064296	6/2/2009	800	611.68	41.9106333	-70.23	600 ft	WSW
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE20064296	6/4/2009	800	611.68	41.9106	-70.22831667	200 ft	W
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE20064296	6/5/2009	835	638.441	41.9105	-70.22805	30 ft	E
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE20064296	6/8/2009	835	638.441	41.9106667	-70.22866667	50 ft	NW
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE20064296	6/9/2009	835	638.441	41.911	-70.22883333	200 ft	S
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE20064296	6/17/2009	840	642.264	41.9106667	-70.22933333	100 ft	S
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE20064296	6/20/2009	840	642.264	41.9097667	-70.22758333	175 ft	S
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE20064296	6/21/2009	600	458.76	41.91	-70.229	1000 ft	W
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE200500382	11/30/2009	750	573.45	41.9103	-70.22735	500 ft	
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE200500382	12/1/2009	750	573.45	41.90995	-70.22718333	300 ft	
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE200500382	12/2/2009	700	535.22	41.91085	-70.2267	400 ft	
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE200500382	12/4/2009	750	573.45	41.9102	-70.22713333	200 ft	
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE200500382	12/7/2009	700	535.22	41.9094167	-70.22708333	400 ft	
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE200500382	12/7/2009	700	535.22	41.9101	-70.2265	500 ft	
POPE'S ISLAND	CITY OF NEW BEDFORD	NAE200500382	12/8/2009	700	535.22	41.911	-70.2261	300 ft	

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POPE'S ISLAND	CITY OF NEW BEDFORD	NAE200500382	12/12/2009	400	305.84	41.9123	-70.22781667	400 ft	
DREDGING IN GREEN HARBOR MARINA	GREEN HARBOR MARINA	NAE200802108	12/13/2009	700	535.22	41.9102833	-70.23071667	400 ft	
DREDGING IN GREEN HARBOR MARINA	GREEN HARBOR MARINA	NAE200802108	12/15/2009	750	573.45	41.9104167	-70.22785	200 ft	
DREDGING IN GREEN HARBOR MARINA	GREEN HARBOR MARINA	NAE200802108	12/15/2009	550	420.53	41.9101333	-70.22771667	300 ft	
DREDGING IN GREEN HARBOR MARINA	GREEN HARBOR MARINA	NAE200802108	12/18/2009	700	535.22	41.90975	-70.22791667	300 ft	
DREDGING IN GREEN HARBOR MARINA	GREEN HARBOR MARINA	NAE200802108	12/19/2009	600	458.76	41.9095333	-70.22715	500 ft	
DREDGING IN GREEN HARBOR MARINA	GREEN HARBOR MARINA	NAE200802108	12/22/2009	100	76.46	41.912	-70.22728333	500 ft	
DREDGING IN GREEN HARBOR MARINA	GREEN HARBOR MARINA	NAE200802108	12/22/2009	700	535.22	41.9101167	-70.22546667	400 ft	
DREDGING IN GREEN HARBOR MARINA	GREEN HARBOR MARINA	NAE200802108	12/24/2009	700	535.22	41.9117333	-70.22731667	400 ft	
DREDGING IN GREEN HARBOR MARINA	GREEN HARBOR MARINA	NAE200802108	12/28/2009	750	573.45	41.9095333	-70.228	400 ft	
DREDGING IN GREEN HARBOR MARINA	GREEN HARBOR MARINA	NAE200802108	12/28/2009	600	458.76	41.9098667	-70.2294	500 ft	
DREDGING IN GREEN HARBOR MARINA	GREEN HARBOR MARINA	NAE200802108	1/13/2010	750	573.45	41.91045	-70.22656667	400 ft	
DREDGING IN GREEN HARBOR MARINA	GREEN HARBOR MARINA	NAE200802108	1/14/2010	600	458.76	41.9105833	-70.22706667	91 ft	
DREDGING IN GREEN HARBOR MARINA	GREEN HARBOR MARINA	NAE200802108	1/15/2010	450	344.07	41.9107833	-70.22721667	400 ft	

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Appendix B

Grain Size Scale Conversions

APPENDIX B
Grain Size Scale Conversions

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

Appendix C

Sediment-Profile Imaging Results

APPENDIX C
Sediment-Profile Imaging Results
September 2010

Station	Rep.	Date	Time	Stop Collar Setting (in)	# of weights (per side)	Water Depth (ft)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Minimum (phi)	Grain Size Maximum (phi)	Penetration Area (sq.cm)	Penetration Mean (cm)	Penetration Minimum (cm)	Penetration Maximum (cm)	Boundary Roughness (cm)	Boundary Roughness Type	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State	Methane	Total DM Area (sq.cm)	Total DM Mean (sq.cm)	Total DM Minimum (sq.cm)	Total DM Maximum (sq.cm)	Low DO?	Feeding Void #	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	COMMENT
CCBDS-A-1	A	9/24/2010	8:54	11.5	0	96	14.6	>4	>4	1	277.7	19.0	18.9	19.3	0.4	Biogenic	53.84	3.7	0		n	277.7	> 19.0	> 18.9	> 19.3	n	0				2 going to 3	DM>pen; soft mud reduced@depth; sand layer/horizon@depth; strong rpd contrast; Nucula shells just below swi; surf tubes
CCBDS-A-1	B	9/24/2010	8:54	11.5	0	96	14.6	>4	>4	1	240.8	16.5	16.2	17.1	0.9	Biogenic	60.23	4.1	0		n	240.8	> 16.5	> 16.2	> 17.1	n	2	2.6	4.8	3.7	1 on 3	DM>pen; soft mud; reduced@depth w/ moderate/strong rpd contrast; void/burrow on left and partial void on right; worm@depth; fibers/particles in sed fabric
CCBDS-A-1	D	9/24/2010	8:56	11.5	0	96	14.6	>4	>4	1	254.9	17.5	16.6	18.4	1.8	Biogenic	55.4	3.8	0		n	254.9	> 17.5	> 16.6	> 18.4	n	1	4.1	4.5	4.3	1 on 3	DM>pen; soft mud reduced@depth; moderate/strong rpd contrast; sandy/granular texture@depth; 1 void+several subsurface worms; burrow opening@far left
CCBDS-A-2	B	9/24/2010	7:31	12	0	93	14.6	>4	>4	1	260.8	17.9	17.4	18.3	0.9	Biogenic	46.6	3.2	0		n	260.8	> 17.9	> 17.4	> 18.3	n	0				1 on 3	DM>pen; soft mud reduced@depth; moderate/strong rpd contrast; small surf tubes; edge of burrow gallery transected at depth
CCBDS-A-2	C	9/24/2010	7:32	12	0	93	14.6	>4	>4	1	274.9	18.8	18.3	19.4	1.1	Biogenic	51.4	3.5	0		n	274.9	> 18.8	> 18.3	> 19.4	n	1	1.7	1.8	1.8	1 on 3	DM>pen; soft mud reduced w/ depth; moderate rpd contrast; small surf tubes; small void@left+subsurface worm@depth center; surf reworking
CCBDS-A-2	D	9/24/2010	7:33	12	0	93	14.6	>4	>4	1	296.5	20.3	20.1	20.8	0.7	Biogenic	43.8	3.0	0		n	296.5	> 20.3	> 20.1	> 20.8	n	1	3.4	7.7	0.0	1 on 3	DM>pen; soft mud, reduced w/ depth; weak rpd contrast; small surf tubes; large void/burrow@left
CCBDS-A-3	A	9/24/2010	9:34	12	1	98	14.6	>4	>4	1	207	14.2	14	14.4	0.4	Biogenic	42.1	2.9	5	b	n	207.0	> 14.2	> 14.0	> 14.4	n	1	6.0	6.2	6.1	1 on 3	DM>pen; soft mud, slightly reduced@depth; moderate rpd contrast; partial void; surf tubes; lots of bio reworking@swi
CCBDS-A-3	B	9/24/2010	9:35	12	1	98	14.6	>4	>4	1	166.2	11.4	10.1	12.3	2.2	Physical	45	3.1	3	r	n	166.2	> 11.4	> 10.1	> 12.3	n	0				2 going to 3	DM>pen; reduced patches@depth; moderate rpd contrast; large reduced m clasts; dense surf tubes, edge of subsurface burrows transected.
CCBDS-A-3	H	9/24/2010	10:03	15	3	98	14.6	2 to 1	>4	-2	74	5.1	3.8	6.1	2.3	Physical	35.5	2.4	0		n	74.0	> 5.1	> 3.8	> 6.1	n	0				2 going to 3	DM>pem; dm is fine to medium sand; some mud+pebbles=poorly sorted; surf tubes; 1 small subsurface worm@right, shallow sub-surface burrows present
CCBDS-A-4	B	9/24/2010	8:05	11.5	0	96	14.6	>4	>4	1	278.9	19.1	18.9	19.6	0.7	Biogenic	40.8	2.8	0		n	278.9	> 19.1	> 18.9	> 19.6	n	0				1 on 3	DM>pen; soft mud, moderately reduced@depth; weak rpd contrast w/ faint redox rebound; particles/firbers in sed fabric, possibly organic matter or leaf litter. Burrow openings visible in PV, evidence of subsurface burrowing in SPI
CCBDS-A-4	C	9/24/2010	8:06	11.5	0	96	14.6	>4	>4	1	246	16.8	16.4	17.2	0.8	Biogenic	25.4	1.7	7	b	n	246.0	> 16.8	> 16.4	> 17.2	n	0				1 on 3	DM>pen; layering w/ relic rpd; soft mud moderately reduced@depth; moderate rpd contrast; particles/fibers in sed fabric; bio reworking of SWI. Evidence of burrowing at depth, burrow openings visible in PV
CCBDS-A-4	D	9/24/2010	8:07	11.5	0	96	14.6	>4	>4	1	261.6	17.9	17.1	18.5	1.4	Biogenic	29.8	2.0	0		n	261.6	> 17.9	> 17.1	> 18.5	n	1	12.9	13.1	13.0	1 on 3	DM>pen; soft mud increasingly reduced w/ depth; weak rpd contrast; 1 void+several small subsurface orgs; fibers/particles
CCBDS-A-5	A	9/24/2010	7:57	11.5	0	95	14.6	>4	>4	1	186.3	12.8	12.5	13	0.5	Biogenic	53.1	3.6	0		n	186.3	> 12.8	> 12.5	> 13.0	n	0				1 on 3	DM>pen; soft mud increasingly reduced w/ depth; weak/moderate rpd contrast; dense surf worm tubes/reworked swi; 1 partial void+a few small subsurface orgs
CCBDS-A-5	C	9/24/2010	7:59	11.5	0	95	14.6	>4	>4	1	239.4	16.4	16.1	16.9	0.8	Biogenic	45.6	3.1	0		n	239.4	> 16.4	> 16.1	> 16.9	n	1	11.6	11.8	11.7	1 on 3	DM>pen; soft mud increasingly reduced w/ depth; moderate rpd contrast; swi appears reworked; 1 void+1 partial void@depth
CCBDS-A-5	D	9/24/2010	8:00	11.5	0	95	14.6	>4	>4	1	264.5	18.1	17.6	18.5	0.9	Biogenic	45.2	3.1	0		n	264.5	> 18.1	> 17.6	> 18.5	n	0				1 on 3	DM>pen; soft homogenous mud reduced@depth; weak/moderate rpd contrast; many small surf tubes; 1 or 2 worms@mid-depth left
CCBDS-A-6	B	9/24/2010	9:18	11.5	0	95	14.6	>4	>4	2	260.9	17.9	17.6	18.4	0.8	Biogenic	32.6	2.2	0		n	260.9	> 17.9	> 17.6	> 18.4	n	0				1 on 3	DM>pen; soft homogenous mud reduced@depth; weak rpd contrast; a few surf tubes with oxidized burrow halos at depth
CCBDS-A-6	C	9/24/2010	9:18	11.5	0	95	14.6	>4	>4	2	212.5	14.6	13.7	16.3	2.6	Biogenic	58.7	4.0	0		n	212.5	> 14.6	> 13.7	> 16.3	n	1	12.8	13.9	13.4	1 on 3	DM>pen; soft homogenous mud reduced@depth; strong rpd contrast (faintly reduced above rpd); surf reworking; 1 void+1 subsurface org
CCBDS-A-6	D	9/24/2010	9:19	11.5	0	95	14.6	>4	>4	2	246.6	16.9	16.2	17.7	1.5	Biogenic	39.6	2.7	1	o	n	246.6	> 16.9	> 16.2	> 17.7	n	1	5.3	5.6	5.5	1 on 3	DM>pen; soft homogenous mud - reduced@depth; moderate rpd contrast; surface reworking; 1 partial void; shallow dwelling bivalves
CCBDS-A-7	A	9/24/2010	7:51	11.5	0	95	14.5	>4	>4	1	250.5	17.3	16.8	17.9	1.1	Biogenic	17	1.2	0		n	250.5	> 17.3	> 16.8	> 17.9	n	1	8.4	8.5	8.5	1 on 3	DM>pen; homogenous soft mud - moderately reduced@depth; shallow rpd w/ weak contrast ; 1 partial void@far right; vertical oxy tube/burrow

Note: ind = indeterminate; Mud clast state: o=oxidized, r=reduced, b=both oxidized and reduced

APPENDIX C
Sediment-Profile Imaging Results
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Station	Rep.	Date	Time	Stop Collar Setting (in)	# of weights (per side)	Water Depth (ft)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Minimum (phi)	Grain Size Maximum (phi)	Penetration Area (sq.cm)	Penetration Mean (cm)	Penetration Minimum (cm)	Penetration Maximum (cm)	Boundary Roughness (cm)	Boundary Roughness Type	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State	Methane	Total DM Area (sq.cm)	Total DM Mean (sq.cm)	Total DM Minimum (sq.cm)	Total DM Maximum (sq.cm)	Low DO?	Feeding Void #	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	COMMENT
CCBDS-A-7	B	9/24/2010	7:52	11.5	0	95	14.6	>4	>4	2	249.4	17.1	15.8	18	2.2	Physical	57.2	3.9	4	b	n	249.4	> 17.1	> 15.8	> 18.0	n	1	7.3	8.0	7.7	1 on 3	DM>pen; homogenous soft mud; moderately reduced@depth; wiper clasts+smear; weak rpd contrast; void@left
CCBDS-A-7	C	9/24/2010	7:53	11.5	0	95	14.6	>4	>4	1	261.7	17.9	17.7	18.4	0.7	Biogenic	36.3	2.5	3	o	n	261.7	> 17.9	> 17.7	> 18.4	n	1	12.7	15.6	14.2	2 on 3	DM>pen; soft homogenous mud; weak rpd contrast; reduced@depth; several white bivalves=Nucula; void+deep oxy burrow/tube
CCBDS-A-8	A	9/24/2010	9:24	11.5	0	95	14.6	>4	>4	1	275.1	18.8	18.6	19.4	0.8	Biogenic	27.6	1.9	0		n	275.1	> 18.8	> 18.6	> 19.4	n	1	18.6	19.4	19.0	1 on 3	DM>pen; soft homogenous mud; v. reduced@depth; moderate rpd contrast; 1 small partial void; several subsurface worms
CCBDS-A-8	B	9/24/2010	9:25	11.5	0	95	14.6	>4	>4	0	225.6	15.5	14.8	16.2	1.4	Physical	ind	Ind	4	r	n	225.6	> 15.5	> 14.8	> 16.2	n	0				ind	DM>pen; soft mud w/ faint sandy horizon@depth; reduced@depth; reduced wiper clasts+significant smearing; sampling artifact at SWI
CCBDS-A-8	C	9/24/2010	9:26	11.5	0	95	14.6	>4	>4	1	233.1	16.0	13.2	17.9	4.7	Physical	58.3	4.0	2	b	n	233.1	> 16.0	> 13.2	> 17.9	n	0				1 on 3	DM>pen; soft homogenous mud reduced@depth; weak rpd contrast; particles/fibers in matrix; wiper clast w/ some smearing; vertical burrow far right and pinkish org w/ burrow@far left
CCBDS-A-9	A	9/24/2010	8:24	11.5	0	96	14.6	>4	>4	2	260.6	17.8	17.5	18.1	0.6	Biogenic	59.7	4.1	0		n	260.6	> 17.8	> 17.5	> 18.1		1	5.8	7.6	6.7	1 on 3	DM>pen; soft homogenous mud; reduced@depth; reduced horizon below swi w/ light colored sed beneath; small surf tubes; large void; a few small subsurf worms
CCBDS-A-9	B	9/24/2010	8:25	11.5	0	96	14.6	>4	>4	2	228.9	15.7	15.5	16.2	0.7	Biogenic	41.4	2.8	0		n	228.9	> 15.7	> 15.5	> 16.2	n	0				1 on 3	DM>pen; soft homogenous mud reduced@depth; weak/moderate rpd contrast; bio reworking of swi; small bivalves below swi; a few v. small worms@depth, burrow openings in PV, burrows transected at depth.
CCBDS-A-9	D	9/24/2010	8:27	11.5	0	96	14.6	>4	>4	2	249.7	17.1	16.8	17.7	0.9	Biogenic	39.5	2.7	0		n	249.7	> 17.1	> 16.8	> 17.7	n	2	8.4	15.2	11.8	1 on 3	DM>pen; soft homogenous mud, moderately reduced@depth; weak/mod rpd contrast; small surf tubes+2 subsurface voids
CCBDS-A-10	A	9/24/2010	9:08	11.5	0	95	14.6	>4	>4	1	260.9	17.9	17	19.2	2.2	Biogenic	61.1	4.2	0		n	260.9	> 17.9	> 17.0	> 19.2	n	2	1.7	6.1	3.9	1 on 3	DM>pen; soft homogenous mud, reduced@depth; shallow rpd w/ weak contrast; 1 shallow thin void+1 partial void w/ org@center; small surf tubes; 1 Nucula visible just under SWI at left
CCBDS-A-10	C	9/24/2010	9:10	11.5	0	95	14.6	>4	>4	1	266.7	18.3	17.7	19	1.3	Biogenic	48.8	3.3	0		n	266.7	> 18.3	> 17.7	> 19.0	n	0				1 on 3	DM>pen; soft homogenous mud strongly reduced@depth; moderate to strong rpd contrast; dense Stg 1 surf tubes;1 white bivalve below swi on right, edges of multiple burrows transected at depth
CCBDS-A-10	D	9/24/2010	9:11	11.5	0	95	14.6	>4	>4	1	233.6	16.0	15.4	16.6	1.2	Biogenic	62	4.2	0		n	233.6	> 16.0	> 15.4	> 16.6	n	1	3.9	4.3	4.1	1 on 3	DM>pen; soft homogenous mud, reduced@depth; moderate rpd; small surf tubes+reworking; 1 large void
CCBDS-A-11	A	9/24/2010	8:46	11.5	0	97	14.6	>4	>4	1	290.5	19.9	18.6	20.8	2.2	Biogenic	33.2	2.3	0		n	290.5	> 19.9	> 18.6	> 20.8	n	1	6.5	7.2	6.9	1 on 3	DM>pen; soft homogenous mud, moderately reduced@depth; weak to moderate rpd contrast; small surf tubes; 1 partial subsurface void
CCBDS-A-11	C	9/24/2010	8:48	11.5	0	97	14.6	>4	>4	1	237.8	16.3	15.7	17.6	1.9	Biogenic	36	2.5	0		n	237.8	> 16.3	> 15.7	> 17.6	n	0				1 on 3	DM>pen; soft homogenous mud, moderately reduced@depth; slight rpd smearing; surf tubes; 2-3 cryptic infaunal orgs
CCBDS-A-11	D	9/24/2010	8:49	11.5	0	97	14.6	>4	>4	1	264.6	18.1	17.7	18.5	0.8	Biogenic	39.7	2.7	0		n	264.6	> 18.1	> 17.7	> 18.5	n	1	14.6	14.4	14.5	1 on 3	DM>pen; soft homogenous mud; mod to strongly reduced@depth; dense surf tubes; 1 subsurface void; several vertical oxy tubes/burrows@depth
CCBDS-A-12	B	9/24/2010	8:39	11.5	0	96	14.6	>4	>4	2	207.6	14.2	13.7	14.6	0.9	Biogenic	41.6	2.8	0		n	207.6	> 14.2	> 13.7	> 14.6	n	0				1 on 3	DM>pen; soft homogenous mud; moderatly to strongly reduced@depth; small surf tubes; burrow openings w/ reduced fecal pellet mound @right
CCBDS-A-12	C	9/24/2010	8:40	11.5	0	96	14.6	>4	>4	1	257.6	17.6	16.7	18.3	1.6	Physical	54.4	3.7	2	r	n	257.6	> 17.6	> 16.7	> 18.3	n	2	13.6	14.0	13.8	1 on 3	DM>pen; soft homogenous mud; mod/strongly reduced@depth; reduced wiper clasts+rpd smear; surf tubes on clast; 2 voids lwr right
CCBDS-A-12	D	9/24/2010	8:41	11.5	0	96	14.6	>4	>4	1	242.5	16.6	15.4	17.5	2.1	Physical	61.9	4.2	3	o	n	242.5	> 16.6	> 15.4	> 17.5	n	2	4.5	4.9	4.7	1 on 3	DM>pen; soft homogenous mud>pen; surface sand patch upper left; two v. small voids; 1 subsurface thin worm lwr left
CCBDS-A-13	A	9/24/2010	7:44	11.5	0	93	14.6	>4	>4	2	307.6	21.1	20.4	21.3	0.9	Biogenic	62.3	4.3	0		n	307.6	> 21.1	> 20.4	> 21.3	n	2	5.9	6.9	6.4	1 on 3	DM>pen; soft homogenous mud>pen; almost overpen; v. reduced mud@depth; appears to be relatively recent dm; small surf tubes+1 or 2 voids/burrow@left;

