Monitoring Cruise at the New London Disposal Site 1992-1998
Volume II
Seawolf Mound

Disposal Area Monitoring System DAMOS

DAMOS
DISPOSAL AREA MONITORING SYSTEM

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13. ABSTRACT **Monitoring surveys of the U.S. Navy Seawolf Mound within the New London Disposal Site (NLDS) were conducted in September 1997 and July 1998. Field operations included data collection of one or more of the following: precision bathymetric surveys, Remote Ecological Monitoring of the Seafloor (REMOTS), sediment-profile surveys, grab sampling of benthic invertebrates, and sediment coring. This report summarizes the disposal and monitoring activities at the Seawolf Disposal Mound from 1995-1998. A companion report, Volume I, covers monitoring conducted at other mounds in the site from 1992-1998.**

The NLDS has been used for on-going disposal throughout the 1990's, including unconfined disposal of suitable sediments, and capped disposal of unsuitable sediments. During 1995-1996, the NLDS received a total barge volume of 877,500 m³ of dredged material generated from three separate projects (Seawolf, Venetian Harbor and Mystic River) in the eastern Long Island Sound region. Disposal resulted in creation of one disposal mound, the U.S. Navy Seawolf Mound, consisting of unsuitable dredged material (Thames River channel and berthing areas, and Mystic River) and suitable cap material (Thames River channel, Venetian Harbor and Mystic River).

Bathymetric surveys, REMOTS data and sediment core data confirmed that the Seawolf Mound was capped with at least 50 cm of suitable dredged material. The Seawolf Mound formed a flat, nearly circular deposit with a diameter of approximately 600 m. After an initial period of consolidation (9 months to 1 year), the mound settled to an average height of 2 m with a small oval apex of 3 m. Across the surface of this mound, a layer (0.5-3 m) of suitable material formed a cap consisting of sandy sediments and gray glacial clays from improvement dredging in the Thames River channel. Based on visual analysis and benthic sampling, recolonization of the fresh dredged material by marine invertebrates proceeded as expected with biological characteristics similar to NLDS reference areas.

Physical and chemical analysis of sediment cores collected in 1997 and 1998 confirmed that the top 50 cm of the mound was chemically consistent with the suitable capping material. There was no evidence of migration or release of contaminants from layers beneath the cap. Only long cores (>2m) clearly penetrated beneath the cap into either ambient sediments or unsuitable material. These results are consistent with the conclusion that the cap is a stable, thick layer that has effectively isolated the unsuitable sediments from the environment of Long Island Sound.

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Volume II
Seawolf Mound

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EXECUTIVE SUMMARY

As part of the Disposal Area Monitoring System (DAMOS) Program, Science Applications International Corporation (SAIC) conducted monitoring surveys of the U.S. Navy Seawolf Mound within the New London Disposal Site (NLDS) in September 1997 and July 1998. Field operations in each survey year included data collection of one or more of the following: precision bathymetric surveys, Remote Ecological Monitoring of the Seafloor (REMOTS®) sediment-profile surveys, grab sampling of benthic invertebrates, and sediment coring. This report summarizes the disposal and monitoring activities at the U.S. Navy Seawolf Disposal Mound from 1995-1998. This information is presented as a single report to provide a clear, concise picture of the use of the Seawolf Mound during this time frame and to synthesize important monitoring information related to this dredged material mound. A companion report, Volume I, covers monitoring conducted at other mounds in the site from 1992-1998.

Since its inception in 1977, the DAMOS Program has investigated dredging and dredged material disposal practices in an effort to minimize adverse physical, chemical, and biological impacts. DAMOS utilizes a flexible, tiered management approach centered on comprehensive environmental monitoring to oversee the placement of sediments at nine open water disposal sites along the coast of New England. Active disposal sites are surveyed on a regular basis to ensure the environmental effects of dredged material deposition on the benthic habitat are localized and temporary.

There has been an active dredged material disposal site near New London since at least 1955. DAMOS monitoring of the New London Disposal Site started in 1977 when the program was established. The New London disposal site has been used for on-going disposal throughout the 1990's, including unconfined disposal of suitable sediments, and capped disposal of unsuitable sediments. During the 1995-1996 disposal season, the NLDS received a total barge volume of 877,500 m^3 of dredged material generated from three separate projects in the eastern Long Island Sound region (Seawolf, Venetian Harbor, Mystic River). Disposal resulted in creation of one disposal mound, the U.S. Navy Seawolf Mound, consisting of unsuitable dredged material (channel, berthing areas and Mystic River) and suitable cap material (Thames River channel, Venetian Harbor and Mystic River).

Bathymetric surveys, REMOTS® data and sediment core data confirmed that the Seawolf Mound was capped with at least 50 cm of suitable dredged material. The Seawolf Mound formed a flat, nearly circular deposit with a diameter of approximately 600 m. After an initial period of consolidation of the fresh dredged material (9 months to 1 year), the mound settled to an average height of 2 m with a small oval apex of 3 m. Across the surface of this mound, a thick layer (0.5-3 m) of suitable material formed a cap consisting of sandy sediments and gray glacial clays from improvement dredging in the Thames River channel. Based on visual analysis and direct sampling of animals in this surface layer, recolonization of the fresh dredged material by marine invertebrates proceeded as expected. The stiff clay

sediments require a longer period to recolonize than harbor silts, but their biological characteristics are very close to the reference areas of NLDS.

Physical and chemical analysis of sediment cores collected in 1997 and 1998 confirmed that the top 50 cm of the mound was chemically consistent with the suitable capping material. There was no evidence of migration or release of contaminants from layers beneath the cap. Only long cores (>2 m) clearly penetrated beneath the cap into either ambient sediments or unsuitable material. These results are consistent with the conclusion that the cap is a stable, thick layer that has effectively isolated the unsuitable sediments from the environment of Long Island Sound.

1.0 INTRODUCTION

This report summarizes disposal and monitoring activities conducted at the Seawolf Mound of the New London Disposal Site (NLDS) from the 1995-1996 dredging season through monitoring in July 1998. This information is presented as a single report to provide a clear, concise picture of use of the Seawolf Mound during this time frame and to include important monitoring information related to this dredged material mound. This is Volume II of a report which covers all monitoring activities at the NLDS from 1992-1998. A companion report (Volume I, SAIC 2001) presented results of activities at all other NLDS mounds during this period.

1.1 Background

Monitoring of the impacts associated with the subaqueous disposal of sediments dredged from harbors, inlets, and bays in the New England region has been overseen by the Disposal Area Monitoring System (DAMOS) Program since its inception in 1977. The goals of the DAMOS Program pertain to detailed investigation and reduction of any adverse physical, chemical, and biological effects on the benthic environment associated with dredged material disposal activities. The activity conducted by DAMOS helps to ensure that the effects of sediment deposition over pre-defined areas of seafloor are local and temporary. A flexible, tiered management protocol is applied in the long-term monitoring of sediment disposal at ten open-water dredged material disposal sites along the coast of New England (Germano et al. 1994).

There has been an active dredged material disposal site near New London since at least 1955. Disposal activity was focused on 19 disposal sites in Long Island Sound (LIS) until the mid-1970s, when the number was reduced to four, including New London (Fredette et al. 1993). The Navy began detailed environmental assessment of the New London site in 1973 (U.S. Navy 1973, 1975). In 1977, the DAMOS Program assumed the monitoring responsibility for active disposal sites in New England including the New London Disposal Site (NLDS) (NUSC 1979; Figure 1-1).