Note: ind = indeterminate; Mud clast state: o=oxidized, r=reduced, b=both oxidized and reduced

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Sediment-Profile Imaging Results
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Station	Rep.	Date	Time	Stop Collar Setting (in)	# of weights (per side)	Water Depth (ft)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Minimum (phi)	Grain Size Maximum (phi)	Penetration Area (sq.cm)	Penetration Mean (cm)	Penetration Minimum (cm)	Penetration Maximum (cm)	Boundary Roughness (cm)	Boundary Roughness Type	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State	Methane	Total DM Area (sq.cm)	Total DM Mean (sq.cm)	Total DM Minimum (sq.cm)	Total DM Maximum (sq.cm)	Low DO?	Feeding Void #	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	COMMENT
CCBDS-A-13	C	9/24/2010	7:46	11.5	0	93	14.6	>4	>4	2	253.5	17.4	16.6	18.4	1.8	Biogenic	9.1	0.6	0		n	253.5	> 17.4	> 16.6	> 18.4	n	0				2 going to 3	DM>pen; soft homognous mud>pen; moderately reduced@depth; shallow rpd w/ moderate contrast; 1 or 2 v. small cryptic worms@depth, evidence of sub-surface burrowing
CCBDS-A-13	D	9/24/2010	7:47	11.5	0	93	14.6	>4	>4	1	270.8	18.5	18.5	19.1	0.6	Physical	ind	2.3	6	r	n	270.8	> 18.5	> 18.5	> 19.1	n	0				1	DM>pen; soft homgenous mud>pen; reduced@depth; large reduced clasts, aRPD from linear measurement at right edge of photo
CCBDS-A-14	B	9/24/2010	8:32	11.5	0	97	14.6	>4	>4	2	274.4	18.8	18.7	18.9	0.2	Biogenic	42.2	2.9	0		n	274.4	> 18.8	> 18.7	> 18.9	n	2	3.6	17.0	10.3	1 on 3	DM>pen; soft homogenous mud>pen; moderately reduced@depth; dense assorted surf tubes; 2 subsurface voids+worm@depth
CCBDS-A-14	C	9/24/2010	8:33	11.5	0	97	14.6	>4	>4	2	279	19.1	18.1	19.7	1.6	Biogenic	39.8	2.7	0		n	279.0	> 19.1	> 18.1	> 19.7	n	0				2 on 3	DM>pen; soft homogenous mud>pen; moderately reduced@depth; a few surf tubes+2 small white bivalves=Nucula; 1 small worm@depth
CCBDS-A-14	D	9/24/2010	8:34	11.5	0	97	14.6	>4	>4	1	257.5	17.6	17.4	18	0.6	Biogenic	49.7	3.4	0		n	257.5	> 17.6	> 17.4	> 18.0	n	2	5.9	8.0	7.0	1 on 3	DM>pen; soft homogenous mud>pen; moderately to strongly reduced@depth; moderate rpd contrast; small surf tubes+bio reworking of swi; 2 subsurface voids
CCBDS-A-15	A	9/24/2010	8:10	11.5	0	96	14.6	>4	>4	2	210.4	14.4	13.4	15.2	1.8	Biogenic	15.8	1.1	0		n	210.4	> 14.4	> 13.4	> 15.2	n	0				1 on 3	DM>pen; soft homogenous mud>pen; shallow rpd w/ weak to mod contrast; surf tubes; edge of subsurface burrow & gallery transected at depth; burrow openings in PV image
CCBDS-A-15	B	9/24/2010	8:11	11.5	0	96	14.6	>4	>4	1	222.9	15.3	14.6	15.9	1.3	Biogenic	54.6	3.7	0		n	222.9	> 15.3	> 14.6	> 15.9	n	0				1 on 3	DM>pen; soft homogenous mud>pen; moderately reduced@depth; shallow+patchy rpd; bio reworking of swi and upper 1 cm; Nucula visible as well as subusrface burrowing evidence
CCBDS-A-15	C	9/24/2010	8:12	11.5	0	96	14.6	>4	>4	1	219.8	15.1	14.1	16	1.9	Biogenic	51.9	3.6	0		n	219.8	> 15.1	> 14.1	> 16.0	n	0				1 on 3	DM>pen; soft homogenous mud>pen; moderately reduced@depth; moderate rpd contrast; bio reworking of upper 1 cm; Nucula near SWI @ center, edge of oxygenated burrow transected at left edge of image
CCBDS-B-1	B	9/23/2010	14:27	12	1	100	14.6	>4	>4	1	245.3	16.8	16.4	17.6	1.2	Biogenic	21.2	1.5	0		n	245.3	> 16.8	> 16.4	> 17.6	n	0				1 on 3	DM>pen; soft homogenous mud>pen; strongly reduced@depth; thin rpd w/ weak contrast; floc@surf; pink large-bodied worm@depth; 1 partial void
CCBDS-B-1	C	9/23/2010	14:28	12	1	100	14.6	>4	>4	-1	296.9	20.3	19.6	20.9	1.3	Biogenic	10.8	0.7	0		n	296.9	> 20.3	> 19.6	> 20.9	n	1	6.5	6.7	6.6	1 on 3	DM>pen; soft mud w/ many small white shell frags and some sand: strongly reduced@depth; shallow rpd w/ weak contrast; surf tubes+1 void@left; DM looks much more recent on this mound (B) than on (A) mound
CCBDS-B-1	D	9/23/2010	14:28	12	1	100	14.6	>4	>4	-1	272.6	18.7	18.2	20	1.8	Biogenic	65.2	4.5	0		n	272.6	> 18.7	> 18.2	> 20.0	n	0				1 on 3	DM>pen; soft mud w/ many small white shell frags; strongly reduced@depth; deep rpd w/ strong contrast; small surf tubes; vertical oxy burrow w/ associated polychaete; oxy burrow w/ mound@far right
CCBDS-B-2	B	9/23/2010	16:06	15	2	87	14.6	>4	>4	-1	298.6	20.5	20.1	20.9	0.8	Biogenic	53.8	3.7	0		n	298.6	> 20.5	> 20.1	> 20.9	n	0				1 on 3	DM>pen; soft mud w/ significant fraction of fine sand+small shell frags; weak rpd contrast; reduced@depth; small surf tubes; 2-3 v. small pink orgs@right=Stg 3
CCBDS-B-2	C	9/23/2010	16:07	15	2	87	14.6	>4	>4	-1	292.9	20.1	19.7	20.7	1.0	Biogenic	37.8	2.6	0		n	292.9	> 20.1	> 19.7	> 20.7	n	0				1 on 3	DM>pen; upper 6-8 cm is sandy mud over more homogenous reduced mud@depth; moderate to strong rpd contrast; former SWI demarcated by orange/rust-colored sed@depth; small surf tubes; a few v. small subsurface orgs
CCBDS-B-2	G	9/23/2010	16:16	12	0	87	14.6	>4	>4	0	218.9	15.0	14.5	15.6	1.1	Biogenic	62.7	4.3	0		n	218.9	> 15.0	> 14.5	> 15.6	n	1	7.1	7.4	7.3	1 on 3	DM>pen; soft mud w/ small shell frags+fine sand; thin veneer of grey sand@swi; reduced@depth; moderate rpd contrast; surf tubes; 1 void+several small infaunal org
CCBDS-B-3	A	9/23/2010	14:32	12	1	100	14.6	>4	>4	1	255.6	17.5	17.3	17.9	0.6	Biogenic	8.9	0.6	0		n	255.6	> 17.5	> 17.3	> 17.9	n	1	5.4	6.2	5.8	1 on 3	DM>pen; soft mud w/ a few small shell frags+some fine sand; reduced patched@depth; thin rpd w/ weak contrast, recent multiple depositional intervals; surf tubes+partial void+long thin white worm@depth

Note: ind = indeterminate; Mud clast state: o=oxidized, r=reduced, b=both oxidized and reduced

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Sediment-Profile Imaging Results
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Station	Rep.	Date	Time	Stop Collar Setting (in)	# of weights (per side)	Water Depth (ft)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Minimum (phi)	Grain Size Maximum (phi)	Penetration Area (sq.cm)	Penetration Mean (cm)	Penetration Minimum (cm)	Penetration Maximum (cm)	Boundary Roughness (cm)	Boundary Roughness Type	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State	Methane	Total DM Area (sq.cm)	Total DM Mean (sq.cm)	Total DM Minimum (sq.cm)	Total DM Maximum (sq.cm)	Low DO?	Feeding Void #	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	COMMENT
CCBDS-B-3	B	9/23/2010	14:33	12	1	100	14.6	>4	>4	0	291.5	20.0	19.4	20.3	0.9	Biogenic	38.2	2.6	0		n	291.5	> 20.0	> 19.4	> 20.3	n	0				1 on 3	DM>pen; soft homgenous mud>pen; some small shell frags; moderately reduced@depth; weak rpd contrast; brittle stars@sed surf ; a few small subsurface orgs
CCBDS-B-3	C	9/23/2010	14:35	12	1	100	14.6	>4	>4	1	260	17.8	17.3	18.5	1.2	Biogenic	40.1	2.7	1	r	n	260.0	> 17.8	> 17.3	> 18.5	n	0				1 on 3	DM>pen; soft homgenous mud>pen; some small shell frags; moderate to strongly reduced@depth; weak rpd contrast; brittle stars@sed surf + @depth; 1 or 2 small subsurface orgs
CCBDS-B-4	A	9/23/2010	14:46	12	1	101	14.6	>4	>4	1	251.2	17.2	16.8	17.7	0.9	Biogenic	17	1.2	0		n	251.2	> 17.2	> 16.8	> 17.7	n	0				1 on 3	DM>pen; soft homogenous mud w/ some sand and shell frags>pen; strongly reduced patch@depth; shallow rpd w/ weak contrast; 2-3 small subsurface orgs, burrow openings in PV image
CCBDS-B-4	C	9/23/2010	14:48	12	1	101	14.6	>4	>4	0	277.4	19.0	17.8	19.8	2.0	Biogenic	26.1	1.8	0		n	277.4	> 19.0	> 17.8	> 19.8	n	0				1 on 3	DM>pen; soft homogenous mud w/ minor sand+shell frags; strongly reduced@depth; uneven rpd; vertical burrow@left; a few small subsurface orgs
CCBDS-B-4	D	9/23/2010	14:48	12	1	101	14.6	>4	>4	1	286.9	19.7	18.6	20.9	2.3	Biogenic	21	1.4	4	r	n	286.9	> 19.7	> 18.6	> 20.9	n	3	11.1	17.2	14.2	1 on 3	DM>pen; soft homogenous mud>p; variable rpd w/ weak/moderate contrast; strongly reduced@depth; some surf tubes; several subsurface voids/burrows; vertical oxy tube@center
CCBDS-B-5	B	9/23/2010	15:16	14	2	84	14.6	>4 to 3	>4	0	102.6	7.0	6.4	7.6	1.2	Biogenic	43	2.9	0		n	102.6	> 7.0	> 6.4	> 7.6	n	0				1 on 3	DM>pen; muddy very fine sand/sandy mud; strongly reduced@depth; moderate rpd contrast; white shell frags@surf; small surf tubes; several small worms near rpd=Stg 3
CCBDS-B-5	H	9/23/2010	15:37	15	4	85	14.6	>4 to 3	>4	-1	98.4	6.7	5.7	7.8	2.1	Physical	10.3	0.7	0		n	98.4	> 6.7	> 5.7	> 7.8	n	0				1 on 3	DM>pen; reduced muddy fine sand/sandy mud; moderate to strongly reduced@depth; many white shell frags; thin rpd w/ strong contrast; small surf tubes+1 larger-bodied worm@depth
CCBDS-B-5	I	9/23/2010	15:38	15	4	85	14.6	>4 to 3	>4	-1	107.3	7.3	7.1	8	0.9	Biogenic	38.2	2.6	0		n	107.3	> 7.3	> 7.1	> 8.0	n	0				2 going to 3	DM>pen; muddy fine sand/sandy mud; strongly reduced@depth; moderate to strong rpd contrast; sand grains@surf; several small worms in surface oxidized layer
CCBDS-B-6	A	9/23/2010	16:35	12	0	96	14.6	>4	>4	1	273.8	18.8	18	19.3	1.3	Biogenic	45.5	3.1	0		n	273.8	> 18.8	> 18.0	> 19.3	n	0				1 on 3	DM>pen; soft homogenous mud>pen; strongly reduced@depth; moderate rpd contrast; small surf tubes; 1 large-bodied worm@depth; a few smaller subsurface orgs
CCBDS-B-6	B	9/23/2010	16:36	12	0	96	14.6	>4	>4	2	240.8	16.5	15.7	18.2	2.5	Biogenic	41.5	2.8	2	b	n	240.8	> 16.5	> 15.7	> 18.2	n	4	3.0	7.3	5.2	1 on 3	DM>pen; soft homogenous mud>pen; strongly reduced@depth; weak/moderate rpd contrast; several subsurface voids/burrows; red sed@surf associated w/ left burrow
CCBDS-B-6	D	9/23/2010	16:38	12	0	96	14.6	>4	>4	1	271.3	18.6	18.2	18.9	0.7	Biogenic	46.8	3.2	4	r	n	271.3	> 18.6	> 18.2	> 18.9	n	1	4.3	4.5	4.4	1 on 3	DM>pen; soft homogenous mud>pen; strongly reduced@depth; weak/moderate rpd contrast; 1 subsurface feeding void+several v. small worms@depth
CCBDS-B-7	A	9/23/2010	16:20	12	0	89	14.6	>4	>4	0	200.1	13.7	13.3	14.1	0.8	Biogenic	33.8	2.3	2	o	n	200.1	> 13.7	> 13.3	> 14.1	n	0				1 on 3	DM>pen; soft homogenous mud>pen; possible DM layering w/ relic rpd; strongly reduced@depth; moderate rpd contrast; surf tubes+several v. small subsurface orgs
CCBDS-B-7	C	9/23/2010	16:22	12	0	89	14.6	>4	>4	1	212.7	14.6	14.5	14.8	0.3	Biogenic	50.5	3.5	0		n	212.7	> 14.6	> 14.5	> 14.8	n	0				1 on 3	DM>pen; soft homogenous mud>pen; appears to be subtle DM layering; strongly reduced@depth w/ grey clay patch; moderate-strong rpd contrast; surf tubes+several v. small/thin subsurf orgs; vertical oxy tube@right
CCBDS-B-7	D	9/23/2010	16:23	12	0	89	14.6	>4	>4	0	238	16.3	15.5	16.6	1.1	Biogenic	25.6	1.8	0		y	238.0	> 16.3	> 15.5	> 16.6	n	1	5.5	7.0	6.3	1 on 3	DM>pen; soft homogenous mud>pen; strongly reduced@depth; large methane bubbles trapped in void/burrow; weak/moderate rpd contrast; surf tubes, burrow openings in PV image
CCBDS-B-8	A	9/23/2010	16:27	12	0	97	14.6	>4	>4	1	225.5	15.4	14.9	15.9	1.0	Biogenic	23.5	1.6	0		n	225.5	> 15.4	> 14.9	> 15.9	n	0				1 on 3	DM>pen; soft homogenous mud>pen; strongly reduced@depth; relatively shallow rpd ; surf reworking w/ some small reddish shallow-dwelling infauna, large burrow openings in PV image

Note: ind = indeterminate; Mud clast state: o=oxidized, r=reduced, b=both oxidized and reduced

APPENDIX C
Sediment-Profile Imaging Results
September 2010

Station	Rep.	Date	Time	Stop Collar Setting (in)	# of weights (per side)	Water Depth (ft)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Minimum (phi)	Grain Size Maximum (phi)	Penetration Area (sq.cm)	Penetration Mean (cm)	Penetration Minimum (cm)	Penetration Maximum (cm)	Boundary Roughness (cm)	Boundary Roughness Type	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State	Methane	Total DM Area (sq.cm)	Total DM Mean (sq.cm)	Total DM Minimum (sq.cm)	Total DM Maximum (sq.cm)	Low DO?	Feeding Void #	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	COMMENT
CCBDS-B-8	B	9/23/2010	16:28	12	0	97	14.6	>4	>4	2	251.1	17.2	17	17.5	0.5	Biogenic	69.1	4.7	0		n	251.1	> 17.2	> 17.0	> 17.5	n	0				1 on 3	DM>pen; soft homogenous mud>pen; strongly reduced@depth; deep rpd, shallow-dwelling bivalves as well as subusrface burrowing/worms @ depth
CCBDS-B-8	C	9/23/2010	16:29	12	0	97	14.6	>4	>4	2	254.5	17.4	17	18.2	1.2	Biogenic	29.9	2.0	8	b	n	254.5	> 17.4	> 17.0	> 18.2	n	2	2.7	4.5	3.6	1 on 3	DM>pen; soft homogenous mud>pen; strongly reduced@depth; patchy rpd w/ patches of strongly red sed; some small surf tubes+2 subsurface voids; 2 thin subsurface worms
CCBDS-B-9	A	9/23/2010	15:50	15	4	92	14.6	4/3 to	>4	-1	283.3	19.4	19.1	20	0.9	Biogenic	46.1	3.2	3	o	n	283.3	> 19.4	> 19.1	> 20.0	n	0				1 on 3	DM>pen; layering of homogenous mud over strongly reduced mud w/ sand+shell frags; moderate rpd contrast; small surf tubes; several small worms@depth
CCBDS-B-9	B	9/23/2010	15:51	15	4	92	14.6	4/3 to	>4	-1	274.5	18.8	18.5	19	0.5	Biogenic	49.3	3.4	0		n	274.5	> 18.8	> 18.5	> 19.0	n	0				1 on 3	DM>pen; layering of homogenous mud over strongly reduced mud w/ sig amount of grey sand+shell frags; moderate to strong rpd contrast; surf tubes+several small subsurface orgs
CCBDS-B-9	E	9/23/2010	15:53	15	4	92	14.6	4/3 to	>4	-1	290.2	19.9	18.8	20.8	2.0	Biogenic	37.3	2.6	0		n	290.2	> 19.9	> 18.8	> 20.8	n	0				1 on 3	DM>pen; layering of homogenous mud over strongly reduced mud w/ sig amount of grey sand+shell frags; weak to moderate rpd contrast; multiple depositional intervals/layering visible in image; burrow opening with reduced fecal pellets at left-center of image.
CCBDS-B-10	F	9/23/2010	15:43	15	4	89	14.6	4 to 3	>4	-1	105.3	7.2	6.5	8.3	1.8	Physical	27.6	1.9	0		n	105.3	> 7.2	> 6.5	> 8.3	n	1	2.3	4.4	3.4	1 on 3	DM>pen; muddy fine to medium sand w/ shell frags; strongly reduced@bottom of image; moderate rpd contrast; void/burrow@left.
CCBDS-B-10	G	9/23/2010	15:44	15	4	89	14.6	4 to 3	>4	0	130.7	9.0	8.7	9.2	0.5	Biogenic	48.3	3.3	0		n	130.7	> 9.0	> 8.7	> 9.2	n	0				1 on 3	DM>pen; mostly muddy fine sand in upper 3-4 cm with some medium to coarse particles; reduced@depth; large crab@surf in farfield; many surf tubes+numerous small subsurface orgs; 1 large-bodied org@bottom of image
CCBDS-B-10	H	9/23/2010	15:45	15	4	89	14.6	>4	>4	0	119.7	8.2	7.8	8.4	0.6	Biogenic	46.2	3.2	0		n	119.7	> 8.2	> 7.8	> 8.4	n	0				1 on 3	DM>pen; mostly mud but significant sand, especially@depth; strongly reduced@depth; moderate rpd contrast; surf tubes; a few v. small cryptic subsurface orgs
CCBDS-B-11	A	9/23/2010	14:59	12	1	99	14.6	>4	>4	0	213	14.6	13.4	15.4	2.0	Biogenic	45.9	3.1	0		n	213.0	> 14.6	> 13.4	> 15.4	n	0				1 on 3	DM>pen; soft homogenous mud w/ some small shell frags>pen; strongly reduced@depth; moderate rpd contrast; many small surf tubes; a few larger-bodied worms@depth; burrow openings from infaunal deposit feeders visible in PV image
CCBDS-B-11	B	9/23/2010	15:00	12	1	99	14.6	>4	>4	0	240.3	16.5	15.8	17.1	1.3	Biogenic	55.1	3.8	0		n	240.3	> 16.5	> 15.8	> 17.1	n	1	1.8	2.0	1.9	1 on 3	DM>pen; soft homogenous mud w/ small shell frags; moderate to strongly reduced@depth; bio reworking@swi; 1 shallow void
CCBDS-B-11	D	9/23/2010	15:02	12	1	99	14.6	>4	>4	0	233.6	16.0	15.6	16.5	0.9	Biogenic	41.1	2.8	0		n	233.6	> 16.0	> 15.6	> 16.5	n	0				1 on 3	DM>pen; soft homogenous mud w/ some sand+shell frags; mod to strongly reduced@depth; mod to strong rpd contrast; numerous surf tubes: v. small cryptic worms at depth
CCBDS-B-12	E	9/23/2010	14:02	12	1	103	14.6	>4	>4	0	248.9	17.0	16.5	17.4	0.9	Biogenic	40	2.7	0		n	248.9	> 17.0	> 16.5	> 17.4	n	0				1 on 3	DM>pen; soft homogenous mud>pen; moderately to strongly reduced@depth; uneven rpd=both deep and shallow; surf tubes; vertical oxy burrow/tube@right; 1-2 small subsurface orgs
CCBDS-B-12	G	9/23/2010	14:04	12	1	103	14.6	>4	>4	0	249.3	17.1	16.9	17.5	0.6	Biogenic	56.3	3.9	2	r	n	249.3	> 17.1	> 16.9	> 17.5	n	0				1 on 3	DM>pen; soft homogenous mud>pen; moderately reduced@depth; reduced mud clasts=wiper clasts; surf tubes+a few v. small worms@depth
CCBDS-B-12	H	9/23/2010	14:05	12	1	103	14.6	>4	>4	1	199.9	13.7	12.9	16.2	3.3	Physical	13.5	0.9	6	b	n	199.9	> 13.7	> 12.9	> 16.2	n	0				1 on 3	DM>pen; soft homogenous mud>pen; strongly reduced@depth; disturbance of sed surf possibly by camera sled numerous large surf tubes; 1 brittlestar arm@surf; 2 large-bodied orgs@depth
CCBDS-B-13	A	9/23/2010	14:52	12	1	100	14.6	>4	>4	0	241.2	16.5	15.1	17.1	2.0	Biogenic	57.3	3.9	0		n	241.2	> 16.5	> 15.1	> 17.1	n	0				1 on 3	DM>pen; soft homogenous mud>pen; strongly reduced@depth; mod to strong rpd contrast; burrow opening; small surf tubes; a few small subsurface orgs
CCBDS-B-13	C	9/23/2010	14:54	12	1	100	14.6	>4	>4	0	246	16.8	15.9	18.4	2.5	Physical	36.5	2.5	0		n	246.0	> 16.8	> 15.9	> 18.4	n	1	16.2	17.1	16.7	1 on 3	DM>pen; soft homogenous mud>pen; moderately reduced@depth; several brittlestar arms@sed surf; surf tubes; deep void

Note: ind = indeterminate; Mud clast state: o=oxidized, r=reduced, b=both oxidized and reduced

APPENDIX C
Sediment-Profile Imaging Results
September 2010

Station	Rep.	Date	Time	Stop Collar Setting (in)	# of weights (per side)	Water Depth (ft)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Minimum (phi)	Grain Size Maximum (phi)	Penetration Area (sq.cm)	Penetration Mean (cm)	Penetration Minimum (cm)	Penetration Maximum (cm)	Boundary Roughness (cm)	Boundary Roughness Type	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State	Methane	Total DM Area (sq.cm)	Total DM Mean (sq.cm)	Total DM Minimum (sq.cm)	Total DM Maximum (sq.cm)	Low DO?	Feeding Void #	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	COMMENT
CCBDS-B-13	D	9/23/2010	14:55	12	1	100	14.6	>4	>4	0	227.7	15.6	15.2	16.1	0.9	Biogenic	82.8	5.7	1	r	n	227.7	> 15.6	> 15.2	> 16.1	n	0				1 on 3	DM>pen; soft homogenous mud>pen; moderately to strongly reduced@depth; v. deep rpd w/ moderate contrast; several brittlestar arms@surf; a few small subsurface orgs
CCBDS-B-14	B	9/23/2010	14:12	12	1	102	14.6	>4	>4	1	287.3	19.7	19.1	20.3	1.2	Biogenic	53.2	3.6	0		n	287.3	> 19.7	> 19.1	> 20.3	n	0				1 on 3	DM>pen; soft homogenous mud>pen; strongly reduced patches@depth; moderate rpd contrast; burrow opening@surf w/ reduced sed; large pink org@depth; numerous small subsurface orgs
CCBDS-B-14	C	9/23/2010	14:13	12	1	102	14.6	>4	>4	1	307.9	21.1	20.4	21.8	ind	ind	44.8	3.1	ind		n	307.9	> 21.1	> 20.4	> 21.8	n	0				1 on 3	DM>pen; partial overpen; strongly reduced@depth; moderate to strong rpd contrast; a few very small subsurface orgs, burrow openings visible in PV image
CCBDS-B-14	D	9/23/2010	14:14	12	1	102	14.6	>4	>4	1	318.7	21.8	>21.8	>21.8	ind	ind	ind	ind	ind		n	318.7	> 21.8	> 21.8	> 21.8	n	3	ind	ind		1 on 3	DM>pen; overpenetration; band of strongly reduced sed@depth=bottom of upper DM layer; several feeding voids
CCBDS-B-15	A	9/23/2010	14:19	12	1	101	14.6	>4	>4	1	287.3	19.7	19.4	20.2	0.8	Biogenic	51.7	3.5	2	b	n	287.3	> 19.7	> 19.4	> 20.2	n	0				1 on 3	DM>pen; soft homogenous mud>pen; strongly reduced@depth; moderate rpd contrast; surf tubes; 1 subsurface worm@center of image
CCBDS-B-15	B	9/23/2010	14:20	12	1	101	14.6	>4	>4	1	261.1	17.9	17.6	18.3	0.7	Biogenic	37.5	2.6	0		n	261.1	> 17.9	> 17.6	> 18.3	n	0				1 on 3	DM>pen; soft homogenous mud>pen; strongly reduced patches@depth; moderate rpd contrast; surf tubes+reworking; 1 thin whitish worm at bottom center=Stg 3?
CCBDS-B-15	C	9/23/2010	14:21	12	1	101	14.6	>4	>4	0	278.2	19.1	17.9	21.2	3.3	Biogenic	10.7	0.7	0		n	278.2	> 19.1	> 17.9	> 21.2	n	0				1 on 3	DM>pen; soft homogenous mud>pen; strongly reduced@depth; shallow+uneven rpd w/ weak contrast; vertical oxy burrow/tube@center of image
CCBDS-C-1	A	9/23/2010	10:11	12	1	103	14.6	>4	>4	1	177.4	12.2	11.3	12.8	1.5	Biogenic	56.7	3.9	0		n	177.4	> 12.2	> 11.3	> 12.8	n	0				1 on 3	DM>pen; homogenous mud>pen; strong reduced@depth; strong rpd contrast; biologically active surf w/ numerous tubes; a few small subsurface orgs
CCBDS-C-1	C	9/23/2010	10:13	12	1	103	14.6	>4	>4	1	137.4	9.4	8.2	10.4	2.2	Physical	40.4	2.8	0		n	137.4	> 9.4	> 8.2	> 10.4	n	0				1 on 3	DM>pen; homogenous mud>pen; clay@depth; strongly reduced@depth; strong rpd contrast; biologically active surf w/ many tubes; 1 large-bodied pink org@depth; vertical oxy tube/burrow
CCBDS-C-1	D	9/23/2010	10:14	12	1	103	14.6	>4	>4	2	174.3	11.9	11.7	12.7	1.0	Biogenic	64.4	4.4	0		n	174.3	> 11.9	> 11.7	> 12.7	n	2	8.1	8.9	8.5	1 on 3	DM>pen; homogenous mud>pen; grey clay@depth; strongly reduced@depth; biologically active surface w/ small tubes; 2 voids+vertical oxy tubes/burrows
CCBDS-C-2	A	9/23/2010	9:11	12	1	103	14.6	>4	>4	2	182.7	12.5	11.9	13.1	1.2	Biogenic	31.1	2.1	6	o	n	182.7	> 12.5	> 11.9	> 13.1	n	0				1 on 3	DM>pen; subtle layering of silty mud over cohesive grey clay; sulfidic patches@depth; dense surf tubes; several thin small worms@depth; vertical oxy burrow/tubes@left center, clasts are camera artifacts.
CCBDS-C-2	B	9/23/2010	9:12	12	1	103	14.6	>4	>4	2	210.6	14.4	14.1	14.7	0.6	Biogenic	45.2	3.1	0		n	210.6	> 14.4	> 14.1	> 14.7	n	0				1 on 3	DM>pen; subtle layering of silt mud over cohesive grey clay; discontinuous sulfidic band@bottom of upper dm lyr; surf tubes/reworking; 1 large-bodied pink subsurface org
CCBDS-C-2	D	9/23/2010	9:14	12	1	103	14.6	>4	>4	2	202.1	13.8	12.9	14.6	1.7	Biogenic	59.7	4.1	0		n	202.1	> 13.8	> 12.9	> 14.6	n	1	12.2	13.3	12.8	2 on 3	DM>pen; subtle layering of silty mud over cohesive grey clay; discontinuous sulfidic band@bottom of upper dm lyr; surf tubes+many Nucula near/@swi; Podocerid amphipod stalk in farfield; 1 large void
CCBDS-C-3	J	9/23/2010	12:48	15	4	103	14.6	>4	>4	2	261	17.9	17.7	18.2	0.5	Biogenic	36.4	2.5	0		n	261.0	> 17.9	> 17.7	> 18.2	n	0				2 on 3	DM>pen; DM layering; soft homogenous mud w/ moderate rpd contrast; tubes+bioreworking@swi; 1 Nucula near SWI, burrow at bottom of image
CCBDS-C-3	K	9/23/2010	12:49	15	4	103	14.6	>4	>4	2	174.2	11.9	10.9	12.9	2.0	Biogenic	48.1	3.3	0		n	174.2	> 11.9	> 10.9	> 12.9	n	0				1 on 3	DM>pen; DM layering; soft homogenous mud w/ moderate rpd contrast; surface tubes; a few subsurface orgs, mostly on right side of image
CCBDS-C-3	L	9/23/2010	12:50	15	4	103	14.6	>4	>4	2	204	14.0	13.2	14.9	1.7	Biogenic	45.9	3.1	1	r	n	204.0	> 14.0	> 13.2	> 14.9	n	0				1 on 3	DM>pen; DM layering; soft homogenous mud w/ moderate rpd contrast; dense surf tubes; several subsurface worms
CCBDS-C-4	A	9/23/2010	9:35	12	1	103	14.6	>4	>4	2	212.4	14.5	14.3	14.8	0.5	Biogenic	47.1	3.2	0		n	212.4	> 14.5	> 14.3	> 14.8	n	0				2 on 3	DM>pen; DM layering; soft homogenous mud, sulfidic band@bottom of upper dm lyr; mod/strong rpd contrast; small surf tubes+white bvalves; several small subsurface orgs

Note: ind = indeterminate; Mud clast state: o=oxidized, r=reduced, b=both oxidized and reduced

APPENDIX C
Sediment-Profile Imaging Results
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Station	Rep.	Date	Time	Stop Collar Setting (in)	# of weights (per side)	Water Depth (ft)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Minimum (phi)	Grain Size Maximum (phi)	Penetration Area (sq.cm)	Penetration Mean (cm)	Penetration Minimum (cm)	Penetration Maximum (cm)	Boundary Roughness (cm)	Boundary Roughness Type	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State	Methane	Total DM Area (sq.cm)	Total DM Mean (sq.cm)	Total DM Minimum (sq.cm)	Total DM Maximum (sq.cm)	Low DO?	Feeding Void #	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	COMMENT
CCBDS-C-4	B	9/23/2010	9:36	12	1	103	14.6	>4	>4	1	239.6	16.4	16.1	17.2	1.1	Biogenic	91.9	6.3	0		n	239.6	> 16.4	> 16.1	> 17.2	n	0				2 on 3	DM>pen; DM layering; soft homogenous - upper dm lyr has lots of fibers/particles+some sand; sulfidic band=lyr bottom; surf tubes+2 small white bivalves near SWI; subsurface orgs; red patch of old wood fibers@depth
CCBDS-C-4	C	9/23/2010	9:37	12	1	103	14.6	>4	>4	1	248.7	17.0	16.6	17.6	1.0	Biogenic	52.6	3.6	0		n	248.7	> 17.0	> 16.6	> 17.6	n	0				2 on 3	DM>pen; DM layering; soft mud over greyish clay w/ reddish streaks; sulfidic band@bottom of surf layer; many tubes+small white bivalves@surf; small subsurface orgs
CCBDS-C-5	D	9/23/2010	11:01	12	1	104	14.6	>4	>4	1	147.7	10.1	9.9	10.6	0.7	Biogenic	41.6	2.8	0		n	147.7	> 10.1	> 9.9	> 10.6	n	0				2 going to 3	DM>pen; subtle layering?; soft homogenous mud, possible stiff clay@depth; sulfidic band; mod to strong rpd contrast; bio reworking of surf; several small subsurface worms
CCBDS-C-5	E	9/23/2010	13:17	14	2	104	14.6	>4	>4	2	196.3	13.4	13	14.3	1.3	Biogenic	46.2	3.2	0		n	196.3	> 13.4	> 13.0	> 14.3	n	0				1 on 3	DM>pen; distinct layering of soft silty mud over grey clay; faint suldific band=bottom of upper dm lyr; mod to strong rpd contrast; dense small surf tubes; a few small subsurface orgs; vertical oxy burrows/tubes
CCBDS-C-5	F	9/23/2010	13:18	14	2	104	14.6	>4	>4	2	159.3	10.9	10.6	11.4	0.8	Biogenic	38.7	2.7	5	b	n	159.3	> 10.9	> 10.6	> 11.4	n	0				1 on 3	DM>pen; distinct layering of soft silty mud over grey clay; sulfidic band=bottom of upper lyr; dense small surf tubes; a few small cryptic subsurface orgs; vertical oxy burrows/tubes
CCBDS-C-6	F	9/23/2010	12:55	14	2	105	14.6	>4	>4	2	250.8	17.2	16.8	17.4	0.6	Biogenic	52.6	3.6	0		n	250.8	> 17.2	> 16.8	> 17.4	n	1	16.7	17.2	17.0	1 on 3	DM>pen; distinct layering of silty mud over grey clay; sulfidic band and thin sand horizon=bottom of upper dm lyr; deep void; surface tubes
CCBDS-C-6	G	9/23/2010	12:56	14	2	105	14.6	>4	>4	1	216.8	14.8	13.9	16.4	2.5	Biogenic	35	2.4	0		n	216.8	> 14.8	> 13.9	> 16.4	n	0				1 on 3	DM>pen; distinct layering of silty mud over grey clay; sulfidic band and fine sand horizon=bottom of upper dm lyr; surf tubes; stick amphipod in farfield; many worms@depth
CCBDS-C-6	H	9/23/2010	12:57	14	2	105	14.6	>4	>4	2	230.1	15.8	15.5	16	0.5	Biogenic	51.6	3.5	0		n	230.1	> 15.8	> 15.5	> 16.0	n	0				1 on 3	DM>pen; distinct layering of silty-sandy mud over grey cohesive clay; sulfidic band+some fine sand=bottom of upper dm lyr; surf tubes; several worms@depth
CCBDS-C-7	A	9/23/2010	9:29	12	1	103	14.6	>4	>4	1	170.5	11.7	11.5	12	0.5	Biogenic	46.7	3.2	0		n	170.5	> 11.7	> 11.5	> 12.0	n	0				2 on 3	DM>pen; subtle layering of silty mud over grey-orange clay@depth; sulfidic band=bottom of upper dm lyr; surf tubes+small white bivalves (Nucula); several small or thin subsurface orgs; burrow transected at depth
CCBDS-C-7	C	9/23/2010	9:30	12	1	103	14.6	>4	>4	1	194.8	13.3	13	14	1.0	Biogenic	40.9	2.8	0		n	194.8	> 13.3	> 13.0	> 14.0	n	1	8.1	8.4	8.3	2 on 3	DM>pen; layering of silt mud over cohesive clay w/ grey and reddish streaks; thin sulfidic band=bottom of upper dm lyr; dense surf tubes; 1 void; 1 partially visible bivalve
CCBDS-C-7	D	9/23/2010	9:31	12	1	103	14.6	>4	>4	1	215.3	14.7	13.2	16.1	2.9	Biogenic	51	3.5	0		n	215.3	> 14.7	> 13.2	> 16.1	n	1	8.6	9.8	9.2	2 on 3	DM>pen; layering of silty mud over cohesive grey clay; sulfidic band=bottom of upper dm lyr; dense surf tubes; 2 cryptic near-surface bivalves@upper left; several small subsurface orgs
CCBDS-C-8	E	9/23/2010	13:02	14	2	106	14.6	>4	>4	1	212.4	14.5	13.7	14.9	1.2	Biogenic	40.6	2.8	0		n	212.4	> 14.5	> 13.7	> 14.9	n	1	11.2	12.4	11.8	1 on 3	DM>pen; sublte layering of silty mud ovr grey clay; faint sulfidic band=bottom of upper dm lyr; dense surf tubes; small/thin subsurface orgs; vertical oxy burrow@right; burrow/void w/ oxy halo on lwr left
CCBDS-C-8	G	9/23/2010	13:03	14	2	106	14.6	>4	>4	2	236.7	16.2	16.2	16.5	0.3	Biogenic	42.8	2.9	0		n	236.7	> 16.2	> 16.2	> 16.5	n	0				2 on 3	DM>pen; distinct layering of silt mud over cohesive grey clay; slight sulfidic band@bottom of surf dm lyr; dense surf tubes+2 small pinkish bivalves@surf; several worms@depth
CCBDS-C-8	H	9/23/2010	13:04	14	2	106	14.6	>4	>4	2	154.6	10.6	9.7	11.3	1.6	Biogenic	45.9	3.1	0		n	154.6	> 10.6	> 9.7	> 11.3	n	0				2 on 3	DM>pen; layering of silt mud over grey cohesive clay@bottom of image; v. dense surf tubes+several small white/pink bivalves@surf; a few cryptic/small orgs@depth; vertical oxy tubes/burrows
CCBDS-C-9	A	9/23/2010	10:38	12	1	106	14.6	>4	>4	2	132.6	9.1	7.5	10.9	3.4	Biogenic	24.7	1.7	0		n	132.6	> 9.1	> 7.5	> 10.9	n	0				2 on 3	DM>pen; subtle layering of silty mud over cohesive grey clay; sulfidic patches/banding; numerous small bivalves on sed surf+ in upper 2 cm; white subsurface org@left, burrow openings in PV image

Note: ind = indeterminate; Mud clast state: o=oxidized, r=reduced, b=both oxidized and reduced