The New London Disposal Site (NLDS) is an active open-water dredged material disposal site located 5.38 km (3.1 nmi) south of Eastern Point, Groton, Connecticut. Centered at 41° 16.306′ N, 72° 04.571′ W (NAD 83), the 3.42 km^2 NLDS has water depths which range from 14 m over the NL-RELIC Mound to 24 m at the southern disposal site boundary.

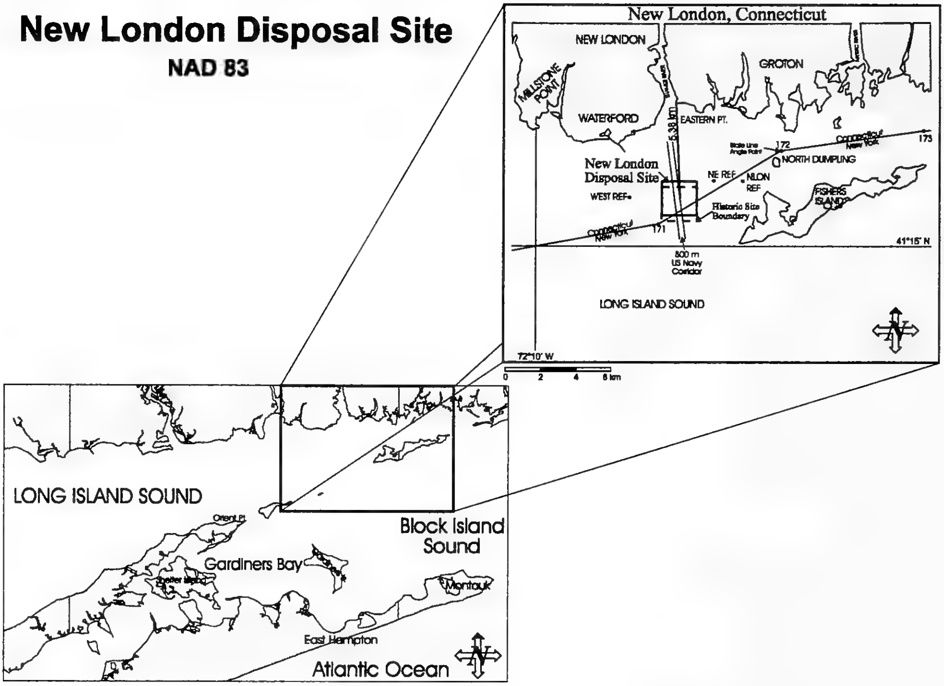


Figure 1-1. Location of the New London Disposal Site

From 1977 to 1992, DAMOS conducted monitoring surveys based on a 1 nmi (nautical mile) square disposal site centered at 41° 16.100' N, 72° 04.600' W (NUSC 1979). In 1982, the Final Programmatic Environmental Impact Statement (FPEIS) for the disposal of dredged material in the LIS region recommended the continued use of the four existing disposal sites in LIS, including New London (USACE 1982). These four sites had been identified prior to the completion of the FPEIS by the Connecticut-New York Interim Plan (NERBC 1980). The Interim Plan identified center coordinates for a slightly different location (0.2 nmi due north of the DAMOS coordinates). As of 1 January 1996, the DAMOS program resolved this discrepancy by adopting the new center coordinates as defined in the Interim Plan as 41° 16.300' N, 72° 04.600' W in North Atlantic Datum 1927 (NAD 27). It is unknown why the original DAMOS center coordinates were not in agreement with the Interim Plan, but no projects were directed to the southern edge of the site during this period, so the change has had no effect on disposal site management or monitoring. This change corrects the slight discrepancy and brings DAMOS into agreement with the FPEIS. Similar changes have been made to the Central Long Island Sound Disposal Site and the Cornfield Shoals Disposal Site.

The location of NLDS intersects with two important management boundaries: a 300 m wide submarine transit corridor; and the New York-Connecticut state boundary (Figure 1-1). The submarine transit corridor has been established to minimize conflict between submarine traffic to, and from, the submarine base in Groton, CT and disposal buoys that may not be seen when submarines transit submerged. The state boundary affects state regulatory authority under the Coastal Zone Management Act (CZMA) and the issuance of state water quality certification for disposal permits (Carey 1998). Under the CZMA, states must concur that disposal activities in their state waters are consistent with their federally approved Coastal Zone Management Plans before permits are issued by the USACE.

The long-term observation of the effects of disposed dredged material is facilitated by the construction of distinct sediment mounds within a disposal site. Development of disposal mounds is achieved by directing barges to predetermined locations typically marked by surface buoys, which have taut-line moorings to maximize position stability. When necessary, mounds are constructed in phases to allow for capping of material deemed unsuitable for open-water disposal. Capping is a subaqueous containment method that utilizes material determined to be suitable for open-water disposal (hereafter referred to as capping dredged material, or CDM) to overlay and isolate deposits of unacceptably-contaminated dredged material (UDM) from the surrounding environment (Fredette 1994).

Recent disposal activity has been located to take advantage of the bottom topography created by historical disposal mounds. Two management objectives have been sought: creation of a "bowl" by placement of mounds in a "ring"; and constraint on the spread of dredged material disposed at the site. The lateral spread of dredged material disposed through the water column is strongly affected by bottom slope (Bokuniewicz et al. 1978). By placement of the taut-wire moored disposal buoys, disposal activity can be directed to specific locations and thereby limit the horizontal spread of material by filling depressions or confining material between adjacent, older mounds. Minimizing lateral spreading of mounds can increase site capacity and reduce the volume of material required for capping. Additionally, in order to reduce the potential effects of bottom currents and storm-generated waves, sediment mounds at the NLDS are developed in a broad, flat manner, maintaining a minimum water depth of 14 meters. This minimum depth also allows for the safe passage of deep draft vessels transiting through the disposal site (NUSC 1979). Presently, there are 10 discernible mounds (NL-95 is merged with the Seawolf Mound) within the boundaries of the disposal site (Figure 1-2).

The Thames River, located in southeastern Connecticut, discharges fresh water and sediment from the interior of eastern Connecticut into Long Island Sound. The mile-wide basin of the lower Thames River and New London Harbor is utilized by military, commercial, and recreational vessels seeking protection from the open waters of Long Island Sound (Figure 1-1). Maintenance dredging of New London Harbor and adjacent coastal areas, overseen by the NAE, is required to insure navigable waterways and adequate dockage for deep draft vessels. Most of the material generated from dredging operations is transported by barge and deposited at the New London Disposal Site (NLDS) in Long Island Sound.

Disposal of dredged material occurred within and around the NLDS area for a number of years before the inception of the DAMOS Program. The formation of the NL-RELIC Mound was a result of dredging and disposal of sediments from the Thames River and New London Harbor prior to 1977 and during the early 1980s (NUSC 1979; SAIC et al. 1985). The area surrounding the NLDS is subject to moderate to high bottom currents (maximum bottom current of 55 $cm \cdot s^{-1}$) relative to other containment disposal sites in Long Island Sound (Waddell et al. 2001). However, the shelter provided by Fisher's Island, the southern fork of Long Island and the Connecticut shoreline, protect the disposal site from the effects of major storm waves. This inference is supported by the fact that historic disposal mounds have remained stable in both height and shape over at least ten years, and in some cases (such as NL-RELIC) twenty years or more (Figure 1-2).