APPENDIX C
Sediment-Profile Imaging Results
September 2010

Station	Rep.	Date	Time	Stop Collar Setting (in)	# of weights (per side)	Water Depth (ft)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Minimum (phi)	Grain Size Maximum (phi)	Penetration Area (sq.cm)	Penetration Mean (cm)	Penetration Minimum (cm)	Penetration Maximum (cm)	Boundary Roughness (cm)	Boundary Roughness Type	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State	Methane	Total DM Area (sq.cm)	Total DM Mean (sq.cm)	Total DM Minimum (sq.cm)	Total DM Maximum (sq.cm)	Low DO?	Feeding Void #	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	COMMENT
CCBDS-C-9	C	9/23/2010	10:39	12	1	106	14.6	>4	>4	2	163.5	11.2	10.8	11.7	0.9	Biogenic	57	3.9	0		n	163.5	> 11.2	> 10.8	> 11.7	n	1	5.5	5.6	5.6	2 on 3	DM>pen; subtle layering of silty mud over cohesive grey clay; discontinuous sulfidic band@bottom of upper lyr; dense surf tubes; several small white/brown bivalves; 1 partial void@left; a few small subsurface orgs
CCBDS-C-9	D	9/23/2010	10:40	12	1	106	14.6	>4	>4	0	180.9	12.4	12.2	12.7	0.5	Biogenic	41.4	2.8	1	o	n	180.9	> 12.4	> 12.2	> 12.7	n	0				2 on 3	DM>pen; subtle layering of silty mud over cohesive grey clay; discontinuous sulfidic band@bottom of upper lyr; dense surf tubes; several small white/brown bivalves@surf; a few small worms@depth
CCBDS-C-10	F	9/23/2010	12:18	14	2	106	14.6	>4	>4	2	183.2	12.5	11.9	13.1	1.2	Biogenic	39.1	2.7	6	b	n	183.2	> 12.5	> 11.9	> 13.1	n	0				1 on 3	DM>pen; subtle layering of silty mud over cohesive grey clay; sulfidic patches@depth; dense surf tubes; several thin small worms@depth; vertical oxy burrow/tubes@left center
CCBDS-C-10	G	9/23/2010	12:19	14	2	106	14.6	>4	>4	0	168.4	11.5	10.6	12.7	2.1	Biogenic	33.1	2.3	0		n	168.4	> 11.5	> 10.6	> 12.7	n	0				2 on 3	DM>pen; layering of silt mud over cohesive grey clay; moderate sulfidic band=bottom of upper dm lyr; dense surf tubes; a few small white near-surf bivalves; a few worms@depth
CCBDS-C-10	H	9/23/2010	12:20	14	2	106	14.6	>4	>4	1	188.5	12.9	12.8	13.2	0.4	Biogenic	32.7	2.2	1	b	n	188.5	> 12.9	> 12.8	> 13.2	n	0				1 on 3	DM>pen; possible multiple layers w/ black sulfidic bands=bottom of two upper lyrs; silty mud over grey clay; surf tubes; several prominent worms@depth
CCBDS-C-11	A	9/23/2010	9:23	12	1	104	14.6	>4	>4	1	125.5	8.6	8.1	9.4	1.3	Biogenic	43.7	3.0	0		n	125.5	> 8.6	> 8.1	> 9.4	n	0				1 on 3	DM>pen; soft homogenous mud moderately reduced@depth; weak to moderate rpd contrast; dense surf tubes; vertical oxy burrow@center
CCBDS-C-11	C	9/23/2010	9:24	12	1	104	14.6	>4	>4	1	175.7	12.0	11.8	12.4	0.6	Biogenic	53.5	3.7	0		n	175.7	> 12.0	> 11.8	> 12.4	n	2	7.4	11.1	9.3	2 on 3	DM>pen; layering of silty mud over cohesive grey clay; faint sulfidic band=bottom of upper dm lyr; surf tubes+1 or 2 surf bivalves; 2 voids@depth
CCBDS-C-11	D	9/23/2010	9:25	12	1	104	14.6	>4	>4	0	169.3	11.6	10.2	12.3	2.1	Biogenic	51.5	3.5	0		n	169.3	> 11.6	> 10.2	> 12.3	n	0				2 on 3	DM>;pen; layering of silty mud over cohesive grey clay; sulfidic horizon=bottom of upper dm lyr; many small white surf bivalves; a few subsurface orgs+vertical oxy burrows
CCBDS-C-12	A	9/23/2010	9:41	12	1	104	14.6	>4	>4	1	120.2	8.2	7.6	9.1	1.5	Biogenic	50.1	3.4	0		n	120.2	> 8.2	> 7.6	> 9.1	n	0				2 on 3	DM>pen; layering of silty mud over grey cohesive clay; sulfidic horizon=bottom of upper dm lyr; dense surf tubes+a few bivalves; several subsurface worms+vertical oxy burrow/tube@center
CCBDS-C-12	E	9/23/2010	12:06	14	2	106	14.6	>4	>4	0	231	15.8	14.3	17	2.7	Biogenic	39.1	2.7	0		n	231.0	> 15.8	> 14.3	> 17.0	n	0				1 on 3	DM>pen; layering of silty mud over grey cohesive clay; thick sulfidic horizon between 2 dm layers; strong rpd contrast; surf tubes; a few small orgs@depth; vertical oxy burrow/tubes@center
CCBDS-C-12	G	9/23/2010	12:08	14	2	106	14.6	>4	>4	0	207.9	14.2	13.8	14.6	0.8	Biogenic	65	4.5	0		n	207.9	> 14.2	> 13.8	> 14.6	n	0				2 on 3	DM>pen; layering of silty-sandy mud over grey cohesive clay; sulfidic horizon=bottom of upper dm lyr; dense surf tubes+2-3 white bivalves; numerous lrg+small subsurface orgs
CCBDS-C-13	A	9/23/2010	9:48	12	1	103	14.6	>4	>4	1	242.3	16.6	16.3	17.1	0.8	Biogenic	26	1.8	0		n	242.3	> 16.6	> 16.3	> 17.1	n	1	4.2	4.4	4.3	1 on 3	DM>pen; layering of silty-sandy mud over grey cohesive clay w/ reddish streaks that appear to be wood waste; multiple depositional layers; dense surf tubes; a few subsurface orgs+1 void@left
CCBDS-C-13	B	9/23/2010	9:48	12	1	103	14.6	>4	>4	2	234	16.0	15.4	16.2	0.8	Biogenic	52.8	3.6	0		n	234.0	> 16.0	> 15.4	> 16.2	n	0				2 on 3	DM>pen; distinct layering of silty mud over cohesive grey clay w/ some reddish streaks; possible multi-layers w/ 2 sulfidic horizons@depth; suf tubes+surf bivalves; several small subsurface orgs; vertical oxy burrows/tubes
CCBDS-C-13	D	9/23/2010	9:50	12	1	103	14.6	>4	>4	1	202.6	13.9	13.3	14.5	1.2	Biogenic	48.8	3.3	3	o	n	202.6	> 13.9	> 13.3	> 14.5	n	0				1 on 3	DM>pen; distinct layering of silty mud over cohesive grey clay w/ reddish streaks; possible multi-layers w/ 2 sulfidic horizons@depth; suf tubes; large-bodied org w/ oxy burrow@depth (Nephtid); a few smaller orgs@depth; vertical oxy tube@left
CCBDS-C-14	D	9/23/2010	10:04	12	1	103	14.6	>4	>4	0	203.7	14.0	13.4	14.4	1.0	Biogenic	47	3.2	1	o	n	203.7	> 14.0	> 13.4	> 14.4	n	0				2 on 3	DM>pen; layering of silty mud over cohesive grey clay; faint remnant sulfidic horizon=bottom of surf dm lyr; rpd smearing; surf tubes+several small bivalves; several small subsurface orgs; 2-3 vertical oxy burrows/tubes

Note: ind = indeterminate; Mud clast state: o=oxidized, r=reduced, b=both oxidized and reduced

APPENDIX C
Sediment-Profile Imaging Results
September 2010

Station	Rep.	Date	Time	Stop Collar Setting (in)	# of weights (per side)	Water Depth (ft)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Minimum (phi)	Grain Size Maximum (phi)	Penetration Area (sq.cm)	Penetration Mean (cm)	Penetration Minimum (cm)	Penetration Maximum (cm)	Boundary Roughness (cm)	Boundary Roughness Type	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State	Methane	Total DM Area (sq.cm)	Total DM Mean (sq.cm)	Total DM Minimum (sq.cm)	Total DM Maximum (sq.cm)	Low DO?	Feeding Void #	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	COMMENT
CCBDS-C-14	F	9/23/2010	12:24	14	2	106	14.6	>4	>4	1	260.9	17.9	17.1	18.7	1.6	Biogenic	58.3	4.0	0		n	260.9	> 17.9	> 17.1	> 18.7	n	0				1 on 3	DM>pen; layering of silty mud over grey cohesive clay; faint sulfidic horizon=bottom of upper dm lyr; particles/fibers in fabric; surf tubes+a few v. small orgs@depth
CCBDS-C-14	H	9/23/2010	12:26	14	2	106	14.6	>4	>4	1	199.7	13.7	13.3	14.1	0.8	Biogenic	50.5	3.5	0		n	199.7	> 13.7	> 13.3	> 14.1	n	0				1 on 3	DM>pen; layering of silty mud over grey cohesive clay; discontinuous fine sand horizon@depth; faint sulfidic horizon; surf tubes; several worms@depth; several vertical oxy burrows/tubes
CCBDS-C-15	D	9/23/2010	10:47	12	1	106	14.6	>4	>4	2	154.1	10.6	9.9	11.4	1.5	Biogenic	51.1	3.5	3	o	n	154.1	> 10.6	> 9.9	> 11.4	n	0				1 on 3	DM>pen; layering of silty mud over grey cohesive clay; subtle rpd w/ v. weak contrast; surf tubes; several v. small subsurface orgs
CCBDS-C-15	I	9/23/2010	13:34	15	4	102	14.6	>4	>4	2	254	17.4	16.8	17.8	1.0	Biogenic	50.7	3.5	0		n	254.0	> 17.4	> 16.8	> 17.8	n	0				1 on 3	DM>pen; multiple layers=mud over grey clay w/ sand over grey clay; \; surf tubes; a few v. small orgs@depth
CCBDS-C-15	J	9/23/2010	13:35	15	4	102	14.6	>4	>4	1	249.6	17.1	16.7	17.5	0.8	Biogenic	49.4	3.4	6	o	n	249.6	> 17.1	> 16.7	> 17.5	n	0				1 on 3	DM>pen; layering of silty mud over cohesive grey clay; wek/moderate rpd contrast; faint sulfidic horizon=bottom of upper dm lyr; surf tubes+1-2 small subsurface orgs
CCBRS-1	A	9/21/2010	16:21	11.5	0	121	14.6	>4	>4	2	219.3	15.0	14.5	16.1	1.6	Biogenic	54.2	3.7	0		n	0.0	0.0	0.0	0.0	n	1				1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; not strongly reduced@depth; brittle star@left surface; biogenic mound@right surface; a few worms@depth
CCBRS-1	B	9/21/2010	16:22	11.5	0	121	14.6	>4	>4	2	222.3	15.2	14.5	16.3	1.8	Biogenic	56.4	3.9	2	b	n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; not strongly reduced@depth; brittle stars@lsurface; surf tubes; edge of oxygenated burrows transected at depth; burrow openings in PV image
CCBRS-1	C	9/21/2010	16:23	11.5	0	121	14.6	>4	>4	2	256.7	17.6	17.1	18.2	1.1	Biogenic	71.4	4.9	0		n	0.0	0.0	0.0	0.0	n	1	16.6	16.9	16.8	1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; faint rpd smearing@right; weakly reduced@depth; surf tubes; 1 deep void
CCBRS-2	A	9/23/2010	8:25	11.5	0	120	14.6	>4	>4	2	225.5	15.4	13.2	17.1	3.9	Physical	34	2.3	0		n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; relatively shallow rpd w/ v. weak contrast; brittlestar arm@surf; surf tubes; several small worms@depth
CCBRS-2	B	9/23/2010	8:26	11.5	0	120	14.6	>4	>4	2	226.2	15.5	15	16	1.0	Biogenic	52	3.6	2	o	n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; moderately reduced patches@depth; amphipod stalk@surf; vertical oxy burrow/tube@right; 1 or 2 small subsurface orgs
CCBRS-2	C	9/23/2010	8:27	11.5	0	120	14.6	>4	>4	2	224.7	15.4	14.8	16	1.2	Biogenic	69.7	4.8	0		n	0.0	0.0	0.0	0.0	n	1	3.3	3.4	3.4	1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; not strongly reduced; brittlestars@surface and @ depth on left w/ associated oxy burrow; 1 small feeding void
CCBRS-3	B	9/23/2010	7:58	11.5	0	123	14.6	>4	>4	2	225.1	15.4	15	15.6	0.6	Biogenic	78.9	5.4	2	o	n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; weak to moderate rpd contrat; sed is moderately reduced@depth; several brittlestars@surf; small bivalves near surface@left; 1 subsurface thin worm
CCBRS-3	C	9/23/2010	7:59	11.5	0	123	14.6	>4	>4	1	237.6	16.3	15.1	16.9	1.8	Biogenic	50.4	3.5	0		n	0.0	0.0	0.0	0.0	n	1	6.6	7.7	7.2	1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; weakly reduced@depth; slightly reduced below swi; surf tubes; void; several small+large worms@depth
CCBRS-3	D	9/23/2010	8:00	11.5	0	123	14.6	>4	>4	2	230.3	15.8	15.3	16.5	1.2	Biogenic	58.7	4.0	2	r	n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; deep rpd w/ weak contrast; prominent vertical oxy burrow w/ opening@surf+org@depth; amphipod stalks+1 brittlestar arm@swi; several worms@depth
CCBRS-4	A	9/21/2010	16:00	12.5	0	122	14.6	>4	>4	2	290.8	19.9	18.2	20.5	2.3	Biogenic	72.5	5.0	4	o	n	0.0	0.0	0.0	0.0	n	4	7.0	8.8	7.9	1 on 3	Ambient soft homogenous mud>pen; deep rpd w/ weak contrast; several subsurface voids/burrows; small surf tubes; brittlestar below swi@right
CCBRS-4	C	9/21/2010	16:02	12.5	0	122	14.6	>4	>4	2	277.3	19.0	18.7	19.4	0.7	Biogenic	56.4	3.9	0		n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; deep rpd w/ weak contrast; vertical oxy burrows/tubes; worms@depth (near bottom of image)
CCBRS-4	D	9/21/2010	16:03	12.5	0	122	14.6	>4	>4	2	268.3	18.4	18.1	18.7	0.6	Biogenic	75.3	5.2	0		n	0.0	0.0	0.0	0.0	n	2	6.7	12.2	9.5	1 on 3	Ambient soft homogenous mud>pen; deep rpd w/ weak contrast; vertical oxy burrows/tubes; brittlestar arm@swi; 1 partial and 1 full feeding void

Note: ind = indeterminate; Mud clast state: o=oxidized, r=reduced, b=both oxidized and reduced

APPENDIX C
Sediment-Profile Imaging Results
September 2010

Station	Rep.	Date	Time	Stop Collar Setting (in)	# of weights (per side)	Water Depth (ft)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Minimum (phi)	Grain Size Maximum (phi)	Penetration Area (sq.cm)	Penetration Mean (cm)	Penetration Minimum (cm)	Penetration Maximum (cm)	Boundary Roughness (cm)	Boundary Roughness Type	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State	Methane	Total DM Area (sq.cm)	Total DM Mean (sq.cm)	Total DM Minimum (sq.cm)	Total DM Maximum (sq.cm)	Low DO?	Feeding Void #	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	COMMENT
CCBRS-5	A	9/23/2010	7:51	11.5	0	119	14.6	>4	>4	2	217.8	14.9	14.1	16	1.9	Physical	42.2	2.9	9	b	n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; brittlestar@sed surf; a few small/short worms@depth
CCBRS-5	B	9/23/2010	7:52	11.5	0	119	14.6	>4	>4	2	218	14.9	14.5	15.3	0.8	Biogenic	37.7	2.6	6	b	n	0.0	0.0	0.0	0.0	n	1	6.0	6.2	6.1	1 on 3	Ambient soft homogenous mud>pen; weak to moderate rpd contrast; moderately reduced patches@depth; brittlestar arms@swi; vertical oxy burrow@left; void@right
CCBRS-5	C	9/23/2010	7:53	11.5	0	119	14.6	>4	>4	2	203.3	13.9	13	15.1	2.1	Biogenic	60.2	4.1	2	b	n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; weak/mod rpd contrast; brittlestar arms@swi; a few subsurface worms
CCBRS-6	A	9/23/2010	8:40	11.5	0	121	14.6	>4	>4	1	195.5	13.4	12.7	14.5	1.8	Biogenic	53.1	3.6	0		n	0.0	0.0	0.0	0.0	n	2	4.9	12.0	8.5	1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; only weakly reduced@depth; surf tubes; shallow burrow/burrow opening@left surf; 2-3 voids
CCBRS-6	B	9/23/2010	8:40	11.5	0	121	14.6	>4	>4	2	170.5	11.7	10.3	13.2	2.9	Biogenic	65.5	4.5	0		n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; deep rpd w/ weak contrast; weakly reduced@depth; brittlestar arms@swi; shallow burrows in upper 2 cm; several small/thin orgs@depth; large burrow opening in PV image
CCBRS-6	C	9/23/2010	8:41	11.5	0	121	14.6	>4	>4	2	227.8	15.6	14.2	16.7	2.5	Biogenic	49	3.4	2	o	n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; a few moderately reduced patches@depth; small surf tubes; vertical oxy burrows@right; 1 or 2 small subsurface orgs
CCBRS-7	A	9/23/2010	8:18	11.5	0	123	14.6	>4	>4	2	190.5	13.0	11.1	14.5	3.4	Biogenic	30.3	2.1	0		n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; biogenic mound@surf; vertical oxy burrows@far right+left; 1 or 2 small worms@depth
CCBRS-7	B	9/23/2010	8:20	11.5	0	123	14.6	>4	>4	2	222.1	15.2	14.8	15.8	1.0	Biogenic	59.3	4.1	0		n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; deep rpd w/ weak contrast; moderately reduced@depth; brittlestars@swi+likely brittlestar@depth w/ vertical oxy burrow; 1-2 small subsurface worms
CCBRS-7	C	9/23/2010	8:21	11.5	0	123	14.6	>4	>4	2	212.8	14.6	12.8	15.7	2.9	Biogenic	62.2	4.3	0		n	0.0	0.0	0.0	0.0	n	2	6.5	10.4	8.5	1 on 3	Ambient soft homogenous mud>pen; deep rpd w/ weak contrast; moderately reduced@depth; brittlestar arms@swi; brittlestar@depth w/ vertical oxy burrow; 2 partial voids
CCBRS-8	A	9/21/2010	16:29	11.5	0	120	14.6	>4	>4	2	236.1	16.2	15.1	16.9	1.8	Biogenic	56	3.8	3	o	n	0.0	0.0	0.0	0.0	n	1	16.3	16.5	16.4	1 on 3	Ambient soft homogenous mud>pen; deep rpd w/ weak contrast; small surf tubes; deep void; 1 long thin worm@center left
CCBRS-8	B	9/21/2010	16:30	11.5	0	120	14.6	>4	>4	2	222.1	15.2	14.7	15.5	0.8	Biogenic	38.9	2.7	0		n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; v. weak rpd contrast; weak to mod reduced@depth; small surf tubes; large-bodied org@bottom of image; 1-2 smaller orgs@depth
CCBRS-8	D	9/21/2010	16:33	11.5	0	120	14.6	>4	>4	2	228.9	15.7	14.5	15.9	1.4	Biogenic	41.1	2.8	2	b	n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; v. weak rpd contrast; weakly reduced@depth; 2 deep sulfidic patches; dense surf tubes; Nucula at SWI on right; brittlestars@surf+@depth
CCBRS-9	A	9/23/2010	8:12	11.5	0	123	14.6	>4	>4	2	236.8	16.2	15.8	16.5	0.7	Biogenic	47.1	3.2	0		n	0.0	0.0	0.0	0.0	n	2	8.5	14.4	11.5	1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; surf tubes+1 brittlestar arm in farfield; 2 subsurface voids on right; a few small subsurface orgs@depth
CCBRS-9	C	9/23/2010	8:13	11.5	0	123	14.6	>4	>4	2	224.6	15.4	14.3	17	2.7	Biogenic	58.2	4.0	3	b	n	0.0	0.0	0.0	0.0	n	1	5.3	5.5	5.4	1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; surf tubes; small void@far left edge of image; worm w/ oxy halo@left subsurface
CCBRS-9	D	9/23/2010	8:14	11.5	0	123	14.6	>4	>4	2	212.9	14.6	13.9	15.6	1.7	Physical	51.4	3.5	8	b	n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; sed surf is physically disturbed from camera frame; mud clast dragdown=rpd is estimate; 1-2 small subsurface worms
CCBRS-10	A	9/21/2010	16:40	11.5	0	120	14.6	>4	>4	2	232.3	15.9	15.7	16.1	0.4	Biogenic	56.5	3.9	2	o	n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; surf tubes; only a few small subsurface orgs, burrow openings in PV image
CCBRS-10	B	9/21/2010	16:41	11.5	0	120	14.6	>4	>4	2	208.9	14.3	13.8	14.7	0.9	Biogenic	54.8	3.8	0		n	0.0	0.0	0.0	0.0	n	1	11.0	11.4	11.2	1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; weakly reduced@depth; brittlestars@surf; surf tubes; void; a few worms@depth
CCBRS-10	D	9/21/2010	16:43	11.5	0	120	14.6	>4	>4	2	252.7	17.3	17	17.6	0.6	Biogenic	52.4	3.6	0		n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; weak to moderately reduced@depth; dense small Stg 1 surf tubes; a few /cryptic orgs@depth, edge of burrows transected

Note: ind = indeterminate; Mud clast state: o=oxidized, r=reduced, b=both oxidized and reduced

APPENDIX C
Sediment-Profile Imaging Results
September 2010

Station	Rep.	Date	Time	Stop Collar Setting (in)	# of weights (per side)	Water Depth (ft)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Minimum (phi)	Grain Size Maximum (phi)	Penetration Area (sq.cm)	Penetration Mean (cm)	Penetration Minimum (cm)	Penetration Maximum (cm)	Boundary Roughness (cm)	Boundary Roughness Type	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State	Methane	Total DM Area (sq.cm)	Total DM Mean (sq.cm)	Total DM Minimum (sq.cm)	Total DM Maximum (sq.cm)	Low DO?	Feeding Void #	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	COMMENT
CCBRS-11	B	9/21/2010	16:57	11.5	0	120	14.6	>4	>4	2	236.4	16.2	15.8	16.4	0.6	Biogenic	70.1	4.8	0		n	0.0	0.0	0.0	0.0	n	1	10.9	12.7	11.8	1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; weak to mod reduced@depth; small surf tubes+brittlestar arm@far right; void; several small/cryptic orgs@depth
CCBRS-11	C	9/21/2010	16:58	11.5	0	120	14.6	>4	>4	2	276.7	19.0	16.9	20	3.1	Biogenic	56.6	3.9	5	o	n	0.0	0.0	0.0	0.0	n	2	6.9	19.6	13.3	2 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; biologically active=brittlestars+Stg 1 tubes+1 Nucula@surf; 2 voids; vertical oxy burrow/tube@right; a few subsurface orgs
CCBRS-11	D	9/21/2010	16:59	11.5	0	120	14.6	>4	>4	2	213.1	14.6	14.4	14.9	0.5	Biogenic	38.6	2.6	0		n	0.0	0.0	0.0	0.0	n	4	2.5	14.7	8.6	1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; dense stg 1 surf tubes; vertical oxy burrow w/ surf opening; several voids; a few small orgs@depth
CCBRS-12	A	9/23/2010	8:32	11.5	0	123	14.6	>4	>4	2	213.3	14.6	13.7	15.1	1.4	Biogenic	28.6	2.0	0		n	0.0	0.0	0.0	0.0	n	1	6.2	6.8	6.5	1 on 3	Ambient soft homogenous mud>pen; somewhat shallow rpd w/ weak contrast; surf tubes; 1 void/burrow
CCBRS-12	B	9/23/2010	8:32	11.5	0	123	14.6	>4	>4	2	198.9	13.6	13.3	14	0.7	Biogenic	41.1	2.8	0		n	0.0	0.0	0.0	0.0	n	2	8.7	12.2	10.5	1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; brittlestar@surf; voids/burrows@depth; numerous shallow burrows in upper 1-2 cm
CCBRS-12	D	9/23/2010	8:34	11.5	0	123	14.6	>4	>4	2	231.5	15.9	15.5	16.3	0.8	Biogenic	62.8	4.3	4	r	n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; reduced patches@depth; surf tubes; larger-bodied org w/ oxy shallow burrow; a few other small orgs@depth
CCBRS-13	B	9/21/2010	16:14	11.5	0	121	14.6	>4	>4	2	233.9	16.0	15.8	16.3	0.5	Biogenic	51	3.5	0		n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; weak-mod reduced@depth; dense Stg 1 surf tubes; several small worms@depth
CCBRS-13	C	9/21/2010	16:15	11.5	0	121	14.6	>4	>4	2	241.3	16.5	16.1	17	0.9	Biogenic	67.6	4.6	0		n	0.0	0.0	0.0	0.0	n	1	13.1	13.5	13.3	1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; weak/mod reduced@depth; surf tubes; 1 brittlestar arm in farfield; void/burrow lwr right; several long thin worms@depth@center
CCBRS-13	D	9/21/2010	16:16	11.5	0	121	14.6	>4	>4	2	231.3	15.8	15.1	16.6	1.5	Biogenic	63.5	4.3	0		n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; weak/mod reduced@depth; surf tubes; brittlestars@surf; vertical oxy burrow@center
CCBRS-14	A	9/21/2010	16:48	11.5	0	121	14.6	>4	>4	2	215.8	14.8	14	15.5	1.5	Biogenic	54.8	3.8	3	o	n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; weakly reduced@depth; small surf tubes; vertical oxy burrow/tube w/ org@depth
CCBRS-14	B	9/21/2010	16:49	11.5	0	121	14.6	>4	>4	2	269.4	18.5	17.9	18.9	1.0	Biogenic	38.5	2.6	0		n	0.0	0.0	0.0	0.0	n	1	5.1	5.6	5.4	1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; a few sulfidic patches@depth; partial void; Nucula near surface; brittlestar arm in farfield
CCBRS-14	C	9/21/2010	16:50	11.5	0	121	14.6	>4	>4	2	263	18.0	17.6	18.3	0.7	Biogenic	64.4	4.4	5	r	n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; weakly reduced@depth; reduced wiper clasts; surf tubes; amphipod stalk; a few small orgs@depth; deep oxy vertiical burrow
CCBRS-15	A	9/23/2010	8:04	11.5	0	124	14.6	>4	>4	2	218.4	15.0	12.7	17.4	4.7	Biogenic	26.4	1.8	0		n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; mod to strongly reduced sed@depth; large burrow opening w/ reduced sed+burrow@depth; surf tubes+brittlestar@right
CCBRS-15	B	9/23/2010	8:05	11.5	0	124	14.6	>4	>4	2	238.5	16.3	15.2	18.1	2.9	Biogenic	43	2.9	0		n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; burrow opening behind profile; surf tubes; brittlestar@depth; 1-2 small orgs@depth
CCBRS-15	C	9/23/2010	8:06	11.5	0	124	14.6	>4	>4	2	268.6	18.4	18.2	18.7	0.5	Biogenic	66.4	4.5	1	o	n	0.0	0.0	0.0	0.0	n	1	6.9	7.5	7.2	1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast+weakly reduced@depth; small tubes+brittlestar arms@surf; white bivalve@left; void@right
NWREF-1	B	9/21/2010	13:24	13	1	112	14.6	>4	>4	2	278	19.0	18.3	19.9	1.6	Biogenic	36.7	2.5	3	r	n	0.0	0.0	0.0	0.0	n	1	16.2	17.1	16.7	1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast+weakly reduced@depth; reduced wiper clasts@swi; tubes+brittlestar arms@surf; deep void; a few small worms@depth
NWREF-1	C	9/21/2010	13:26	13	1	112	14.6	>4	>4	2	243	16.6	16.3	17.4	1.1	Biogenic	57	3.9	0		n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast+weakly reduced@depth; small tubes+brittlestar arm@surf; shallow dwelling polychaete upper right; a few small orgs@depth

Note: ind = indeterminate; Mud clast state: o=oxidized, r=reduced, b=both oxidized and reduced

APPENDIX C
Sediment-Profile Imaging Results
September 2010

Station	Rep.	Date	Time	Stop Collar Setting (in)	# of weights (per side)	Water Depth (ft)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Minimum (phi)	Grain Size Maximum (phi)	Penetration Area (sq.cm)	Penetration Mean (cm)	Penetration Minimum (cm)	Penetration Maximum (cm)	Boundary Roughness (cm)	Boundary Roughness Type	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State	Methane	Total DM Area (sq.cm)	Total DM Mean (sq.cm)	Total DM Minimum (sq.cm)	Total DM Maximum (sq.cm)	Low DO?	Feeding Void #	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	COMMENT
NWREF-1	D	9/21/2010	13:27	13	1	112	14.6	>4	>4	1	276.4	18.9	18.4	19.7	1.3	Biogenic	59.9	4.1	0		n	0.0	0.0	0.0	0.0	n	3	8.7	18.4	13.6	2 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; patch of sulfidic sed@depth; near-surf Nucula; surf tubes; large organism w/ oxy burrow@far right; many long thin worms@depth
NWREF-2	A	9/21/2010	14:35	13	1	111	14.6	>4	>4	0	318.7	21.8	21.6	>21.8	ind	ind	ind	2.9	0		n	0.0	0.0	0.0	0.0	n	ind				3	Overpen; appears to be ambient soft homogenous mud; aRPD linear measurement estimate from center of image where SWI is visible; edge of void transected in center subsurface of image, deposit feeders definitely present (burrow openings visible in PV image)
NWREF-2	B	9/21/2010	14:36	13	1	111	14.6	>4	>4	0	253.9	17.4	16.7	18.5	1.8	Biogenic	42.9	2.9	0		n	0.0	0.0	0.0	0.0	n	2	7.9	12.6	10.3	2 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; weakly reduced@depth; surf tubes; shallow-dwelling bivalves (most likely Nucula); brittlestar arms in farfield; voids; larger-bodied worm near void
NWREF-2	D	9/21/2010	14:38	13	1	111	14.6	>4	>4	1	276.4	18.9	18.7	19.6	0.9	Biogenic	52.7	3.6	0		n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; sulfidic patches@depth; surf tubes; biogenic mound; a few small worms@depth
NWREF-3	A	9/21/2010	13:44	13	1	111	14.6	>4	>4	0	ind	ind	ind	ind	ind	ind	ind	ind	ind		n	0.0	0.0	0.0	0.0	n	ind				ind	Overpen; appears to be ambient soft homogenous mud>pen w/ weak rpd contrast
NWREF-3	C	9/21/2010	13:45	13	1	111	14.6	>4	>4	1	189.4	13.0	12.5	14	1.5	Biogenic	53.3	3.7	0		n	0.0	0.0	0.0	0.0	n	2	11.5	12.4	12.0	2 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; small white nearsurface bivalves; brittlestar arms in farfield; burrow opening behind profile; voids, org+vertical oxy burrow/tube
NWREF-3	D	9/21/2010	13:46	13	1	111	14.6	>4	>4	1	306.1	21.0	19.8	21.7	1.9	Biogenic	56.3	3.9	0		n	0.0	0.0	0.0	0.0	n	0				2 on 3	Partial overpen; ambient soft homogenous mud>pen; weak rpd contrast; weak-moderate reduced@depth; shallow-dwelling bivalves; several small short orgs@depth
NWREF-4	A	9/21/2010	14:53	13	1	111	14.6	>4	>4	1	278.5	19.1	17.7	20.4	2.7	Biogenic	41.3	2.8	0		n	0.0	0.0	0.0	0.0	n	5	4.5	19.0	11.8	1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; weak/moderate reduced@depth; numerous surf tubes; several voids+vertical oxy burrow/tube
NWREF-4	B	9/21/2010	14:54	13	1	111	14.6	>4	>4	1	223.4	15.3	13.2	17.5	4.3	Biogenic	70.7	4.8	0		n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; sufidic patches@depth; white shallow dwelling bivalve (Nucula); brittlestar arm+tubes@surf; vertical oxy burrow/tube w/ org@depth
NWREF-4	D	9/21/2010	14:55	13	1	111	14.6	>4	>4	2	230.2	15.8	15.3	16.2	0.9	Biogenic	64.4	4.4	0		n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; moderate rpd contrast w/ sulfidic patches@depth; dense surf tubes; large vertical oxy burrow; several small/thin worms@depth
NWREF-5	A	9/21/2010	15:08	13	1	105	14.6	>4	>4	1	287.8	19.7	19.4	20.1	0.7	Biogenic	76.3	5.2	0		n	0.0	0.0	0.0	0.0	n	1	5.9	6.7	6.3	1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; sulfidic patch@depth; surf tubes; Nucula present; void; vertical oxy burrow w/ org@bottom of image
NWREF-5	B	9/21/2010	15:09	13	1	105	14.6	>4	>4	2	95	6.5	6.4	6.9	0.5	Biogenic	49.5	3.4	0		n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient moderately firm homogenous mud>pen; weak rpd contrast; reduced patches@depth; intense bio reworking @ SWI; burrow opening in PV and edge of transected oxidized burrows visible in right half of image
NWREF-5	D	9/21/2010	15:11	13	1	105	14.6	>4	>4	2	290.4	19.9	19.3	20.4	1.1	Biogenic	59.2	4.1	8	r	n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; moderate rpd contrast; weak/moderately reduced@depth; reduced wiper clasts; a few surf tubes; 2 small thin worms@depth
NWREF-6	B	9/21/2010	13:34	13	1	111	14.6	>4	>4	2	282	19.3	18.7	20.4	1.7	Biogenic	48.6	3.3	4	r	n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; sulfidic patches@depth; reduced wiper clasts; surf tubes; several small/thin worms@depth
NWREF-6	C	9/21/2010	13:35	13	1	111	14.6	>4	>4	2	280.4	19.2	18.8	19.7	0.9	Biogenic	22.3	1.5	2	r	n	0.0	0.0	0.0	0.0	n	3	5.8	14.5	10.2	1 on 3	Ambient soft homogenous mud>pen; relatively shallow rpd w/ weak contrast; numerous surf tubes; 2-3 voids; 1 white shallow-dwelling bivalve
NWREF-6	D	9/21/2010	13:38	13	1	111	14.6	>4	>4	1	306.7	21.0	20.5	21.2	0.7	Biogenic	4.3	0.3	2	r	n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; very shallow rpd w/ reduced sed@surf+reduced horizon in upper 3 cm; 1-2 white bivalve, biogenic particle sorting (edge of void) just below reduced horizon in center of image. Large burrow openings visible in PV image

Note: ind = indeterminate; Mud clast state: o=oxidized, r=reduced, b=both oxidized and reduced

APPENDIX C
Sediment-Profile Imaging Results
September 2010

Station	Rep.	Date	Time	Stop Collar Setting (in)	# of weights (per side)	Water Depth (ft)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Minimum (phi)	Grain Size Maximum (phi)	Penetration Area (sq.cm)	Penetration Mean (cm)	Penetration Minimum (cm)	Penetration Maximum (cm)	Boundary Roughness (cm)	Boundary Roughness Type	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State	Methane	Total DM Area (sq.cm)	Total DM Mean (sq.cm)	Total DM Minimum (sq.cm)	Total DM Maximum (sq.cm)	Low DO?	Feeding Void #	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	COMMENT
NWREF-7	A	9/21/2010	14:09	13	1	111	14.6	>4	>4	1	308.9	21.2	21.1	21.3	0.2	Biogenic	62.9	4.3	ind		n	0.0	0.0	0.0	0.0	n	3	9.5	12.4	11.0	3	Partial overpen; Ambient soft homogenous mud>pen; weak rpd contrast; a few sulfidic patches@depth; several voids/burrows@depth; several long/thin worms@depth
NWREF-7	C	9/21/2010	14:11	13	1	111	14.6	>4	>4	1	306.9	21.0	20.7	21.2	0.5	Biogenic	43.8	3.0	ind	ind	n	0.0	0.0	0.0	0.0	n	1	19.4	20.6	20.0	1 on 3	Partial overpen; Ambient soft homoenous mud>pen; weak rpd contrast; sulfidic patches@depth; surf tubes@left; large subsurface void; 1-2 small orgs@depth
NWREF-7	D	9/21/2010	14:12	13	1	111	14.6	>4	>4	2	263.3	18.0	17.8	18.3	0.5	Biogenic	39.3	2.7	3	r	n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; a few sulfidic patches@depth; brittlestar arms@sed surf+upper 4 cm; several small/thin worms@depth
NWREF-8	A	9/21/2010	14:26	13	1	111	14.6	>4	>4	1	307.2	21.0	20.3	21.7	1.4	Biogenic	50.4	3.5	0		n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; weak to moderate rpd contrast; weak sulfidic band@depth; surf tubes; several small thin worms@depth, burrow openings visible in PV image
NWREF-8	C	9/21/2010	14:28	13	1	111	14.6	>4	>4	2	240.8	16.5	15.9	18	2.1	Biogenic	46.2	3.2	0		n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; weak to moderate rpd contrast; sed surf is floccy; surf tubes and possible Podocerid stalks on right; brittlestar arm in farfield; several small worms@depth
NWREF-8	D	9/21/2010	14:29	13	1	111	14.6	>4	>4	2	243.5	16.7	16.2	17.4	1.2	Biogenic	67.5	4.6	10	o	n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; weak to moderate rpd contrast; reworked sed surf; several small white-brown bivalves in upper 1 cm; a few small/thin worms@depth.
NWREF-9	A	9/21/2010	15:25	13	1	109	14.6	>4	>4	2	277.5	19.0	18.8	19.3	0.5	Biogenic	58.4	4.0	3	r	n	0.0	0.0	0.0	0.0	n	4	12.0	18.5	15.3	1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; a few sulfidic patches@depth; surf tubes; white bivalve upper right; large-bodied worm@center; several deep voids
NWREF-9	B	9/21/2010	15:26	13	1	109	14.6	>4	>4	1	287	19.7	19.1	20.2	1.1	Biogenic	78.8	5.4	5	o	n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; deep rpd w/ weak contrast; surf tubes; amphipod stalk and brittlestar arm@surf; shallow dwelling whitish bivalves; 1 or 2 very small subsurface orgs, large burrow openings visible in PV image
NWREF-9	C	9/21/2010	15:27	13	1	109	14.6	>4	>4	1	294.8	20.2	19.8	21.1	1.3	Biogenic	58.8	4.0	4	o	n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; deep rpd w/ weak to moderate contrast; small surf tubes; a few small worms@depth; vertical oxy burrow/tube@depth
NWREF-10	B	9/21/2010	13:54	13	1	111	14.6	>4	>4	1	298	20.4	19.8	20.7	0.9	Physical	57.6	3.9	8	r	n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; wiper clast smearing of rpd; weak to moderate rpd contrast; brittle-star arm in farfield; surf tubes; a few small worms@depth, burrow openings as well as mud clasts from base frame visible in PV image
NWREF-10	C	9/21/2010	13:55	13	1	111	14.6	>4	>4	0	304.2	20.8	19.5	21.8	2.3	Physical	ind	ind	1	r	n	0.0	0.0	0.0	0.0	n	1	18.7	20.2	19.5	1 on 3	Partial overpen; Ambient soft homogenous mud>pen; sulfidic patches@depth; a few surf tubes; larger-bodied org@center; vertical oxy burrow@right; deep void, SWI disturbed by camera frame from previous replicate image
NWREF-10	D	9/21/2010	13:56	13	1	111	14.6	>4	>4	1	309.4	21.2	20.8	21.6	0.8	Biogenic	51	3.5	1	r	n	0.0	0.0	0.0	0.0	n	2	11.9	19.8	15.9	2 on 3	Partial overpen; Ambient soft homogenous mud>pen; weak rpd contrast but sulfidic@depth; large burrow/void@left; long vertical oxy burrow/tube@right of void; pink/white small bivalves nearsurface; several small orgs@depth
NWREF-11	A	9/21/2010	15:00	13	1	110	14.6	>4	>4	2	278.2	19.1	17.8	19.7	1.9	Biogenic	60.2	4.1	0		n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; weak to moderate rpd contrast; distinct long vertical burrow w/ opening@surf; brittle star@burrow opening@surf
NWREF-11	B	9/21/2010	15:01	13	1	110	14.6	>4	>4	2	284.4	19.5	18.8	20.2	1.4	Biogenic	47.8	3.3	3	r	n	0.0	0.0	0.0	0.0	n	2	6.9	8.5	7.7	1 on 3	Ambient soft homogenous mud>pen; weak to moderate rpd contrast; several sulfidic patches@depth; small tubes+brittlestars@surf; 1 near-surface small white bivalve; voids
NWREF-11	D	9/21/2010	15:03	13	1	110	14.6	>4	>4	1	299.3	20.5	20.1	21.1	1.0	Biogenic	57.2	3.9	6	r	n	0.0	0.0	0.0	0.0	n	2	14.2	20.2	17.2	1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; reduced wiper clasts@surf; 1 near-surface bivalve; 2 voids; vertical oxy burrow w/ worm@depth
NWREF-12	A	9/21/2010	15:17	13	1	108	14.6	>4	>4	1	295.4	20.2	20.1	20.5	0.4	Biogenic	54.4	3.7	2	o	n	0.0	0.0	0.0	0.0	n	1	18.1	18.9	18.5	1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; a few small sulfidic patches@depth; surf tubes; 1 white nearsurface bivalve; deep void; a few small worms@depth

Note: ind = indeterminate; Mud clast state: o=oxidized, r=reduced, b=both oxidized and reduced