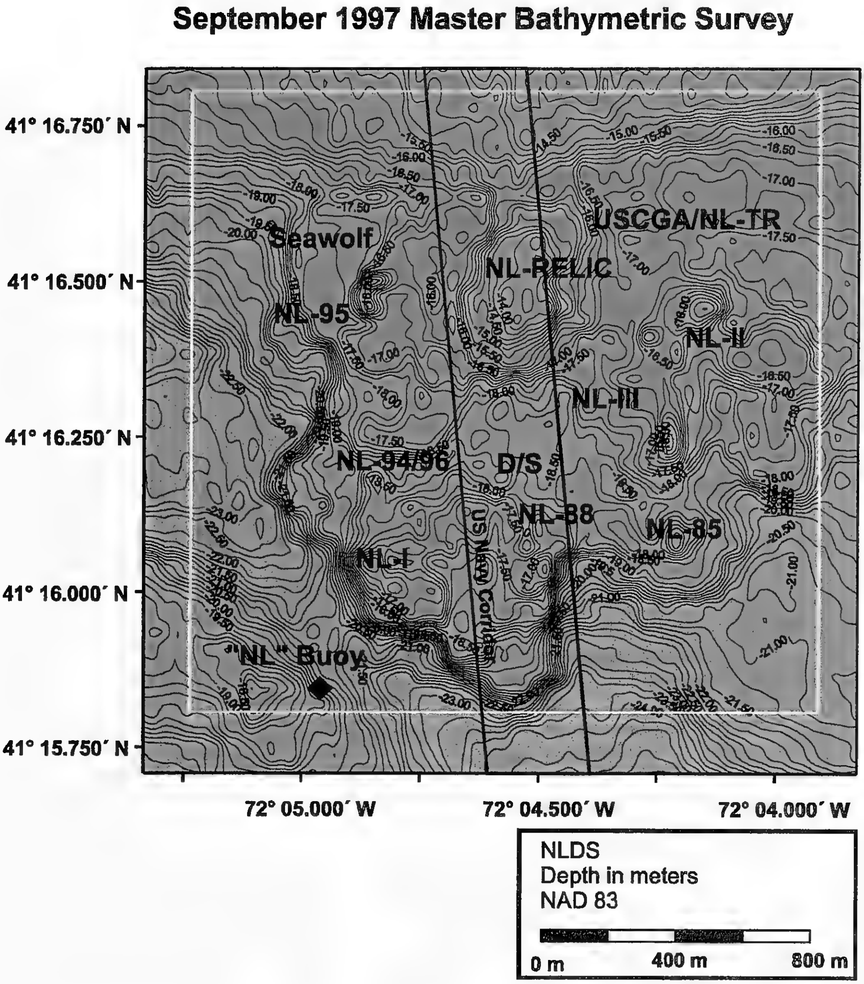


Figure 1-2. Bathymetric chart of New London Disposal Site (contour interval = 0.25 m)

1.2 Seawolf Disposal Mound

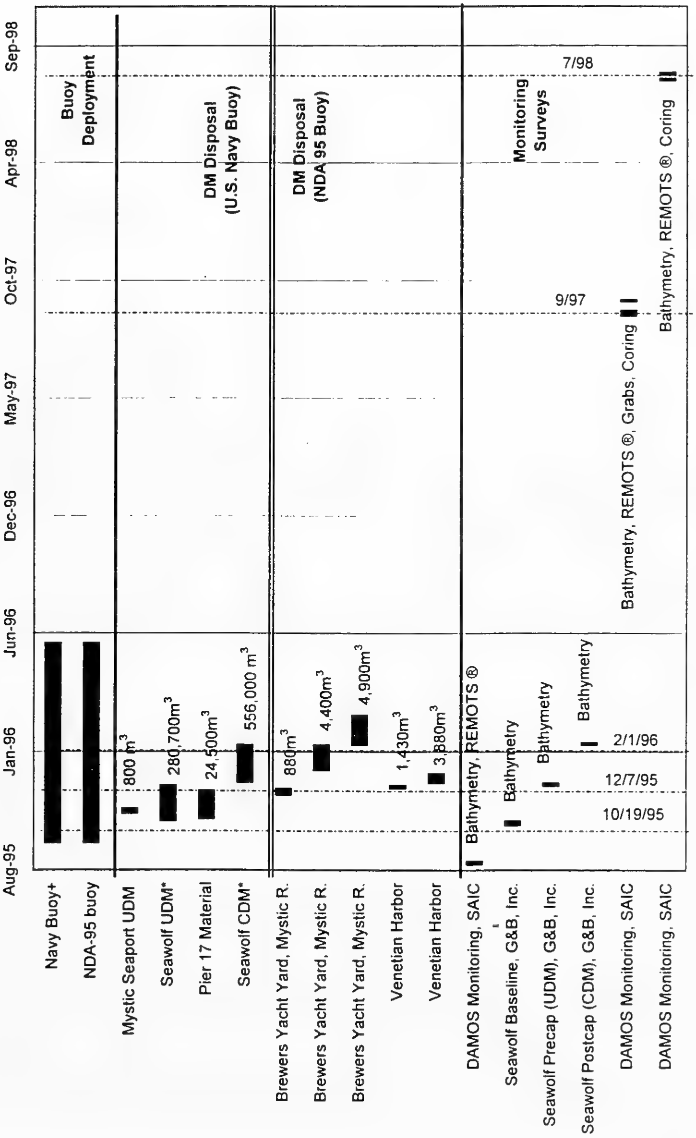
In September 1997, Science Applications International Corporation (SAIC) conducted a master bathymetric survey at the NLDS (Figure 1-2). The master bathymetric survey provides a reference frame for locating the disposal and monitoring activities conducted from 1991-1998. The disposal history of each mound complex has been described in Volume I of this report (SAIC 2001). The disposal history of the U.S. Navy Seawolf Mound is described below, followed by a summary of monitoring activities. A timeline of all activities associated with the Seawolf Mound (Figure 1-3) has been provided to summarize the events; details of the survey methods are provided in Section 2.0.

The September 1997 master bathymetric survey also marked the conversion from the horizontal navigational reference system of the North American Datum of 1927 (NAD 27) to the North American Datum of 1983 (NAD 83) for all future bathymetric surveys conducted at this site (see Methods section).

1.2.1 U.S. Navy Seawolf Disposal Activity

The decision by the U.S. Navy to homeport *Seawolf* class submarines in Groton, CT required deepening of the federal navigation channel and berthing areas in the Thames River to provide safe navigational depth for submerged transit (Maguire Group, 1995). Permits were issued in 1995 to dredge the channel and berthing areas and deposit the materials at NLDS. The work was completed during the 1995-1996 dredging season (September-May). Disposal of maintenance work (material dredged within an authorized depth) and new work (material dredged to a newly authorized depth) resulted in a total estimated disposal volume of 877,500 m^3 of sediments.

The first portion of the project, an approximate barge volume of 305,200 m^3 of UDM originating primarily from the New London Naval Submarine Base (Piers 8, 10 [and 17 under a separate permit]) and the Thames River navigational channel (a 1.92 km reach north of I-95 bridge), was deposited at a temporary buoy labeled "Navy" deployed by the U.S. Navy at 41° 16.506′ N, 72° 04.797′ W (41° 16.500′ N, 72° 04.826′ W, NAD 27). In addition, 800 m^3 of UDM from a separate project in the Mystic River (Mystic Seaport) was disposed at the Navy buoy prior to capping operations (Figure 1-3). Following the placement of UDM, capping operations began. Between 8 December 1995 and 31 January 1996, an estimated barge volume of 556,000 m^3 of CDM dredged from the Thames River channel was placed over the Seawolf Mound area, yielding a 1.82 to 1.0 CDM to UDM ratio.