APPENDIX C
Sediment-Profile Imaging Results
September 2010

Station	Rep.	Date	Time	Stop Collar Setting (in)	# of weights (per side)	Water Depth (ft)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Minimum (phi)	Grain Size Maximum (phi)	Penetration Area (sq.cm)	Penetration Mean (cm)	Penetration Minimum (cm)	Penetration Maximum (cm)	Boundary Roughness (cm)	Boundary Roughness Type	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State	Methane	Total DM Area (sq.cm)	Total DM Mean (sq.cm)	Total DM Minimum (sq.cm)	Total DM Maximum (sq.cm)	Low DO?	Feeding Void #	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	COMMENT
NWREF-12	B	9/21/2010	15:18	13	1	108	14.6	>4	>4	1	296.1	20.3	19.4	21	1.6	Biogenic	51.1	3.5	6	b	n	0.0	0.0	0.0	0.0	n	2	15.0	16.4	15.7	1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; sulfidic patches@depth; surf tubes; small brown/white bivalves@surface+just below; burrow/void w/ oxy sed@depth
NWREF-12	C	9/21/2010	15:19	13	1	108	14.6	>4	>4	1	271.4	18.6	18.4	19	0.6	Biogenic	53.8	3.7	0		n	0.0	0.0	0.0	0.0	n	1	10.6	11.3	11.0	1 on 3	Ambient soft homogenous mud>pen; moderate rpd contrast w/ sulfidic patches@depth; prominent vertical oxy burrow w/ reduced pseudofeces@surf; numerous worms@depth
NWREF-13	A	9/21/2010	14:16	13	1	111	14.6	>4	>4	1	301.3	20.6	20.2	21.2	1.0	Biogenic	55	3.8	0		n	0.0	0.0	0.0	0.0	n	1	14.8	15.0	14.9	1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; sulfidic patch@depth; dense surf tubes; void@depth; a few small orgs@depth
NWREF-13	B	9/21/2010	14:18	13	1	111	14.6	>4	>4	1	260.6	17.8	16.4	19.8	3.4	Biogenic	38.4	2.6	6	r	n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; reduced wiper clasts; small sulfidic patches; possible burrow opening behind profile; surf tubes; a few small worms@depth
NWREF-13	C	9/21/2010	14:19	13	1	111	14.6	>4	>4	1	271.3	18.6	17.9	19.2	1.3	Biogenic	17.7	1.2	4	b	n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; shallow rpd; sulfidic patch@depth; surf tubes; a few small worms@depth
NWREF-14	A	9/21/2010	14:01	13	1	111	14.6	>4	>4	1	291.4	20.0	17.8	21.1	3.3	Biogenic	64.4	4.4	0		n	0.0	0.0	0.0	0.0	n	1	14.6	15.0	14.8	2 on 3	Ambient soft homogenous mud>pen; weak to moderate rpd contrast; 1 white near-surface bivalve; void w/ vertical oxy burrow; several worms@depth
NWREF-14	B	9/21/2010	14:02	13	1	111	14.6	>4	>4	2	236.9	16.2	16.1	16.4	0.3	Biogenic	56.9	3.9	3	o	n	0.0	0.0	0.0	0.0	n	2	1.9	3.2	2.6	1 on 3	Ambient soft homogenous mud>pen; weak to moderate rpd contrast; surf tubes; shallow voids/burrow; cryptic org below voids; shallow worm@right
NWREF-14	C	9/21/2010	14:03	13	1	111	14.6	>4	>4	0	267.7	18.3	17.7	18.8	1.1	Biogenic	59.6	4.1	3	o	n	0.0	0.0	0.0	0.0	n	4	1.9	12.0	7.0	1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; surf tubes; prominent vertical oxy burrow/void complex w/ opening@surf; 2 Nucula @depth in burrow
NWREF-15	B	9/21/2010	14:46	13	1	111	14.6	>4	>4	1	302.6	20.7	19.9	21.2	1.3	Biogenic	45.5	3.1	5	b	n	0.0	0.0	0.0	0.0	n	1	3.4	4.8	4.1	1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; a few small sulfidic patches@depth; surf tubes; a few small worms@depth; void; vertical burrow@far right
NWREF-15	C	9/21/2010	14:47	13	1	111	14.6	>4	>4	1	308.8	21.2	19.8	21.6	1.8	Biogenic	56.6	3.9	ind		n	0.0	0.0	0.0	0.0	n	4	12.3	20.2	16.3	1 on 3	Partial overpen; Ambient soft homogenous mud>pen; weak rpd contrast; white near-surface bivalve upper left; several subsurface voids
NWREF-15	D	9/21/2010	14:48	13	1	111	14.6	>4	>4	1	302.9	20.7	19.4	21.6	2.2	ind	ind	ind	ind		n	0.0	0.0	0.0	0.0	n	0				1 on 3	Surface disturbed by base sled from previous camera sampling; partial overpen; Ambient soft homogenous mud>pen; vertical oxy burrow/tube on left side; a few small orgs@depth
SWREF-1	A	9/21/2010	10:00	14	2	102	14.6	>4	>4	1	295.2	20.2	19.8	20.9	1.1	Biogenic	51.3	3.5	0		n	0.0	0.0	0.0	0.0	n	1	12.0	12.2	12.1	1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; large sulfidic patch@depth; small surf tubes; void@depth w/ oxy vertical burrow below
SWREF-1	B	9/21/2010	10:01	14	2	102	14.6	>4	>4	1	261.8	17.9	17.2	18.6	1.4	Biogenic	34.6	2.4	3	o	n	0.0	0.0	0.0	0.0	n	2	4.0	5.1	4.6	1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; a few small sulfidic patches@depth; small surf tubes; 1 shallow void/burrow; several small thin worms@depth, large burrow openings in PV image
SWREF-1	D	9/21/2010	10:03	14	2	102	14.6	>4	>4	0	308.8	21.2	20.9	21.3	0.4	Biogenic	54.3	3.7	2	r	n	0.0	0.0	0.0	0.0	n	2	6.1	7.3	6.7	1 on 3	Ambient soft homogenous mud>pen; slight overpen; moderate rpd contrast; reduced wiper clast@far right surf; surf tubes; 1-2 voids/burrows; a few small worms@depth
SWREF-2	A	9/21/2010	12:59	13	1	101	14.6	>4	>4	1	268.2	18.4	17.6	18.7	1.1	Biogenic	44.6	3.1	0		n	0.0	0.0	0.0	0.0	n	1	10.0	10.4	10.2	1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; weak to moderately reduced@depth; numerous stg 1 surf tubes; a few near-surface bivalves; 1 void; a few small/thin worms@depth
SWREF-2	B	9/21/2010	13:00	13	1	101	14.6	>4	>4	1	232.1	15.9	15.2	17.3	2.1	Biogenic	38.3	2.6	3	r	n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; weak/mod reduced@depth; 1 white bivalve near surface; vertical oxidized burrow traces at depth
SWREF-2	D	9/21/2010	13:02	13	1	101	14.6	>4	>4	0	281.9	19.3	18.8	19.7	0.9	Biogenic	55.1	3.8	1	o	n	0.0	0.0	0.0	0.0	n	1	13.4	14.8	14.1	1 on 3	Ambient soft homogenous mud>pen; weak/moderate rpd contrast; surf tubes; void/burrow; several small/thin worms@depth

Note: ind = indeterminate; Mud clast state: o=oxidized, r=reduced, b=both oxidized and reduced

APPENDIX C
Sediment-Profile Imaging Results
September 2010

Station	Rep.	Date	Time	Stop Collar Setting (in)	# of weights (per side)	Water Depth (ft)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Minimum (phi)	Grain Size Maximum (phi)	Penetration Area (sq.cm)	Penetration Mean (cm)	Penetration Minimum (cm)	Penetration Maximum (cm)	Boundary Roughness (cm)	Boundary Roughness Type	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State	Methane	Total DM Area (sq.cm)	Total DM Mean (sq.cm)	Total DM Minimum (sq.cm)	Total DM Maximum (sq.cm)	Low DO?	Feeding Void #	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	COMMENT
SWREF-3	A	9/21/2010	10:22	13	1	102	14.6	>4	>4	1	234.6	16.1	15.8	16.5	0.7	Biogenic	58.5	4.0	0		n	0.0	0.0	0.0	0.0	n	1	8.8	12.1	10.5	1 on 3	Ambient soft homogenous mud>pen; moderate rpd contrast; surf tubes; near-surface bivalve@far left; prominent burrow/void; a few small worms@depth
SWREF-3	B	9/21/2010	10:23	13	1	102	14.6	>4	>4	1	277.9	19.0	17.4	19.8	2.4	Biogenic	33.4	2.3	2	r	n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; weak to moderate rpd contrast; reduced wiper clasts; surf tubes; shallow vertical oxy burrow; several small thin worms@depth
SWREF-3	C	9/21/2010	10:24	13	1	102	14.6	>4	>4	2	237.2	16.2	15.8	16.9	1.1	Biogenic	43	2.9	3	r	n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; surf tubes; large-bodied worm@depth near center; several smaller worms@depth
SWREF-4	A	9/21/2010	11:02	13	1	102	14.6	>4	>4	2	220.2	15.1	14.3	16.1	1.8	Biogenic	51.2	3.5	3	o	n	0.0	0.0	0.0	0.0	n	1	10.8	12.9	11.9	1 on 3	Ambient soft homogenous mud>pen; weak to moderate rpd contrast; numerous surf tubes; one white near-surface bivalve; void+a few small worms@depth
SWREF-4	C	9/21/2010	11:04	13	1	102	14.6	>4	>4	1	236	16.2	14.8	17.4	2.6	Biogenic	25	1.7	0		n	0.0	0.0	0.0	0.0	n	0				2 on 3	Ambient soft homogenous mud>pen; sulfidic patches@depth; surf tubes+near surface bivalves; a few small worms+1 larger-bodied org@depth
SWREF-4	D	9/21/2010	11:05	13	1	102	14.6	>4	>4	1	240.6	16.5	16.3	16.8	0.5	Biogenic	46.4	3.2	0		n	0.0	0.0	0.0	0.0	n	0				2 on 3	Ambient soft homogenous mud>pen; weak to moderate rpd contrast; surf tubes+Podocerids; white near-surf bivalves@left; several small/thin worms@depth
SWREF-5	B	9/21/2010	11:27	13	1	102	14.6	>4	>4	1	246.7	16.9	16	17.4	1.4	Biogenic	46.6	3.2	0		n	0.0	0.0	0.0	0.0	n	1	14.6	16.9	15.8	2 on 3	Ambient soft homogenous mud>pen; weak to moderate rpd contrast; surf tubes; 1 white near-surf bivalve; large burrow@depth; several small worms@depth
SWREF-5	C	9/21/2010	11:28	13	1	102	14.6	>4	>4	1	215.9	14.8	13.9	15.6	1.7	Biogenic	56.8	3.9	0		n	0.0	0.0	0.0	0.0	n	1	7.5	7.7	7.6	1 on 3	Ambient soft homogenous mud>pen; weak to moderate rpd contrast; sulfidic band@depth; surf tubes; several small thin worm+1 void@depth
SWREF-5	D	9/21/2010	11:29	13	1	102	14.6	>4	>4	1	214.5	14.7	13.2	16.2	3.0	Biogenic	67.5	4.6	0		n	0.0	0.0	0.0	0.0	n	1	5.7	6.0	5.9	2 on 3	Ambient soft homogenous mud>pen; slight sandy texture in upper 2-3 cm; burrow opening behind profile; white near-surf bivalve@right; 2 larger-bodied subsurface orgs
SWREF-6	B	9/21/2010	11:20	13	1	102	14.6	>4	>4	2	234.1	16.0	15.6	16.6	1.0	Biogenic	44.7	3.1	0		n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; weak to moderate rpd contrast; small surf tubes; 1 larger-bodied worm+1 or 2 smaller orgs@depth
SWREF-6	C	9/21/2010	11:21	13	1	102	14.6	>4	>4	1	271.7	18.6	17.8	19.8	2.0	Biogenic	32	2.2	1	r	n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; reduced wiper clast; surf tubes; 1 small worm@ 3.9 cm depth, edge of void transected at lower left
SWREF-6	D	9/21/2010	11:22	13	1	102	14.6	>4	>4	0	268	18.4	17.6	18.9	1.3	Biogenic	43	2.9	0		n	0.0	0.0	0.0	0.0	n	0				2 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; moderately reduced@depth; 2 white near-surface bivalves; larger-bodied worm+a few smaller orgs@depth
SWREF-7	A	9/21/2010	10:32	13	1	102	14.6	>4	>4	1	259	17.7	17.3	18.4	1.1	Biogenic	21.5	1.5	0		n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; dense surf tubes; a few v. small orgs@depth, large burrow openings visible in PV image
SWREF-7	B	9/21/2010	10:33	13	1	102	14.6	>4	>4	1	278.9	19.1	19	19.7	0.7	Biogenic	44.5	3.0	4	b	n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; weak to moderate rpd contrast; small surf tubes; several small orgs@depth
SWREF-7	D	9/21/2010	10:35	13	1	102	14.6	>4	>4	1	258.5	17.7	17.3	18.1	0.8	Biogenic	50.8	3.5	3	r	n	0.0	0.0	0.0	0.0	n	4	6.2	8.7	7.5	1 on 3	Ambient soft homogenous mud>pen; weak to moderate rpd contrast; surf tubes; 2 shallow-dwelling white bivalves@right; voids+several long thin worms@depth
SWREF-8	A	9/21/2010	12:53	13	1	101	14.6	>4	>4	1	261.9	17.9	17.6	18.2	0.6	Biogenic	46.3	3.2	0		n	0.0	0.0	0.0	0.0	n	1	16.8	17.6	17.2	1 on 3	Ambient soft homogenous mud>pen; weak/mod rpd contrast; somewhat reduced@depth; surf tubes; large-bodied worm+void@depth
SWREF-8	B	9/21/2010	12:53	13	1	101	14.6	>4	>4	1	222.8	15.3	14.1	15.9	1.8	Biogenic	48.3	3.3	0		n	0.0	0.0	0.0	0.0	n	1	14.6	14.8	14.7	1 on 3	Ambient soft homogenous mud>pen; weak/mod rpd contrast; thin veneer of grey fine sand; surf tubes; a few near-surface white bivalves; partial void+a few worms@depth
SWREF-8	C	9/21/2010	12:54	13	1	101	14.6	>4	>4	1	237.5	16.3	15.9	16.6	0.7	Biogenic	52.4	3.6	4	r	n	0.0	0.0	0.0	0.0	n	1	15.1	15.6	15.4	1 on 3	Ambient soft homogenous mud>pen; weak/mod rpd contrast; sulfidic patches@depth; reduced wiper clasts; surf tubes+1 white bivalve; deep void+a few small/thin worms@depth

Note: ind = indeterminate; Mud clast state: o=oxidized, r=reduced, b=both oxidized and reduced

APPENDIX C
Sediment-Profile Imaging Results
September 2010

Station	Rep.	Date	Time	Stop Collar Setting (in)	# of weights (per side)	Water Depth (ft)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Minimum (phi)	Grain Size Maximum (phi)	Penetration Area (sq.cm)	Penetration Mean (cm)	Penetration Minimum (cm)	Penetration Maximum (cm)	Boundary Roughness (cm)	Boundary Roughness Type	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State	Methane	Total DM Area (sq.cm)	Total DM Mean (sq.cm)	Total DM Minimum (sq.cm)	Total DM Maximum (sq.cm)	Low DO?	Feeding Void #	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	COMMENT
SWREF-9	A	9/21/2010	11:11	13	1	102	14.6	>4	>4	1	223.6	15.3	14.4	16.9	2.5	Biogenic	54.6	3.7	1	o	n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; moderate rpd contrast; sulfidic patches@depth; surf tubes; a few small org@depth; vertical oxy burrow@right
SWREF-9	B	9/21/2010	11:12	13	1	102	14.6	>4	>4	0	225.1	15.4	15.1	15.8	0.7	Biogenic	57.8	4.0	0		n	0.0	0.0	0.0	0.0	n	1	4.6	4.8	4.7	1 on 3	Ambient soft homogenous mud>pen; weak/moderate rpd contrast; surf tubes; partial void; a few small thin orgs@depth.
SWREF-9	C	9/21/2010	11:13	13	1	102	14.6	>4	>4	1	255.3	17.5	17.3	17.7	0.4	Biogenic	51.2	3.5	1	o	n	0.0	0.0	0.0	0.0	n	2	9.5	15.0	12.3	1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; rpd smearing artifact ignored in measurement; dense surf tubes; voids; small orgs@depth
SWREF-10	A	9/21/2010	11:42	13	1	103	14.6	>4	>4	1	234.8	16.1	14.8	17.7	2.9	Biogenic	53	3.6	0		n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; moderate to strong rpd contrast; sulfidic patches; surf tubes; Caprellid; large vertical oxy burrow w/ opening behind profile; large-bodied orgs@depth
SWREF-10	B	9/21/2010	11:43	13	1	103	14.6	>4	>4	1	219.6	15.0	14.1	16	1.9	Physical	36.9	2.5	3	r	n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; moderate rpd contrast; reduced wiper clasts; surf tubes; Caprellid+1 other org@surf; a few small orgs@depth; vertical oxy burrow/tube@right
SWREF-10	C	9/21/2010	11:44	13	1	103	14.6	>4	>4	1	290.1	19.9	18.9	20.3	1.4	Biogenic	52.6	3.6	2	b	n	0.0	0.0	0.0	0.0	n	4	4.4	18.6	11.5	1 on 3	Ambient soft homogenous mud>pen; weak to moderate rpd contrast; surf tubes; 1 white near surface bivalve; several voids
SWREF-11	A	9/21/2010	11:34	13	1	102	14.6	>4	>4	1	252.9	17.3	16.8	17.7	0.9	Biogenic	51.9	3.6	0		n	0.0	0.0	0.0	0.0	n	0				2 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; surf tubes; several white near-surface bivalves; a few v. small orgs@depth
SWREF-11	C	9/21/2010	11:36	13	1	102	14.6	>4	>4	1	234.8	16.1	15.3	16.9	1.6	Biogenic	34.9	2.4	0		n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; weak/mod rpd contrast; sulfidic patch@depth; burrow opening behind profile; near-surf bivalve to right of burrow opening
SWREF-11	D	9/21/2010	11:37	13	1	102	14.6	>4	>4	1	199.1	13.6	13.4	13.9	0.5	Biogenic	50	3.4	6	b	n	0.0	0.0	0.0	0.0	n	0				1 on 3	Ambient soft homogenous mud>pen; weak/mod rpd contrast; surf tubes; several small worms@depth; larger-bodied worm in lwr. right corner
SWREF-12	A	9/21/2010	10:47	13	1	101	14.6	>4	>4	1	211.9	14.5	13.9	15.5	1.6	Biogenic	41.1	2.8	7	o	n	0.0	0.0	0.0	0.0	n	1	4.5	4.8	4.7	1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; many surf tubes; numerous v. small worms@depth; 1 void
SWREF-12	B	9/21/2010	10:48	13	1	101	14.6	>4	>4	1	196.7	13.5	13	13.8	0.8	Biogenic	48.1	3.3	3	r	n	0.0	0.0	0.0	0.0	n	1	1.3	1.9	1.6	1 on 3	Ambient soft homogenous mud>pen; weak/moderate rpd contrast; surf tubes; biogenic mounds@surf; shallow void/burrow; a few worms@depth; reduced wiper clast
SWREF-12	C	9/21/2010	10:49	13	1	101	14.6	>4	>4	1	239.3	16.4	15.4	16.8	1.4	Biogenic	44.5	3.0	0		n	0.0	0.0	0.0	0.0	n	1	9.8	10.2	10.0	1 on 3	Ambient soft homogenous mud>pen; weak/moderate rpd contrast; dense surf tubes; a few small orgs@depth; 1 void
SWREF-13	A	9/21/2010	12:30	13	1	100	14.6	>4	>4	1	229.2	15.7	14.9	16.2	1.3	Biogenic	39.9	2.7	1	r	n	0.0	0.0	0.0	0.0	n	1	15.2	15.4	15.3	2 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; sulfidic patches@depth; surf tubes; white shallow-dwelling bivalves; 1 stick amphipod; deep void; several worms@depth
SWREF-13	B	9/21/2010	12:31	13	1	100	14.6	>4	>4	1	233.7	16.0	15.5	16.8	1.3	Biogenic	47.3	3.2	2	o	n	0.0	0.0	0.0	0.0	n	0				2 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; 1 sulfidic patch; white near-surf bivalve; surf tubes; a few small worms@depth
SWREF-13	C	9/21/2010	12:31	13	1	100	14.6	>4	>4	1	221.8	15.2	14.1	16.3	2.2	Biogenic	37.9	2.6	0		n	0.0	0.0	0.0	0.0	n	0				2 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; surf tubes; 1-2 near-surf bivalves; a few small worms@depth
SWREF-14	A	9/21/2010	12:37	13	1	102	14.6	>4	>4	1	254	17.4	16.6	18	1.4	Biogenic	46.1	3.2	0		n	0.0	0.0	0.0	0.0	n	1	9.2	10.8	10.0	2 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; more reduced@depth; surf tubes; several surf/near-surf bivalves; void/burrow+a few worms@depth
SWREF-14	B	9/21/2010	12:38	13	1	102	14.6	>4	>4	1	268.8	18.4	17.8	19.4	1.6	Biogenic	63.6	4.4	5	r	n	0.0	0.0	0.0	0.0	n	4	2.6	17.9	10.3	1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; more reduced@depth; surf tubes; surf burrow opening@right; several voids; several worms@depth
SWREF-14	D	9/21/2010	12:40	13	1	102	14.6	>4	>4	1	252.1	17.3	17.1	17.7	0.6	Biogenic	39.5	2.7	4	b	n	0.0	0.0	0.0	0.0	n	2	10.2	15.3	12.8	2 on 3	Ambient soft homogenous mud>pen; weak/moderate rpd contrast; sulfidic patches; surf tubes; 1 white near-surf bivalve; voids; a few small worms@depth
SWREF-15	A	9/21/2010	12:45	13	1	101	14.6	>4	>4	1	195.6	13.4	12.4	14.1	1.7	Biogenic	32.6	2.2	0		n	0.0	0.0	0.0	0.0	n	3	4.2	12.9	8.6	1 on 3	Ambient soft homogenous mud>pen; relatively shallow rpd w/ moderate contrast; surf tubes; several voids; reduced sed@surf@right=biogenic