- \+ Navy buoy deployment and retrieval times estimated.
- * Seawolf UDM and CDM refer to material from the Naval Submarine Base and the Thames River

Figure 1-3. Timeline of disposal and monitoring activity

In September 1995, the NDA 95 buoy was deployed at 41° 16.402′ N, 72° 04.905′ W (41° 16.396′ N, 72° 04.934′ W, NAD 27), approximately 245 m southwest of the central disposal point for the Seawolf Mound. DAMOS disposal logs indicated a total estimated barge volume of 10,590 m^3 of sediments determined to be suitable for unconfined open-water disposal was deposited at the NDA 95 buoy; this material was dredged from Venetian Harbor and Mystic River in southeastern Connecticut and disposed at the site between 25 November 1995 through 11 March 1996 (Figure 1-3 and Appendix A). The resulting dredged material deposit overlapped the Seawolf Mound. After postcapping surveys conducted in February 1996 (see below), a small volume of CDM sediment (4,900 m^3) from Mystic River was placed near NDA 95 through 11 March 1996.

Pre-dredging characterization of the Seawolf Project sediments detected elevated levels of polycyclic aromatic hydrocarbons (PAHs) and trace metals (Cu, Cr, and Zn) in a small area adjacent to the proposed submarine berthing areas (Maguire Group 1995). These contaminants were found in low (Class I) to moderate (Class II) concentrations (NERBC 1980) and were attributed to storage and maintenance of vessels in the area (Maguire Group 1995). A fraction of these Seawolf Project sediments with elevated contaminant levels were classified as UDM based on biological testing. In addition, a small volume of the Mystic River sediments from Mystic Seaport was also classified as UDM. The unacceptably contaminated sediments from these projects required a comprehensive disposal site monitoring program to insure adequate coverage of CDM to isolate the UDM from the marine environment. The monitoring program included baseline, precapping, and postcapping surveys to ensure the proper placement of UDM and adequate coverage with CDM (Figure 1-3).

Several bathymetric surveys were sponsored by the U.S. Navy during the 1995-1996 disposal season to track post-depositional changes in the Seawolf Disposal Mound (Table 1-1). A summary of these earlier monitoring efforts conducted under contract to the Navy by Gahagan and Bryant, Inc. of Baltimore, MD is included in the Results section of this report. SAIC conducted surveys at the Seawolf Mound in 1997 and 1998 through the DAMOS Program to meet technical and management objectives of the U.S. Navy monitoring plan (Maguire Group 1995). Bathymetric surveys were conducted to document the changes in bottom topography due to dredged material disposal (Table 1-1). Sediment profile imaging was used to assess the benthic recolonization status of the Seawolf Mound relative to three reference areas surrounding NLDS. Sediment grab samples were collected to examine the benthic infaunal species diversity and relative abundance over the surface of the Seawolf Mound. Finally, cores were collected at the mound to assess the physical and chemical composition of the deposited sediments and to determine the thickness of the cap material layer.

Table 1-1
Time series of Bathymetric Surveys over the Seawolf Mound

Survey Date	Description	Conducted by:
October 1995	Baseline	Gahagan and Bryant, Inc.
December 1995	Precap (UDM)	Gahagan and Bryant, Inc.
February 1996	Postcap (CDM)	Gahagan and Bryant, Inc.
September 1997	1.5 yr. after Postcap	SAIC
July 1998	2.4 yr. after Postcap	SAIC

1.3 Monitoring Activity

1.3.1 September 1997 Monitoring Survey

The September 1997 field effort consisted of a 1000 × 1000 m bathymetric survey, Remote Ecological Monitoring of the Seafloor (REMOTS®) sediment-profile photography, benthic grab sampling, and sediment coring over the Seawolf Mound. The specific objectives of the 1997 monitoring survey over the New London Disposal Site and the Seawolf Mound were to:

- Use sediment profile photography to assess the benthic recolonization status of the Seawolf Mound relative to the three reference areas surrounding NLDS;
- Collect cores along cross-sections of the Seawolf Disposal Mound to characterize the physical and chemical composition of the sediments and to verify the presence of at least 50 cm of cap material;
- Examine the benthic infaunal species diversity and relative abundance over the surface of the Seawolf Mound through analysis of six sediment grab samples;
- Perform a detailed master bathymetric survey of the region surrounding NLDS as defined by the 1982 FPEIS; and
- Document and delineate any changes in bottom topography (accumulation and consolidation) in the areas of concentrated disposal since August 1995.

Analyses of data collected during the September 1997 field effort at NLDS were used to test several hypotheses consistent with the DAMOS Tiered Monitoring Protocols (Germano et al. 1994). First, it was hypothesized that the past two years of disposal activity at NLDS had resulted in the formation of a broad, flat sediment mound encompassing material deposited at both the US NAVY and NDA 95 buoys. Second, a Stage I to II benthic infaunal community was expected over the majority of the Seawolf Mound, with some progression into Stage III on the mound periphery. Third, contaminant levels in the top 50 cm of the mound were predicted to be consistent with CDM material.

1.3.2 July 1998 Monitoring Survey

Field operations at the NLDS in July 1998 consisted of a 1000 × 1000 m bathymetric survey, REMOTS® sediment-profile photography, and sediment coring over the Seawolf Mound. These surveys repeated those conducted in 1997.

The objectives of the 1998 monitoring surveys were to:

- Document and delineate any changes in bottom topography over the Seawolf Mound since September 1997;
- Collect cores along cross-sections of the Seawolf Mound to continue characterizing the physical and chemical composition of the sediments and verify the presence of at least 50 cm of cap material; and
- Assess the benthic recolonization status of the Seawolf Mound relative to the three reference areas surrounding the NLDS and to the 1997 survey.

Analyses of data collected during the July 1998 field effort at the NLDS were used to test several hypotheses consistent with the DAMOS Tiered Monitoring Protocols (Germano et al. 1994). First, it was hypothesized that consolidation over the Seawolf Mound would decrease relative to that observed during the first year and a half after the postcap survey. Second, geochemical analysis was predicted to show an absence of UDM in the top 50 cm of the mound based on contaminant levels consistent with CDM material. Third, healthy benthic assemblages with Stage III individuals were expected over the Seawolf Mound.

2.0 METHODS

Upon completion of the UDM and CDM placement activities during the 1995-1996 disposal seasons, the DAMOS Program with funding from the Navy, implemented the long-term monitoring of the capped Seawolf Mound. The environmental monitoring surveys presented in this report were performed in September 1997 and July 1998 order to document cap integrity, disposal mound consolidation, and benthic recolonization over the Seawolf Mound.

Precision bathymetry and REMOTS® sediment-profile photography have been employed as standard tools for tracking the placement of dredged material, examining long term fate of individual sediment deposits, and assessing biological conditions over a disposal mound relative to nearby reference areas. These methods were developed in the context of a rigorous tiered monitoring approach (Germano et al. 1994). Sediment sampling (grab sampling and vibracoring) also was utilized to examine benthic infaunal species diversity and cap integrity, over the Seawolf Mound in the surveys conducted in September 1997 and July 1998 (Table 2-1).

2.1 Bathymetry and Navigation

2.1.1 1997 and 1998 Survey Activity

During both the 1997 and 1998 field efforts, SAIC's Portable Integrated Navigation and Survey System (PINSS) was used for precision navigation and data acquisition. This system utilizes a Toshiba® 3200DX series computer to provide real-time navigation, as well as collect position, depth, and time data for later analysis. In addition, PINSS provides a helm-display and a project database, which stored planned bathymetric survey lines, as well as multiple station locations to facilitate point sampling (i.e., REMOTS®, grabs, and cores).

Positioning information for the field efforts over the Seawolf Mound was obtained via differentially corrected Global Position System (DGPS) data in the horizontal control of North American Datum of 1983 (NAD 83). In 1997, a Magnavox MX4200D GPS receiver was used to provide real-time positioning while a Trimble 4000 GPS receiver was used during the 1998 field effort. In both instances, the GPS receivers were interfaced with a Leica MX41R differential beacon receiver to improve the overall accuracy of the positioning data. Signals broadcast from the U.S. Coast Guard differential beacon at Montauk Point, New York (293 kHz) were utilized for satellite corrections due to its geographic position relative to NLDS. When merged with the satellite data, the correctors provide DGPS positions to an accuracy of ±3 m with an update rate of 1 Hz.

Table 2-1.
Summary of Survey activity performed over the Seawolf Disposal Mound in 1997 and 1998.

YEAR	AREA	NUMBER OF STATIONS	PATTERN
1997			
Bathymetry	2100 × 2100 m Master Bathymetric Survey (NAD 83)		25-m lane spacing
	1000 × 1000 m Bathymetric Survey over the Seawolf Mound (NAD 83)		25-m lane spacing
REMOTS® Sediment Profile Photography	Seawolf Mound	29	Radial (8 Arm)
	W-REF	4	Random
	NE-REF	5	Random
	NLON-REF	4	Random
Vibracores	Seawolf Mound	12	
	WEST REF	1	
Grab Sampling	Seawolf Mound	6	
1998			
Bathymetry	1000 × 1000 m (NAD 83)		25-m lane spacing
REMOTS® Sediment Profile Photography	Seawolf Mound	29	Radial (8 Arm)
	W-REF	4	Random
	NE-REF	5	Random
	NLON-REF	4	Random
Vibracores	Seawolf Mound	12	
	WEST REF	1	

In accordance with the bathymetric surveys performed by Gahagan and Bryant Associates, a 1000 × 1000 m bathymetric survey grid, centered on the reported position of the US Navy disposal buoy (41° 16.506′ N, 72° 04.797′ W), was established over the northwest quadrant of NLDS (Figure 2-1). A total of 41 lanes, oriented north-south with a 25 m lane spacing, were occupied during the September 1997 and July 1998 field operations to confirm disposal mound stability and quantify mound consolidation.

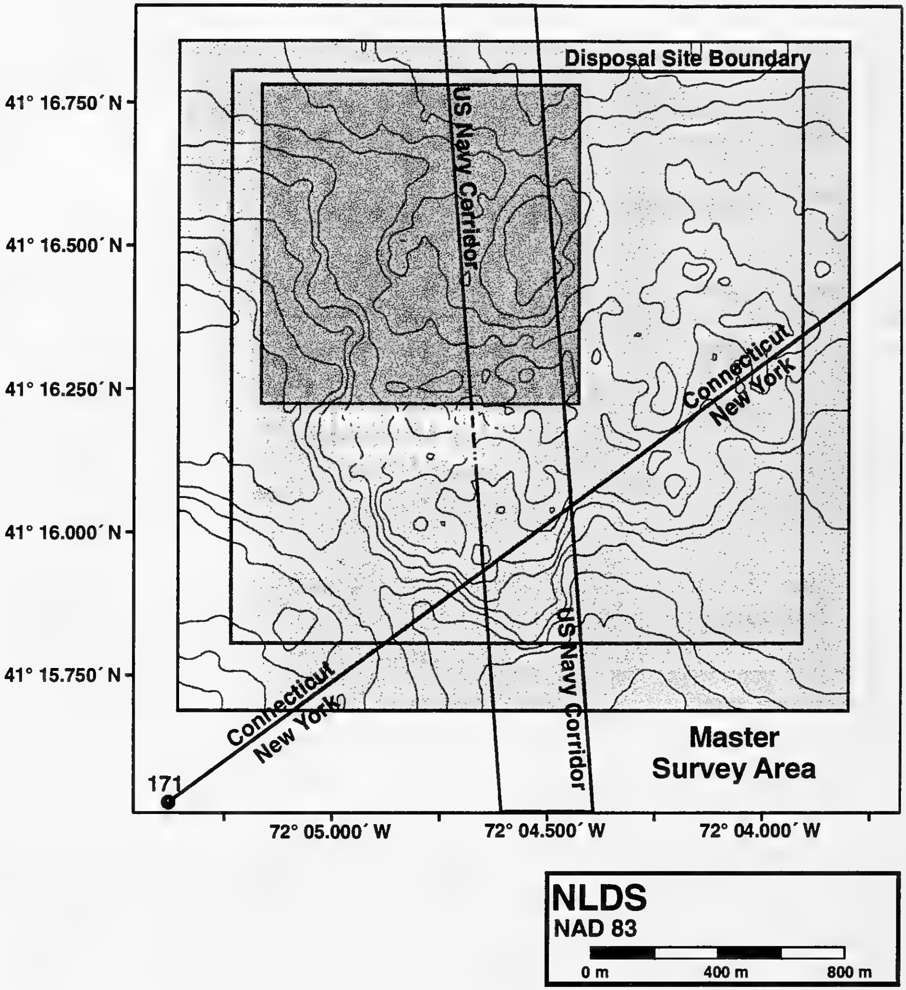
2.1.2 Bathymetric Data Collection

During the 1997 and 1998 bathymetric surveys, an ODOM DF3200 Echotrac® Survey Fathometer equipped with a narrow beam, 208 kHz transducer was used to measure individual depths to a vertical resolution of 3.0 cm (0.1 ft; Murray and Selvitelli 1996). The fathometer was interfaced directly with the navigation system. Depth soundings were collected along each of the 41 survey lanes established over the Seawolf project area. The depth soundings collected by the Odom fathometer were adjusted for transducer depth and transmitted to PINSS at a frequency of 10 Hz. The soundings were averaged by PINSS, merged with positional and time information, and recorded at a frequency of 1 Hz. Survey vessel speed and course were tightly controlled (2 to 3 meters per second) to ensure adequate numbers of depth values collected along the survey lane.

A Seabird Instruments, Inc. SEACAT SBE 19-01 Conductivity, Temperature, and Depth (CTD) probe was used to obtain sound velocity measurements at the start, midpoint, and end of each survey day. The data collected by the CTD probe were bin-averaged to 1 meter depth intervals to account for any pycnoclines, rapid changes in density that create distinct layers within the water column. Sound velocity correction factors were then calculated using the bin-averaged values.

2.1.3 Bathymetric Data Processing

During data analysis, the raw bathymetric data from PINSS were corrected for changes in tidal height and sound velocity. Tidal height corrections were based on the observed National Oceanic and Atmospheric Administration (NOAA) data for the New London, Connecticut tidal station. Six-minute observed tidal data obtained via NOAA's Ocean and Lake Levels Division's National Water Level Observation Network were utilized for the surveys performed over NLDS.



September 1997 Bathymetric Survey Area

Figure 2-1. Location of the bathymetric survey area over the Seawolf Mound relative to the disposal site boundaries, US Navy submarine lane, and New York-Connecticut State Line.

Observed tide data are downloaded through the Internet in a station datum or referenced to Mean Lower Low Water (MLLW) and based on Coordinated Universal Time. For the 1997 and 1998 surveys over the Seawolf Mound, data from NOAA tide station 8461490 in New London Harbor, New London, Connecticut were downloaded in the MLLW and corrected for local time. Tide differences based on the entrance to West Harbor, Fishers Island, New York were applied to the observed data.

The bathymetric data were analyzed using SAIC's Hydrographic Data Analysis System (HDAS), version 1.03. Raw bathymetric data were imported into HDAS, corrected for sound velocity, and standardized to MLLW using the NOAA observed tides. The bathymetric data were then processed to produce depth models of the survey area. A model is a depth matrix used to generate graphical representations of the survey area (i.e., three-dimensional plots and depth contours). A detailed discussion of the bathymetric analysis technique is provided in the DAMOS Navigation and Bathymetry Standard Operating Procedures (Murray and Selvitelli, 1996).