Note: ind = indeterminate; Mud clast state: o=oxidized, r=reduced, b=both oxidized and reduced

APPENDIX C
Sediment-Profile Imaging Results
September 2010

Station	Rep.	Date	Time	Stop Collar Setting (in)	# of weights (per side)	Water Depth (ft)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Minimum (phi)	Grain Size Maximum (phi)	Penetration Area (sq.cm)	Penetration Mean (cm)	Penetration Minimum (cm)	Penetration Maximum (cm)	Boundary Roughness (cm)	Boundary Roughness Type	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State	Methane	Total DM Area (sq.cm)	Total DM Mean (sq.cm)	Total DM Minimum (sq.cm)	Total DM Maximum (sq.cm)	Low DO?	Feeding Void #	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	COMMENT
SWREF-15	C	9/21/2010	12:47	13	1	101	14.6	>4	>4	0	291.6	20.0	19.6	20.4	0.8	Biogenic	41.4	2.8	1	r	n	0.0	0.0	0.0	0.0	n	5	2.5	19.3	10.9	1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; surf tubes; near-surf bivalves; several voids; large-bodied org associated w/ deep void
SWREF-15	D	9/21/2010	12:47	13	1	101	14.6	>4	>4	2	237.6	16.3	15.7	17	1.3	Biogenic	52.9	3.6	2	r	n	0.0	0.0	0.0	0.0	n	2	7.9	14.7	11.3	1 on 3	Ambient soft homogenous mud>pen; weak rpd contrast; surf tubes; reduced wiper clasts; 2 prominent voids; a few small thin worms@depth

Note: ind = indeterminate; Mud clast state: o=oxidized, r=reduced, b=both oxidized and reduced

Appendix D

Plan-View Imaging Results

APPENDIX D
Plan-View Imaging Results
September 2010

Station	Rep.	Date	Time	Length of image (cm)	Height of image (cm)	Field of View imaged (m^2)	Sediment Type	Bedforms	Infauna	Burrows	Tubes	Tracks	Epifauna	Mudclasts	Debris	Comment
CCBDS-A-1	A	9/24/2010	8:54	88.3	58.4	0.52	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ large burrow openings, tracks, and numerous brittlestars
CCBDS-A-1	C	9/24/2010	8:56	78	51.7	0.40	silt-clay	n	n	n	n	y	y	n	n	soft mud w/ tracks; half of image shows oxy mud and half shows reduced mud; org in lwr right corner
CCBDS-A-1	D	9/24/2010	8:56	80	53.1	0.42	silt-clay	n	y	y	y	y	n	y	n	soft mud w/ large burrow openings and tracks; reduced sediment expelled from burrows
CCBDS-A-2	A	9/24/2010	7:30	87.4	57.8	0.51	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrow openings and tracks
CCBDS-A-2	C	9/24/2010	7:32	78.6	52	0.41	silt-clay	n	y	n	y	y	y	y	n	soft mud w/ tracks and reduced mud clasts (possible camera frame artifacts)
CCBDS-A-2	D	9/24/2010	7:33	90.9	60.2	0.55	silt-clay	n	n	n	y	n	n	y	n	soft mud w/ many large reduced mud clasts, most likely dredged material
CCBDS-A-3	B	9/24/2010	9:35	75.4	50	0.38	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ a few small burrow openings and tracks
CCBDS-A-3	C	9/24/2010	9:36	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	water shot/high turbidity
CCBDS-A-3	D	9/24/2010	9:37	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	water shot/high turbidity
CCBDS-A-4	A	9/24/2010	8:04	77.3	51.2	0.40	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ burrows and tracks
CCBDS-A-4	B	9/24/2010	8:05	78.6	52.1	0.41	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ tracks and burrows and triangular feeding pits
CCBDS-A-4	C	9/24/2010	8:06	77.7	51.6	0.40	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ faint tracks, burrows, trianglular feeding pits
CCBDS-A-5	A	9/24/2010	7:57	77.7	51.5	0.40	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrow openings and tracks
CCBDS-A-5	B	9/24/2010	7:58	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	water shot/high turbidity
CCBDS-A-6	A	9/24/2010	9:17	82.4	54.5	0.45	silt-clay	n	y	n	y	y	n	n	n	soft mud w/ tracks
CCBDS-A-6	C	9/24/2010	9:19	82.4	54.5	0.45	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ tracks, burrows and triangular feeding pit
CCBDS-A-6	D	9/24/2010	9:19	82.7	54.9	0.45	silt-clay	n	y	y	y	y	n	y	n	soft mud w/ tracks, burrows, reduced mud clasts
CCBDS-A-7	A	9/24/2010	7:51	82.3	54.4	0.45	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ tracks, several large burrow openings
CCBDS-A-7	C	9/24/2010	7:53	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	water shot/high turbidity
CCBDS-A-7	D	9/24/2010	7:54	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	water shot/high turbidity
CCBDS-A-8	A	9/24/2010	9:24	85.7	56.8	0.49	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ tracks, burrows/feeding pits
CCBDS-A-8	B	9/24/2010	9:27	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	water shot/high turbidity
CCBDS-A-8	D	9/24/2010	9:28	78.6	52.1	0.41	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ tracks, 1 seastar, 2 large burrow openings
CCBDS-A-9	A	9/24/2010	8:24	81	53.8	0.44	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ several large burrow openings, tracks, epifauna; reduced mud@surf expelled from burrows
CCBDS-A-9	B	9/24/2010	8:25	81.8	54.3	0.44	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrow openings, tracks, small epifauna
CCBDS-A-9	C	9/24/2010	8:26	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	water shot/high turbidity
CCBDS-A-10	C	9/24/2010	9:10	97.4	64.6	0.63	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ tracks, burrows, 1-2 v. small epifauna
CCBDS-A-10	D	9/24/2010	9:11	76.5	50.7	0.39	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ tracks, burrow openings, 2 small orange epifauna upper right corner
CCBDS-A-11	A	9/24/2010	8:46	83.7	55.4	0.46	silt-clay	n	y	y	y	y	y	y	n	soft mud w/ tracks, burrow openings, feeding pits?, epifauna
CCBDS-A-11	B	9/24/2010	8:47	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	water shot/high turbidity
CCBDS-A-11	C	9/24/2010	8:48	89.7	59.5	0.53	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ tracks, burrows, feeding pits
CCBDS-A-12	A	9/24/2010	8:39	88.5	58.6	0.52	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ tracks, burrows, feeding pits
CCBDS-A-12	B	9/24/2010	8:40	81.2	53.8	0.44	silt-clay	n	y	n	y	y	y	n	n	soft mud w/ tracks and epifauna
CCBDS-A-12	D	9/24/2010	8:42	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	water shot/high turbidity
CCBDS-A-13	A	9/24/2010	7:44	79.6	52.8	0.42	silt-clay	n	y	n	y	n	y	y	n	soft mud w/ tubes and epifauna
CCBDS-A-13	B	9/24/2010	7:45	77.9	51.7	0.40	silt-clay	n	y	y	y	n	n	n	n	soft mud w/ small burrow openings and feeding pits
CCBDS-A-13	D	9/24/2010	7:47	79.4	52.6	0.42	silt-clay	n	y	n	y	n	n	y	n	mud in the form of oxy and reduced mud clasts+large clumps=disposed DM
CCBDS-A-14	A	9/24/2010	8:31	79	52.7	0.42	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ burrows, feeding pits, distinctive tracks
CCBDS-A-14	B	9/24/2010	8:32	70.9	47	0.33	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ tracks, burrows, and epifauna
CCBDS-A-14	D	9/24/2010	8:34	80.6	53.3	0.43	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ burrow opening/feeding pit and faint tracks
CCBDS-A-15	A	9/24/2010	8:10	83.9	55.8	0.47	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ burrow openings and faint tracks
CCBDS-A-15	B	9/24/2010	8:11	82.7	55.7	0.46	silt-clay	n	y	y	y	n	n	n	n	murky image; soft mud w/ burrow opening
CCBDS-A-15	D	9/24/2010	8:13	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	water shot/high turbidity
CCBDS-B-1	A	9/23/2010	14:26	91.7	60.6	0.56	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, and feeding pits; seastar associated w/ tracks
CCBDS-B-1	B	9/23/2010	14:27	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	water shot/high turbidity
CCBDS-B-1	D	9/23/2010	14:29	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	water shot/high turbidity
CCBDS-B-2	A	9/23/2010	16:05	92.4	61.2	0.57	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrow openings and tracks
CCBDS-B-2	B	9/23/2010	16:06	98.8	65.6	0.65	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ burrow openings and tracks
CCBDS-B-2	C	9/23/2010	16:07	90.6	60	0.54	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ small burrow openings, tracks, and feeding pits
CCBDS-B-3	A	9/23/2010	14:33	93.9	62.1	0.58	silt-clay	n	y	y	n	n	y	n	n	soft mud w/ burrowing openings, feeding pit, and very dense brittlestars
CCBDS-B-3	B	9/23/2010	14:34	85.8	56.9	0.49	silt-clay	n	y	n	n	n	y	n	n	soft mud w/ very dense brittlestars and 1 larger seastar

Note: ind=indeterminate

APPENDIX D
Plan-View Imaging Results
September 2010

Station	Rep.	Date	Time	Length of image (cm)	Height of image (cm)	Field of View imaged (m^2)	Sediment Type	Bedforms	Infauna	Burrows	Tubes	Tracks	Epifauna	Mudclasts	Debris	Comment
CCBDS-B-3	C	9/23/2010	14:35	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	water shot/high turbidity
CCBDS-B-4	A	9/23/2010	14:46	89	59.1	0.53	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ tracks, burrow openings and feeding pits
CCBDS-B-4	B	9/23/2010	14:47	91.9	60.9	0.56	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ tracks and small burrow openings
CCBDS-B-4	C	9/23/2010	14:48	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	water shot/high turbidity
CCBDS-B-5	A	9/23/2010	15:15	83.9	55.8	0.47	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ sandy patches+shell frags; small burrow openings, tracks, feeding pits
CCBDS-B-5	F	9/23/2010	15:36	76.1	50.5	0.38	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ numerous tracks and a few shells and shell frags
CCBDS-B-5	H	9/23/2010	15:37	83.8	55.4	0.46	silt-clay	n	y	n	y	n	n	y	y	soft mud w/ clusters of shells, shell frags and reduced mud clasts - looks like DM debris
CCBDS-B-6	A	9/23/2010	16:35	86	56.8	0.49	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ tracks; large depressions in sed=biogenic or from SPI camera prism?
CCBDS-B-6	B	9/23/2010	16:36	87.4	58	0.51	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ small burrow openings, faint tracks, biogenic feeding pit@right?
CCBDS-B-6	C	9/23/2010	16:37	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	water shot/high turbidity
CCBDS-B-7	A	9/23/2010	16:20	95.5	63.2	0.60	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ extensive tracks; crab and yellow sponge/tunicate; shrimp ahead of crab
CCBDS-B-7	B	9/23/2010	16:21	91.7	60.9	0.56	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ large burrow openings and extensive tracks
CCBDS-B-7	D	9/23/2010	16:23	84.7	56.1	0.48	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ small burrow openings and extensive tracks
CCBDS-B-8	A	9/23/2010	16:27	84.3	55.8	0.47	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ several large burrow openings and tracks
CCBDS-B-8	B	9/23/2010	16:28	76.5	50.7	0.39	silt-clay	n	y	n	y	y	n	n	n	soft mud w/ tracks
CCBDS-B-8	D	9/23/2010	16:31	89.7	59.5	0.53	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ tracks and some small burrow openings; image is somewhat fuzzy
CCBDS-B-9	A	9/23/2010	15:50	91.8	60.8	0.56	silt-clay	n	y	y	y	y	n	y	n	soft mud w/ burrow openings; tracks; a few small reduced mud clasts
CCBDS-B-9	B	9/23/2010	15:51	89	59.2	0.53	silt-clay	n	y	n	y	n	n	n	n	soft mud w/ some tubes
CCBDS-B-9	E	9/23/2010	15:54	87.7	58.1	0.51	silt-clay	n	y	y	y	n	y	n	n	soft mud w/ small burrow openings+a few v. small red/orange epifauna; surface somewhat rough
CCBDS-B-10	A	9/23/2010	15:07	86.4	57.2	0.49	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrow openings and tracks; a few shells
CCBDS-B-10	C	9/23/2010	15:08	99	65.6	0.65	silt-clay	n	y	y	y	y	n	n	y	soft mud w/ 1 small burrow opening+weathered tracks; debris=many weathered shells+shell frags=DM influence?
CCBDS-B-10	E	9/23/2010	15:42	89.9	59.6	0.54	silt-clay	n	n	n	n	y	n	n	y	soft mud w/ faint tracks+weathered shell debris
CCBDS-B-11	A	9/23/2010	15:00	86	56.6	0.49	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ several large and small burrow openings and faint tracks
CCBDS-B-11	B	9/23/2010	15:01	91.9	60.6	0.56	silt-clay	n	y	y	y	y	n	n	n	image partially obscured by turbidity; soft mud w/ tracks and burrow openings
CCBDS-B-11	D	9/23/2010	15:02	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	water shot/high turbidity
CCBDS-B-12	A	9/23/2010	13:49	91	60.1	0.55	silt-clay	n	y	y	y	y	y	n	y	soft mud w/ burrow openings+abundant brittlestars; several shrimp near burrow opening; white debris or shell frag?
CCBDS-B-12	C	9/23/2010	13:51	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	water shot/high turbidity
CCBDS-B-12	E	9/23/2010	14:02	93.4	61.9	0.58	silt-clay	n	y	y	y	n	y	y	n	mud w/ numerous brittlestars; clumps of reduced mud=DM disposal signature; 1 burrow opening@right
CCBDS-B-13	A	9/23/2010	14:52	97.5	64.5	0.63	silt-clay	n	ind	ind	ind	ind	y	ind	n	mud w/ dense brittlestars; image somewhat fuzzy
CCBDS-B-13	B	9/23/2010	14:53	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	water shot/high turbidity
CCBDS-B-13	D	9/23/2010	14:55	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	water shot/high turbidity
CCBDS-B-14	A	9/23/2010	14:11	92.7	61.2	0.57	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ tracks and burrow opening upper left corner; image is somewhat fuzzy
CCBDS-B-14	B	9/23/2010	14:12	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	water shot/high turbidity
CCBDS-B-14	C	9/23/2010	14:13	83.3	55.3	0.46	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrow openings+small tracks
CCBDS-B-15	A	9/23/2010	14:19	85.5	56.9	0.49	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ large burrow openings and tracks
CCBDS-B-15	B	9/23/2010	14:20	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	water shot/high turbidity
CCBDS-B-15	C	9/23/2010	14:21	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	water shot/high turbidity
CCBDS-C-1	A	9/23/2010	10:12	101.1	67	0.68	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrow openings, tracks, feeding pits, and flatfish (flounder?)
CCBDS-C-1	B	9/23/2010	10:12	99.7	64.4	0.64	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ burrow openings and tracks; image somewhat fuzzy
CCBDS-C-1	C	9/23/2010	10:13	86.3	57.3	0.49	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows and tracks
CCBDS-C-2	A	9/23/2010	9:12	90.6	60	0.54	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ burrow and tubes; 1 large burrow opening w/ expelled reduced sediment
CCBDS-C-2	B	9/23/2010	9:12	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	water shot/high turbidity
CCBDS-C-2	C	9/23/2010	9:13	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	water shot/high turbidity
CCBDS-C-3	A	9/23/2010	10:52	89.8	58.3	0.52	silt-clay	n	ny	y	y	y	n	n	n	murky image; soft mud w/ tracks and burrow openings
CCBDS-C-3	B	9/23/2010	10:53	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	image is too murky; seafloor not visible in sufficient detail for analysis
CCBDS-C-3	D	9/23/2010	10:54	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	image is too murky; seafloor not visible in sufficient detail for analysis
CCBDS-C-4	A	9/23/2010	9:35	92.4	61.1	0.56	silt-clay	n	y	y	y	y	n	n	y	soft mud w/ burrows, tracks and 1 piece of debris
CCBDS-C-4	B	9/23/2010	9:36	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	image is too murky; seafloor not visible in sufficient detail for analysis

Note: ind=indeterminate

APPENDIX D
Plan-View Imaging Results
September 2010

Station	Rep.	Date	Time	Length of image (cm)	Height of image (cm)	Field of View imaged (m^2)	Sediment Type	Bedforms	Infauna	Burrows	Tubes	Tracks	Epifauna	Mudclasts	Debris	Comment
CCBDS-C-4	D	9/23/2010	9:38	92.1	61.1	0.56	silt-clay	n	y	n	y	n	n	y	n	soft mud; numerous large and small oxy and reduced mud clasts+clumps=DM disposal or camera sled disturbance artifact?
CCBDS-C-5	A	9/23/2010	10:58	85.5	56.5	0.48	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ tracks, tubes, small burrow openings, and small epifauna
CCBDS-C-5	B	9/23/2010	10:59	89.1	59.2	0.53	silt-clay	n	y	y	y	y	n	y	n	soft mud w/ tracks, mud clasts, burrow openings; reduced clasts associated w/ burrow
CCBDS-C-5	C	9/23/2010	11:00	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	high turbidity; sed surf only partly visible; looks like silt-clay w/ numerous mud clasts
CCBDS-C-6	A	9/23/2010	10:22	96.6	64.1	0.62	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ tracks, burrows, tubes; and 1 juvenile flatfish (14 cm length)
CCBDS-C-6	C	9/23/2010	10:24	95.9	62.8	0.60	silt-clay	n	y	n	n	n	n	y	n	image partially obscured by turbidity; camera frame imprint on sed surf; many clasts=camera artifacts?
CCBDS-C-6	D	9/23/2010	10:25	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	water shot/high turbidity
CCBDS-C-7	A	9/23/2010	9:29	97.7	64.7	0.63	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ tracks and burrow openings
CCBDS-C-7	C	9/23/2010	9:30	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	water shot/high turbidity
CCBDS-C-7	D	9/23/2010	9:31	101.3	68.2	0.69	silt-clay	n	y	n	y	y	n	y	n	image partly obscured by turbidity; soft mud w/ faint tracks, several reduced mud clasts/clumps, and small tubes
CCBDS-C-8	A	9/23/2010	10:29	93.9	62.2	0.58	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ small burrow openings, tubes, faint tracks
CCBDS-C-8	B	9/23/2010	10:30	89.1	59.1	0.53	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ tracks, tubes, small burrow openings, hermit crab; patch of reduced sed in upper left
CCBDS-C-8	C	9/23/2010	10:31	92.8	61.4	0.57	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ burrows, tracks, feeding pits?
CCBDS-C-9	A	9/23/2010	10:38	98.9	65.5	0.65	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ large+small burrows, tracks, pits, and 1 pink shrimp
CCBDS-C-9	C	9/23/2010	10:40	93.9	62.1	0.58	silt-clay	n	y	y	y	y	n	n	n	soft mud w. burrows, tracks and pits
CCBDS-C-9	D	9/23/2010	10:41	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	water shot/high turbidity
CCBDS-C-10	A	9/23/2010	9:55	92.2	61.2	0.56	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ many tracks, a few small burrows; pits+tubes
CCBDS-C-10	B	9/23/2010	9:56	88.8	58.7	0.52	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ tracks, small burrows, pits and tubes
CCBDS-C-10	D	9/23/2010	9:58	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	water shot/high turbidity
CCBDS-C-11	A	9/23/2010	9:23	89.2	59.2	0.53	silt-clay	n	y	y	y	y	y	y	n	soft mud w/ several grey clay clasts (or rocks?); tracks, large burrow opening, one fish (sculpin?); 1 pink shrimp
CCBDS-C-11	B	9/23/2010	9:24	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	water shot/high turbidity
CCBDS-C-11	C	9/23/2010	9:24	97	64.3	0.62	silt-clay	n	y	y	y	y	y	y	n	soft mud w/ a couple of grey clasts (or rocks?); tracks, burrows, pits; pink shrimp near upper clast
CCBDS-C-12	A	9/23/2010	9:42	98.8	65.5	0.65	silt-clay	n	y	y	y	y	n	y	n	soft mud w/ tracks, small burrows, pits, one small grey clay clast in upper left corner
CCBDS-C-12	B	9/23/2010	9:42	96.7	64.2	0.62	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ numerous rocks; crab, sculpin, snail; 1 or 2 small burrows; tracks
CCBDS-C-12	D	9/23/2010	9:44	93.2	61.6	0.57	silt-clay	n	y	y	y	y	n	y	n	soft mud w/ numerous small rocks; camera frame footprint; tracks; small burrows
CCBDS-C-13	A	9/23/2010	9:48	91	60.3	0.55	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ many tracks and some burrow openings
CCBDS-C-13	B	9/23/2010	9:49	87.4	58	0.51	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ many tracks and some burrow openings
CCBDS-C-13	D	9/23/2010	9:50	90.5	60.1	0.54	silt-clay	n	y	y	y	y	y	y	n	soft mud w/ mud clasts, burrow openings, faint tracks, tubes, 1 small pink epifaunal org
CCBDS-C-14	A	9/23/2010	10:02	92.2	61.1	0.56	silt-clay	n	y	y	y	y	y	y	n	soft mud w/ tracks, mud clasts, burrow openings; epifauna=crab and flatfish
CCBDS-C-14	C	9/23/2010	10:04	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	water shot/high turbidity
CCBDS-C-14	D	9/23/2010	10:05	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	water shot/high turbidity
CCBDS-C-15	A	9/23/2010	10:44	97.9	64.8	0.63	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ burrow openings, pits and tracks; expelled reduced mud around 1 burrow opening
CCBDS-C-15	B	9/23/2010	10:45	113.6	75.3	0.86	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ burrows, pits, and tracks
CCBDS-C-15	C	9/23/2010	10:46	82.4	54.6	0.45	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ burrows, tracks and pits
CCBRS-1	A	9/21/2010	16:22	87.3	58	0.51	silt-clay	n	y	y	y	n	y	n	n	soft mud w/ a few burrow openings and numerous brittlestars
CCBRS-1	B	9/21/2010	16:22	86.8	57.6	0.50	silt-clay	n	y	y	y	n	y	n	n	soft mud w/ a few burrow openings and numerous brittlestars
CCBRS-1	D	9/21/2010	16:24	89.7	59.4	0.53	silt-clay	n	y	y	y	n	y	n	n	soft mud w/ a few burrow openings and numerous brittlestars
CCBRS-2	A	9/23/2010	8:25	90.8	60.2	0.55	silt-clay	n	y	y	y	n	y	n	n	soft mud w/ a few burrow openings and numerous brittlestars; at least 4 pink shrimp
CCBRS-2	C	9/23/2010	8:27	90	59.6	0.54	silt-clay	n	y	y	y	n	y	n	n	soft mud w/ several burrow openings and numerous brittlestars
CCBRS-2	D	9/23/2010	8:28	88.2	58.4	0.52	silt-clay	n	y	y	y	n	y	n	n	soft mud w/ large burrow openigns, numerous brittlestars and a few pink shrimp
CCBRS-3	A	9/23/2010	7:57	91.2	60.4	0.55	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ a few burrow openings, pits, tracks and numerous brittlestars
CCBRS-3	B	9/23/2010	7:58	88.7	58.9	0.52	silt-clay	n	y	y	y	n	y	n	n	soft mud w/ a few burrows and numerous brittlestars
CCBRS-3	C	9/23/2010	7:09	83.1	54.9	0.46	silt-clay	n	y	y	n	n	y	n	n	soft mud w/ several large burrow openings and numerous brittlestars
CCBRS-4	A	9/21/2010	16:00	84.4	55.9	0.47	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrow openings, tracks, and numerous brittlestars
CCBRS-4	B	9/21/2010	16:01	75.6	50.2	0.38	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, numerous brittlestars, and 1 pink shrimp
CCBRS-4	C	9/21/2010	16:02	91.6	60.6	0.56	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, faint tracks, and numerous brittlestars

Note: ind=indeterminate

APPENDIX D
Plan-View Imaging Results
September 2010

Station	Rep.	Date	Time	Length of image (cm)	Height of image (cm)	Field of View imaged (m^2)	Sediment Type	Bedforms	Infauna	Burrows	Tubes	Tracks	Epifauna	Mudclasts	Debris	Comment
CCBRS-5	A	9/23/2010	7:52	69.5	45.9	0.32	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ a few burrows, faint tracks, and numerous evenly-spaced brittlestars
CCBRS-5	B	9/23/2010	7:52	84.9	56.2	0.48	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrow openings, numerous brittlestars and 2 pink shrimp
CCBRS-5	C	9/23/2010	7:53	76.8	50.9	0.39	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, faint tracks, and numerous brittlestars
CCBRS-6	A	9/23/2010	8:40	95.8	63.5	0.61	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, faint tracks, and numerous brittlestars
CCBRS-6	B	9/23/2010	8:41	87.7	58.2	0.51	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, faint tracks, and numerous brittlestars
CCBRS-6	C	9/23/2010	8:41	37.3	24.7	0.09	silt-clay	n	y	n	y	y	y	n	n	reduced field of view (close-up of sed surf); soft mud w/ brittlestars
CCBRS-7	A	9/23/2010	8:18	95.4	63.2	0.60	silt-clay	n	y	y	y	y	y	n	n	fuzzy image; soft mud w/ burrows, faint tracks, numerous brittlestars
CCBRS-7	B	9/23/2010	8:20	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	water shot/high turbidity
CCBRS-7	C	9/23/2010	8:21	87.8	58.1	0.51	silt-clay	n	y	y	y	y	y	y	n	soft mud w/ burrows, faint tracks, numerous brittlestars, and reduced mud clasts
CCBRS-8	A	9/21/2010	16:29	75.3	49.8	0.37	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ large and small burrow openings, faint tracks, dense brittlestars
CCBRS-8	B	9/21/2010	16:30	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	water shot/high turbidity
CCBRS-8	D	9/21/2010	16:34	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	water shot/high turbidity
CCBRS-9	A	9/23/2010	8:12	91.2	60.6	0.55	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrow openings and numerous brittlestars
CCBRS-9	B	9/23/2010	8:12	ind	ind	ind	silt-clay	n	y	ind	ind	ind	y	ind	ind	image partially obsured by turbidity; soft mud w/ brittlestars
CCBRS-9	D	9/23/2010	8:14	89.2	57	0.51	silt-clay	n	y	n	n	n	y	y	n	mud w/ numerous clasts+clumps@swi; a few brittlestars; camera frame disturbance of sed surf?
CCBRS-10	A	9/21/2010	16:40	89.2	59.2	0.53	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrow openings, tracks, pits, and numerous brittlestars
CCBRS-10	C	9/21/2010	16:42	75	49.6	0.37	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrow openings, tracks, pits, and numerous brittlestars; 2 pink shrimp; reduced sed expelled near burrow
CCBRS-10	D	9/21/2010	16:43	83.4	54.2	0.45	silt-clay	n	y	y	y	y	y	n	n	partially obscured by turbidity; soft mud w/ brittlestars
CCBRS-11	A	9/21/2010	16:56	89.5	59.2	0.53	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ many burrow openings, faint tracks, dense brittlestars
CCBRS-11	B	9/21/2010	16:57	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	water shot/high turbidity
CCBRS-11	D	9/21/2010	16:59	83.4	54.2	0.45	silt-clay	n	y	y	y	y	y	n	n	partially obscured by turbidity; soft mud w/ brittlestars
CCBRS-12	A	9/23/2010	8:32	88.4	58.5	0.52	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrow openings, tracks, dense brittlestars
CCBRS-12	B	9/23/2010	8:33	86.8	57.6	0.50	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrow openings, tracks, dense brittlestars
CCBRS-12	D	9/23/2010	8:34	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	water shot/high turbidity
CCBRS-13	A	9/21/2010	16:13	83.5	55.4	0.46	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrow openings, tracks, dense brittlestars
CCBRS-13	B	9/21/2010	16:14	93.5	62	0.58	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrow openings, tracks, dense brittlestars
CCBRS-13	D	9/21/2010	16:16	93.5	61.9	0.58	silt-clay	n	y	y	n	n	y	y	n	partially obscured; soft mud w/ burrows+dense brittlestars; mud clasts=possible camera disturbance?
CCBRS-14	A	9/21/2010	16:49	88.6	58.7	0.52	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ pits, faint tracks, burrows, numerous brittlestars
CCBRS-14	B	9/21/2010	16:49	90.2	59.7	0.54	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ faint tracks, burrows, numerous brittlestars
CCBRS-14	D	9/21/2010	16:50	73	48.3	0.35	silt-clay	n	ind	ind	ind	y	y	y	n	soft mud w/ many brittlestars; numerous reduced mud clasts+clumps=disturbance by camera frame?
CCBRS-15	A	9/23/2010	8:04	83.1	55.2	0.46	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ several large burrow openings and numerous brittlestars
CCBRS-15	B	9/23/2010	8:05	88.5	58.5	0.52	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ several large burrow openings, tracks and many brittlestars
CCBRS-15	C	9/23/2010	8:06	83.3	55.2	0.46	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ several large burrow openings, tracks, dense brittlestars, and 1 pink shrimp@top of image
NWREF-1	A	9/21/2010	13:23	78.7	52.2	0.41	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, and many brittlestars
NWREF-1	C	9/21/2010	13:26	84.6	56.3	0.48	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ large burrows, tracks, and one brittlestar
NWREF-1	D	9/21/2010	13:28	82.3	53.3	0.44	silt-clay	n	y	y	y	y	y	y	n	partially obscured; soft mud w/ burrows, brittlestars, and reduced mud clasts; clasts from camera frame?
NWREF-2	A	9/21/2010	14:35	84.2	55.9	0.47	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, and many brittlestars
NWREF-2	B	9/21/2010	14:36	82.1	54	0.44	silt-clay	n	y	y	y	y	y	y	n	soft mud w/ burrows, tracks, and many brittlestars; some reduced sed+small mudclasts upper right
NWREF-2	D	9/21/2010	14:38	84.1	55.5	0.47	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, and a few brittlestars
NWREF-3	A	9/21/2010	13:44	80.6	53.3	0.43	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ burrows and tracks; some pits
NWREF-3	B	9/21/2010	13:45	89.8	59.7	0.54	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, and several brittlestars; large burrow w/ organism (lobster?) emerging
NWREF-3	C	9/21/2010	13:46	84.2	55.8	0.47	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, and several brittlestars; large burrow opening w/ organism (seastar?)
NWREF-4	A	9/21/2010	14:53	82.9	54.8	0.45	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, and several brittlestars; tracks are very prominent
NWREF-4	C	9/21/2010	14:55	81.6	53.9	0.44	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, and many brittlestars

Note: ind=indeterminate

APPENDIX D
Plan-View Imaging Results
September 2010

Station	Rep.	Date	Time	Length of image (cm)	Height of image (cm)	Field of View imaged (m^2)	Sediment Type	Bedforms	Infauna	Burrows	Tubes	Tracks	Epifauna	Mudclasts	Debris	Comment
NWREF-4	D	9/21/2010	14:56	91.2	60.5	0.55	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ several large burrows and tracks
NWREF-5	A	9/21/2010	15:08	79.1	52.3	0.41	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ burrows and tracks; depression w/ reduced mud=SPI prism imprint (measures 14 cm across)
NWREF-5	C	9/21/2010	15:10	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	water shot/high turbidity
NWREF-5	D	9/21/2010	15:11	93.3	61.7	0.58	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ a few small burrows, tracks, and numerous brittlestars
NWREF-6	A	9/21/2010	13:33	78.4	51.9	0.41	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, pits and brittlestars
NWREF-6	C	9/21/2010	13:35	94.4	62.5	0.59	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, and many brittlestars
NWREF-6	D	9/21/2010	13:38	83.4	55.2	0.46	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ 2 large burrows, tracks, and many brittlestars
NWREF-7	A	9/21/2010	14:09	70.3	46.6	0.33	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, and 1 brittlestar
NWREF-7	B	9/21/2010	14:10	83.9	55.5	0.47	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, and many brittlestars
NWREF-7	D	9/21/2010	14:12	88.1	58.2	0.51	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, and many brittlestars
NWREF-8	A	9/21/2010	14:26	78.7	52.2	0.41	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, and many brittlestars
NWREF-8	B	9/21/2010	14:28	85.6	56.6	0.48	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, pits, and many brittlestars
NWREF-8	D	9/21/2010	14:30	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	water shot/high turbidity
NWREF-9	A	9/21/2010	15:25	84.5	55.9	0.47	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, and dense brittlestars
NWREF-9	B	9/21/2010	15:26	86.8	57.4	0.50	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, and dense brittlestars
NWREF-9	C	9/21/2010	15:27	89.5	59.3	0.53	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, and several brittlestars
NWREF-10	A	9/21/2010	13:53	81.1	53.7	0.44	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, and dense brittlestars
NWREF-10	B	9/21/2010	13:54	84.9	55.9	0.47	silt-clay	n	y	y	y	y	y	y	n	soft mud w/ burrows, tracks, and several brittlestars; reduced mud clasts+mud clumps=camera artifacts?; 1 seastar lwr right
NWREF-10	D	9/21/2010	13:56	91.1	60.2	0.55	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ burrows, tracks, and pits
NWREF-11	A	9/21/2010	15:00	90.2	59.8	0.54	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, and many brittlestars
NWREF-11	B	9/21/2010	15:01	82.4	54.7	0.45	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, and dense brittlestars; 1 or 2 pink shrimp
NWREF-11	C	9/21/2010	15:02	87.3	57.7	0.50	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, and many brittlestars; 2 pink shrimp
NWREF-12	A	9/21/2010	15:17	79.1	52.4	0.41	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, and several brittlestars
NWREF-12	B	9/21/2010	15:18	80.1	53.1	0.43	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, and dense brittlestars
NWREF-12	C	9/21/2010	15:19	93	61.7	0.57	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, and many brittlestars
NWREF-13	A	9/21/2010	14:16	81.1	53.8	0.44	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, pits, tracks, and many brittlestars
NWREF-13	B	9/21/2010	14:18	94.7	62.7	0.59	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, and a few brittlestars
NWREF-13	D	9/21/2010	14:20	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	water shot/high turbidity
NWREF-14	A	9/21/2010	14:01	81.2	54	0.44	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, pits and one brittlestar
NWREF-14	B	9/21/2010	14:03	86.4	57.4	0.50	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ burrows, tracks, and pits
NWREF-14	C	9/21/2010	14:03	85.2	56.6	0.48	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ burrows, tracks, and pits; tracks associated with burrow opening
NWREF-15	A	9/21/2010	14:45	95.1	63.1	0.60	silt-clay	n	y	y	y	y	n	n	n	fuzzy image; looks like soft mud w/ burrows, tracks, and pits
NWREF-15	B	9/21/2010	14:46	95.2	63	0.60	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ burrows, tracks, pits, and several brittlestars
NWREF-15	D	9/21/2010	14:48	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	image very fuzzy from turbidity; most likely soft mud
SWREF-1	A	9/21/2010	10:00	93.5	62	0.58	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ burrows, tracks, and pits
SWREF-1	B	9/21/2010	10:01	88.1	58.5	0.52	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, pits, and 1 small pink org
SWREF-1	D	9/21/2010	10:03	88.9	58.8	0.52	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ burrows, tracks, and pits
SWREF-2	A	9/21/2010	13:00	95.4	63.2	0.60	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ burrows, tracks, and pits
SWREF-2	B	9/21/2010	13:00	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	water shot/high turbidity
SWREF-2	C	9/21/2010	13:01	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	water shot/high turbidity
SWREF-3	A	9/21/2010	10:22	85.6	56.7	0.49	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, and pits; a few small fish and burrowing anemones
SWREF-3	C	9/21/2010	10:24	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	image too fuzzy to analyze due to high turbidity
SWREF-3	D	9/21/2010	10:25	85.8	56.8	0.49	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, pits, and one small pink epifaunal org near burrow opening
SWREF-4	A	9/21/2010	11:03	95.5	63.4	0.61	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ burrows, tracks, and pits
SWREF-4	B	9/21/2010	11:04	95.2	63.1	0.60	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ burrows, tracks, and pits
SWREF-4	C	9/21/2010	11:05	92.9	59.9	0.56	silt-clay	n	y	y	y	y	y	n	n	partially obscured by turbidity; soft mud w/ burrows, tracks, and pits; pink shrimp in upper right corner
SWREF-5	A	9/21/2010	11:26	96	63.7	0.61	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ burrows, tracks, and pits
SWREF-5	B	9/21/2010	11:27	82.6	54.7	0.45	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, and pits; 1-2 small pink epifaunal orgs
SWREF-5	C	9/21/2010	11:28	89.3	59	0.53	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, and pits; 1-2 small pink epifaunal orgs
SWREF-6	A	9/21/2010	11:19	85.6	56.5	0.48	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, and pits; 1-2 small pink epifaunal orgs

Note: ind=indeterminate

APPENDIX D
Plan-View Imaging Results
September 2010

Station	Rep.	Date	Time	Length of image (cm)	Height of image (cm)	Field of View imaged (m^2)	Sediment Type	Bedforms	Infauna	Burrows	Tubes	Tracks	Epifauna	Mudclasts	Debris	Comment
SWREF-6	B	9/21/2010	11:20	87	57.6	0.50	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, and pits; 1-2 small pink epifaunal orgs
SWREF-6	D	9/21/2010	11:22	87.2	58	0.51	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, and pits; 1-2 small pink epifaunal orgs
SWREF-7	A	9/21/2010	10:32	88	58.3	0.51	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, and pits; 1-2 small pink epifaunal orgs; 1 pink shrimp
SWREF-7	B	9/21/2010	10:33	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	water shot/high turbidity
SWREF-7	D	9/21/2010	10:35	85.2	56	0.48	silt-clay	n	y	y	ind	y	ind	ind	ind	fuzzy image; looks like soft mud w/ burrows, pits and tracks
SWREF-8	A	9/21/2010	12:53	81.5	53.9	0.44	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, and pits; 1-2 small pink epifaunal orgs
SWREF-8	B	9/21/2010	12:54	90.3	59.8	0.54	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, and pits; a few small pink epifaunal orgs
SWREF-8	C	9/21/2010	12:54	86.9	57.7	0.50	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, and pits; 1-2 small pink epifaunal orgs
SWREF-9	A	9/21/2010	11:11	89	58.7	0.52	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, and pits; a few small pink epifaunal orgs
SWREF-9	B	9/21/2010	11:12	88.8	58.7	0.52	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, and pits; a few small pink epifaunal orgs
SWREF-9	C	9/21/2010	11:13	93.8	62.2	0.58	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, and pits; 1-2 small pink epifaunal orgs
SWREF-10	A	9/21/2010	11:42	79.9	52.7	0.42	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, and pits; 1-2 small pink epifaunal orgs
SWREF-10	B	9/21/2010	11:43	91.5	60.7	0.56	silt-clay	n	y	y	y	y	y	y	n	soft mud w/ burrows, tracks, and pits; 1-2 small pink epifaunal orgs; reduced mud clasts=camera artifact?
SWREF-10	C	9/21/2010	11:44	91.3	60.3	0.55	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ burrows, tracks, and pits
SWREF-11	A	9/21/2010	11:34	81.7	54.1	0.44	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, and pits; 1-2 small pink epifaunal orgs
SWREF-11	C	9/21/2010	11:35	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	water shot/high turbidity
SWREF-11	D	9/21/2010	11:37	89.8	59.4	0.53	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ burrows, tracks, and pits
SWREF-12	A	9/21/2010	10:47	83.3	55.2	0.46	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ burrows, tracks, and pits
SWREF-12	C	9/21/2010	10:48	87.7	57.9	0.51	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, and pits; 1-2 small pink epifaunal orgs
SWREF-12	D	9/21/2010	10:51	81.1	53.5	0.43	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, and pits; algal/plant detritus w/ many pink shrimp; hermit crab; flounder on left
SWREF-13	A	9/21/2010	12:30	86.4	57	0.49	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ burrows, tracks, and pits
SWREF-13	C	9/21/2010	12:32	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	ind	water shot/high turbidity
SWREF-13	D	9/21/2010	12:33	92.6	61.1	0.57	silt-clay	n	y	n	y	y	n	n	n	mud w/ some sand; tracks and pits; debris on far right side
SWREF-14	A	9/21/2010	12:37	90.5	59.8	0.54	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ burrows, tracks, and pits
SWREF-14	C	9/21/2010	12:39	87.4	57.9	0.51	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ burrows, tracks, and pits
SWREF-14	D	9/21/2010	12:40	79.7	52.7	0.42	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, and pits; 1-2 small pink epifaunal orgs
SWREF-15	A	9/21/2010	12:45	83.4	55.2	0.46	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ burrows, tracks, and pits
SWREF-15	C	9/21/2010	12:47	78.8	52.1	0.41	silt-clay	n	y	y	y	y	y	n	n	soft mud w/ burrows, tracks, and pits; 1-2 smalll pinks epifaunal orgs
SWREF-15	D	9/21/2010	12:48	77.3	50.5	0.39	silt-clay	n	y	y	y	y	n	n	n	soft mud w/ burrows, tracks, and pits

Note: ind=indeterminate