The depth models constructed for each survey performed over the Seawolf Disposal Mound were subjected to depth difference routines in HDAS to document the formation and consolidation of the bottom feature over time. The end result of each depth difference comparison was a graphical representation of the disposal mound or changes in mound morphology. However, due to a variety of factors (tidal corrections, changes in sound velocity through the water column, slope of the bottom, and vertical motion of the survey vessel) comparisons of sequential bathymetric surveys can only reliably detect changes in depth of 20 cm or greater. These factors often introduce artifacts that may appear to be small areas of depth increase or decrease. As a result, the lateral extent of a disposal mound or apron is often below the threshold of the bathymetric data products. Other monitoring techniques are often employed to define the thinner margins of the disposal mound (i.e., sediment-profile photography).

2.2 Sediment Profile Photography

REMOTS® sediment-profile photography is a benthic sampling technique used to detect and map the distribution of thin (<20 cm) dredged material layers, map benthic disturbance gradients, and monitor the process of benthic recolonization over the disposal mound. This is a reconnaissance survey technique used for rapid collection, interpretation and mapping of data on physical and biological seafloor characteristics. REMOTS® utilizes a Benthos Model 3731 Sediment-Profile Camera, designed to obtain undisturbed, vertical cross-section photographs (*in situ* profiles) of the upper 15 to 20 cm of the seafloor, for analysis and interpretation.

The REMOTS® hardware consists of a wedge-shaped optical prism having a standard 35mm-camera mounted horizontally above in a watertight housing (Figure 2-2). The prism resembles an inverted periscope, with a clear Plexiglas window measuring 15 cm wide and 20 cm high and an internal mirror mounted at a 45° angle to reflect the image in the window up to the camera. Light is provided by an internal strobe that resides within the optical prism. In order to equalize pressure and reduce refraction, the prism is filled with distilled water. The prism sits inside a stainless steel external frame, and the entire assembly is lowered to the seafloor using a standard winch mounted aboard the survey vessel. Upon contact with the bottom, the prism descends slowly into the seafloor, cutting a vertical cross-section profile of the upper 15 to 20 cm of sediment, and a photograph is taken of the sediment in contact with the window. The resulting 35-mm slides (images) showing relatively undisturbed sediment profiles are then analyzed for a standard suite of measured parameters (Rhoads and Germano 1982; 1986).

Computer-aided analysis of each REMOTS® sediment profile image yields a series of measurements. The standard measured parameters include sediment grain size major mode, camera prism penetration depth (an indirect measure of sediment bearing capacity/density), small-scale surface boundary roughness, depth of the apparent redox potential discontinuity (RPD), infaunal successional stage, and Organism-Sediment Index (a summary parameter reflecting the overall benthic habitat quality). A detailed description of REMOTS® photograph acquisition and interpretive rationale is given in DAMOS Contribution No. 60 (Parker and Revelas 1989), as well as in Rhoads and Germano (1982; 1986). The following paragraphs provide brief descriptions of the interpretive framework and methods used for the various measurement parameters.

The sediment grain size major mode values are visually estimated from the REMOTS® photographs by overlaying a grain size comparator that is at the same scale. For REMOTS® analysis, sediment grain size major mode is expressed in phi units. This measurement represents the dominant grain size in the entire frame (field of view) and may not distinguish layers of coarser or finer material. A grain size scale for sediments has been provided in Table 2-2, to allow easy conversion between phi units, millimeters, and standard sieve sizes.

The REMOTS sediment profile camera consists of an optical prism, which penetrates the bottom under a static driving force imparted by its own weight. The penetration depth into the bottom depends on the force exerted by the optical prism and the

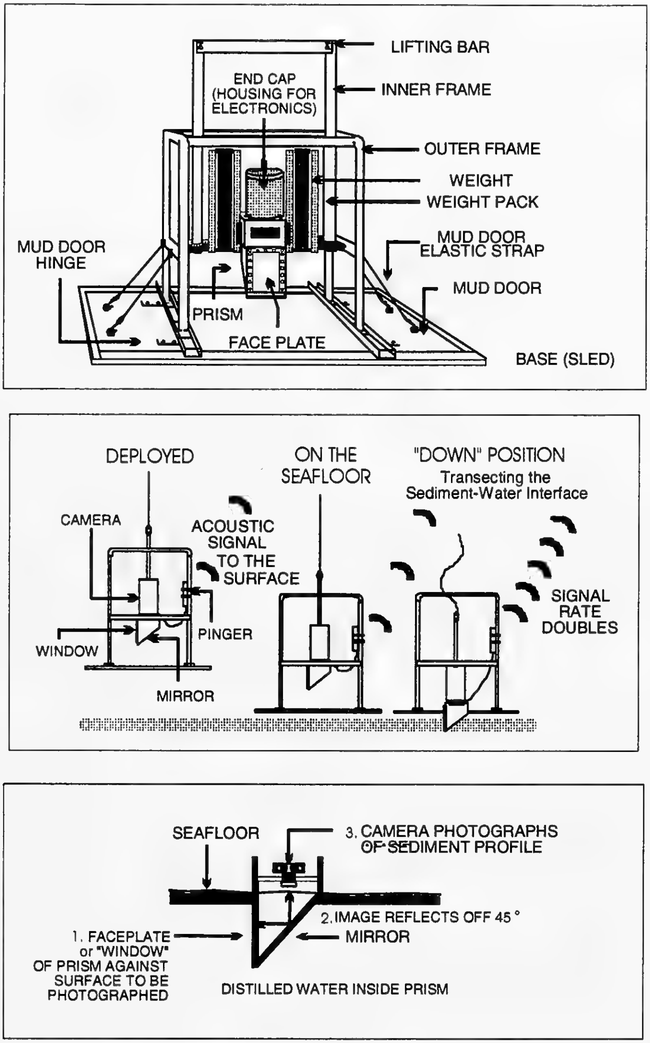


Figure 2-2. Schematic diagram of Benthos, Inc. Model 3731 REMOTS® sediment-profile camera and sequence of operation on deployment.

Table 2-2. Grain Size Scales for Sediments

ASTM (Unified) Classification[1]	U.S. Std. Sieve[2]	Size in mm	Phi (Φ) Size	Wentworth Classification[3]
Boulder		4096.	-12.0	Boulder
		1024.	-10.0	
	12 in (300 mm)	256.	-8.0	
Cobble		128.	-7.0	Large Cobble
		107.64	-6.75	Small Cobble
		90.51	-6.5	
	3 in (75mm)	76.11	-6.25	
		64.00	-6.0	
Coarse Gravel		53.82	-5.75	Very Large Pebble
		45.26	-5.5	
		38.05	-5.25	
		32.00	-5.0	
		26.91	-4.75	Large Pebble
		22.63	-4.5	
	3/4 in (19 mm)	19.03	-4.25	
		16.00	-4.0	
Fine Gravel		13.45	-3.75	
		11.31	-3.5	Medium Pebble
		9.51	-3.25	
	2.5	8.00	-3.0	
	3	6.73	-2.75	
	3.5	5.66	-2.5	Small Pebble
	4 (4.75 mm)	4.76	-2.25	
	5	4.00	-2.0	
Coarse Sand	6	3.36	-1.75	
	7	2.83	-1.5	Granule
	8	2.38	-1.25	
	10 (2.0 mm)	2.00	-1.0	
	12	1.68	-0.75	
Medium Sand	14	1.41	-0.5	Very Coarse Sand
	16	1.19	-0.25	
	18	1.00	0.0	
	20	0.84	0.25	
	25	0.71	0.5	
	30	0.59	0.75	Coarse Sand
	35	0.50	1.0	
	40 (0.425 mm)	0.420	1.25	
	45	0.354	1.5	
	50	0.297	1.75	Medium Sand
Fine Sand	60	0.250	2.0	
	70	0.210	2.25	
	80	0.177	2.5	
	100	0.149	2.75	Fine Sand
	120	0.125	3.0	
	140	0.105	3.25	
	170	0.088	3.5	
	200 (0.075 mm)	0.074	3.75	Very Fine Sand
	230	0.0625	4.0	
	270	0.0526	4.25	
Fine-grained Soil: Clay if PI ³ 4 and plot of PI vs. LL* is on or above "A" line Silt if PI < 4 and plot of PI vs. LL* is below "A" line * and the presence of organic matter does not influence LL.	325	0.0442	4.5	
	400	0.0372	4.75	
		0.0312	5.0	Coarse Silt
		0.0156	6.0	
		0.0078	7.0	
		0.0039	8.0	
		0.00195	9.0	Medium Silt
		0.00098	10.0	Fine Silt
		0.00049	11.0	Very Fine Silt
		0.00024	12.0	Coarse Clay
		0.00012	13.0	Medium Clay
		0.000061	14.0	Fine Clay

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

bearing strength of the sediment. If the weight of the camera prism is held constant, the change in penetration depth over a surveyed site will reflect changes in geotechnical properties of the bottom. In this sense, the camera prism acts as a static-load penetrometer. The depth of penetration of the optical prism into the bottom can be a useful parameter, because dredged and capped materials often will have different shear strengths and bearing capacities.

Small-scale surface boundary roughness is the amount of surface relief at the sediment-water interface, and is calculated by measuring the vertical distance between the high and low points of the interface in each sediment-profile photograph. Boundary roughness can be categorized as biological, physical, or indeterminate. Biological disturbances, typically the result of macrofaunal activity, usually result in only a small increase is boundary roughness (<1 cm). A mature and undisturbed benthic environment tends to have biological boundary roughness. Physical disturbances can be anthropogenic in origin (for example, by bottom trawling or dredged material disposal) or attributed to natural processes such as wave and current motion.

The Apparent Redox Potential Discontinuity (RPD) depth is the boundary between oxygenated sediment and the underlying hypoxic or anoxic sediment. The RPD depth is a sensitive indicator of the biological mixing depth, infaunal successional status, and within-station patchiness (Revelas et al. 1987). The RPD is determined by measuring the thickness of the high reflectance sediment layer at the sediment-water interface formed by light-colored oxygenated or oxidized sediment.

Successional stage mapping is based upon the hypothesis that organism-sediment interactions follow a predictable successional sequence after a major seafloor disturbance (Rhoads and Germano 1986). A disturbance can be any type of event that induces seafloor erosion, changes seafloor chemistry, or causes major reorganization of the resident benthos. These perturbations can be natural events (i.e., strong currents or a passing storm) or anthropogenic events (i.e., dredged material disposal or power plant effluent).

Pioneering assemblages (Stage I) usually consist of dense aggregations of near-surface living, tube-dwelling polychaetes. These organisms begin to populate a sediment deposit within days of a benthic disturbance, as they readily exploit the competition-free space. Due to their limited interaction with the sediment, these organisms are usually associated with a shallow RPD.

In more stable environments Stage I assemblages are replaced by infaunal deposit feeders or larger tube dwellers (Stage II). Typical Stage II organisms in Long Island Sound include shallow-dwelling bivalves and tubicolous amphipods. In general, tubicolous amphipods are common in eastern Long Island Sound. The presence of dense aggregations of these amphipods (*Ampelisca* sp.) in the area surrounding NLDS has been identified as a cyclical phenomenon as the spring-summer and over-winter populations mature, reproduce, and decline. As a result, the timing of the individual REMOTS® surveys over the years have documented the amphipod populations in eastern Long Island Sound during different stages of the life cycle.

Stage III biota represent a high-order successional stage and are usually associated with areas of seafloor that are not usually subject to surface disturbances. Stage III assemblages (infaunal invertebrates) are typically head-down deposit feeders whose feeding behavior usually results in distinctive subsurface voids. The foraging activities of Stage III organisms are capable of introducing oxygen-rich bottom water to the sediment at depths approaching 10-20 cm below the sediment-water interface. As a result, the bioturbational activity of Stage III organisms tends to cause the deepening of the RPD.

A multi-parameter REMOTS® Organism-Sediment Index (OSI) has been constructed to characterize habitat quality (Table 2-3). Habitat quality is defined relative to two end-member standards. The lowest value is given to those sediments that have low or no dissolved oxygen in the overlying bottom water, very shallow RPD depth, no apparent macrofaunal life, and methane gas present in the sediment. The REMOTS® OSI value for such a condition is minus 10 (-10). At the other end of the scale, an aerobic bottom with a deep RPD, evidence of a mature macrofaunal assemblage, and no apparent methane gas bubbles at depth will have an OSI value of plus 11 (+11). OSI values of +6 or less are indicative of chronically stressed benthic habitats and/or those that have experienced recent disturbance (i.e., erosion, sediment transport, dredged material disposal, hypoxia, intense demersal predator foraging, etc.; Rhoads and Germano 1982).

2.2.1 Seawolf Disposal Mound

The Seawolf Mound was first examined with the use of sediment-profile photography in September 1997. A 29-station REMOTS® sampling grid centered at 41°16.456′ N, 72°04.863′ W was established over the disposal mound, based on the reported size and morphology of the bottom feature upon completion of capping operations. Four stations were established at distances of 75 m, 150 m, 300 m, and 450 m along each of seven arms radiating from the center station (Figure 2-3; Table 2-4). The follow-on survey performed in July 1998 occupied the same station grid to facilitate comparisons with the 1997 data set.

Table 2-3
Calculation of REMOTS® Organism Sediment Index Value

A. CHOOSE ONE VALUE:

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

B. CHOOSE ONE VALUE:

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

C. CHOOSE ONE OR BOTH IF APPROPRIATE:

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

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

RANGE: -10 - +11

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

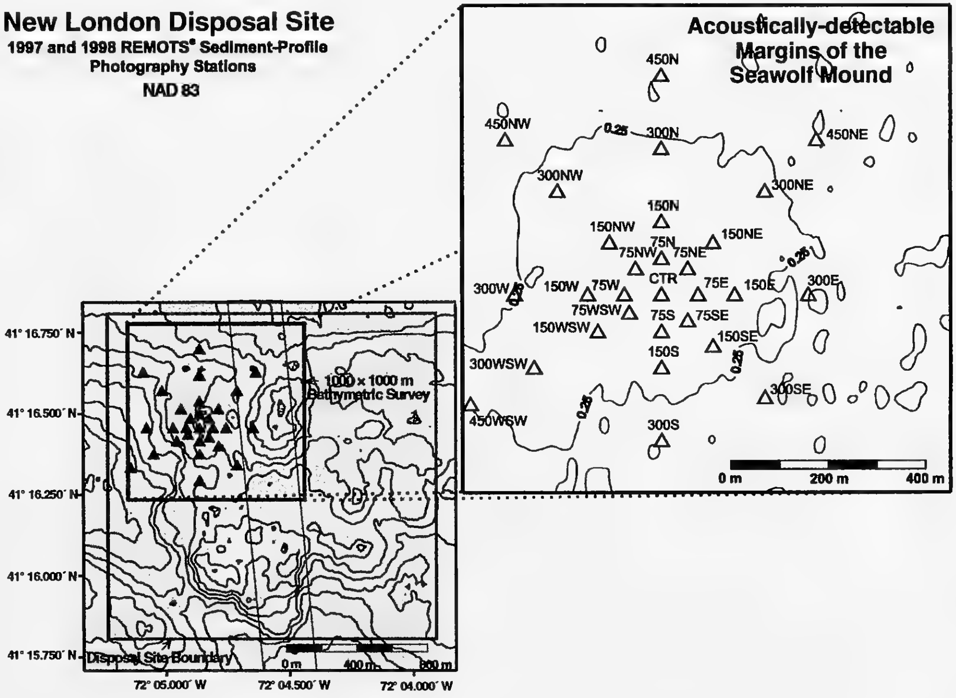


Figure 2-3. Distribution of 1997 and 1998 REMOTS® sediment-profile photography stations (29) over the Seawolf disposal mound, relative to 1000 × 1000 m survey area, disposal site boundary, and US Navy submarine lane.

Table 2-4
Seawolf Disposal Mound and NLDS Reference Areas
1997 and 1998 REMOTS® Sediment-Profile Photography Stations

1997 and 1998 NAD83			
Area	**Station**	**Latitude**	**Longitude**
Seawolf Mound 1997 and 1998 41° 16.456′ N 72° 04.863′ W	CTR	41° 16.456′ N	72° 04.863′ W
	75N	41° 16.496′ N	72° 04.863′ W
	150N	41° 16.537′ N	72° 04.863′ W
	300N	41° 16.618′ N	72° 04.863′ W
	450N	41° 16.699′ N	72° 04.863′ W
	75NE	41° 16.485′ N	72° 04.824′ W
	150NE	41° 16.514′ N	72° 04.787′ W
	300NE	41° 16.571′ N	72° 04.711′ W
	450NE	41° 16.627′ N	72° 04.636′ W
	75E	41° 16.456′ N	72° 04.809′ W
	150E	41° 16.456′ N	72° 04.756′ W
	300E	41° 16.456′ N	72° 04.648′ W
	75SE	41° 16.427′ N	72° 04.825′ W
	150SE	41° 16.399′ N	72° 04.787′ W
	300SE	41° 16.342′ N	72° 04.711′ W
	75S	41° 16.415′ N	72° 04.863′ W
	150S	41° 16.375′ N	72° 04.863′ W
	300S	41° 16.294′ N	72° 04.863′ W
	75WSW	41° 16.436′ N	72° 04.910′ W
	150WSW	41′ 16.415′ N	72° 04.956′ W
	300WSW	41° 16.375′ N	72° 05.049′ W
	450WSW	41° 16.334′ N	72° 05.142′ W
	75W	41° 16.456′ N	72° 04.917′ W
	150W	41° 16.456′ N	72° 04.970′ W
	300W	41° 16.456′ N	72° 05.078′ W
	75NW	41° 16.485′ N	72° 04.901′ W
	150NW	41° 16.514′ N	72° 04.939′ W
	300NW	41° 16.571′ N	72° 05.015′ W
	450NW	41° 16.628′ N	72° 05.091′ W

1997 NAD83			
Area	**Station**	**Latitude**	**Longitude**
NLON REF 1997 41° 16.666′ N 72° 01.971′ W	STAT. 1	41° 16.707′ N	72° 01.963′ W
	STAT. 2	41° 16.568′ N	72° 02.046′ W
	STAT. 3	41° 16.695′ N	72° 01.895′ W
	STAT. 4	41° 16.562′ N	72° 01.838′ W
NE REF 1997 41° 16.686′ N 72° 03.371′ W	STAT. 5	41° 16.663′ N	72° 03.313′ W
	STAT. 6	41° 16.684′ N	72° 03.373′ W
	STAT. 7	41° 16.765′ N	72° 03.360′ W
	STAT. 8	41° 16.693′ N	72° 03.544′ W
	STAT. 9	41° 16.675′ N	72° 03.254′ W
WEST REF 1997 41° 16.206′ N 72° 05.971′ W	STAT. 10	41° 16.208′ N	72° 05.925′ W
	STAT. 11	41° 16.331′ N	72° 05.851′ W
	STAT. 12	41° 16.200′ N	72° 05.978′ W
	STAT. 13	41° 16.172′ N	72° 05.849′ W

1998 NAD83			
Area	**Station**	**Latitude**	**Longitude**
NLON REF 1998 41° 16.666′N 72° 01.971′W	STAT. 1	NA	NA
	STAT. 2	41° 16.569′ N	72° 01.878′ W
	STAT. 3	41° 16.663′ N	72° 02.091′ W
	STAT. 4	41° 16.658′ N	72° 01.951′ W
NE REF 1998 41° 16.686′N 72° 03.371′W	STAT. 9	41° 16.660′ N	72° 03.325′ W
	STAT. 10	41° 16.715′ N	72° 03.325′ W
	STAT. 11	41° 16.744′ N	72° 03.557′ W
	STAT. 12	41° 16.676′ N	72° 03.381′ W
	STAT. 13	41° 16.679′ N	72° 03.335′ W
WEST REF 1998 41° 16.206′N 72° 05.971′W	STAT. 5	41° 16.208′N	72° 05.925′W
	STAT. 6	41° 16.331′N	72° 05.851′W
	STAT. 7	41° 16.200′N	72° 05.978′W
	STAT. 8	41° 16.172′N	72° 05.849′W

2.2.2 NLDS Reference Areas

Data from three reference areas (NLON REF, NE REF, and WEST REF) were used for comparison of ambient eastern Long Island Sound sediments relative to the material deposited at NLDS through disposal operations (Figure 2-4). These three reference areas are often sampled as part of sediment chemistry and benthic habitat surveys at NLDS. During the 1997 and 1998 surveys, the NLDS reference areas were sampled as part of the sediment-profile photography surveys over the Seawolf Mound. In addition, sediment cores were obtained from randomly selected locations within WEST REF in 1997 and 1998 to serve as a basis of comparison with sediment samples collected over the Seawolf Mound.

A random sampling scheme was used each year to select stations within a 300 m radius of the center of each reference area. A total of 13 stations were distributed between the three reference areas. NLON REF (41°16.666′ N, 72°01.971′ W) and WEST REF (41°16.206′ N, 72°05.971′ W) were each sampled at four randomly selected stations. NE REF (41°16.686′ N, 72°03.371′ W) was sampled at five randomly selected stations (Table 2-4).

2.3 Benthic Community Sampling

2.3.1 Sediment Grab Sampling

Sediment grab samples were collected at 6 of the 29 REMOTS® stations established over the Seawolf Disposal Mound during the September 1997 monitoring survey only (Figure 2-5; Table 2-5). The grab samples were used to examine the benthic infauna population and diversity, supplementing the benthic community assessment information provided by the 1997 sediment-profile photographs. A 0.04 m^2 Young-modified Van Veen grab sampler was used to obtain sediment samples from Stations CTR, 75E, 150N, 150W, 300SE, and 300WSW. One bottom grab was recovered from each station, and the sediments were examined for color, texture, and redox potential discontinuity (RPD) depth.

The sediment samples were then washed into a bucket and sieved through a 0.5 mm screen. All material remaining on the screen (biota, shell, wood fragments, etc.) was transferred to individual one liter plastic containers and fixed with a 10% buffered formalin/seawater solution. The samples were left undisturbed for 48 hours, then re-sieved with fresh water and transferred to a Rose Bengal stained, 70% methanol solution for long-term preservation. The samples were then shipped to Cove Corporation of Lusby, Maryland for species identification and enumeration (Blake and Williams 1997).

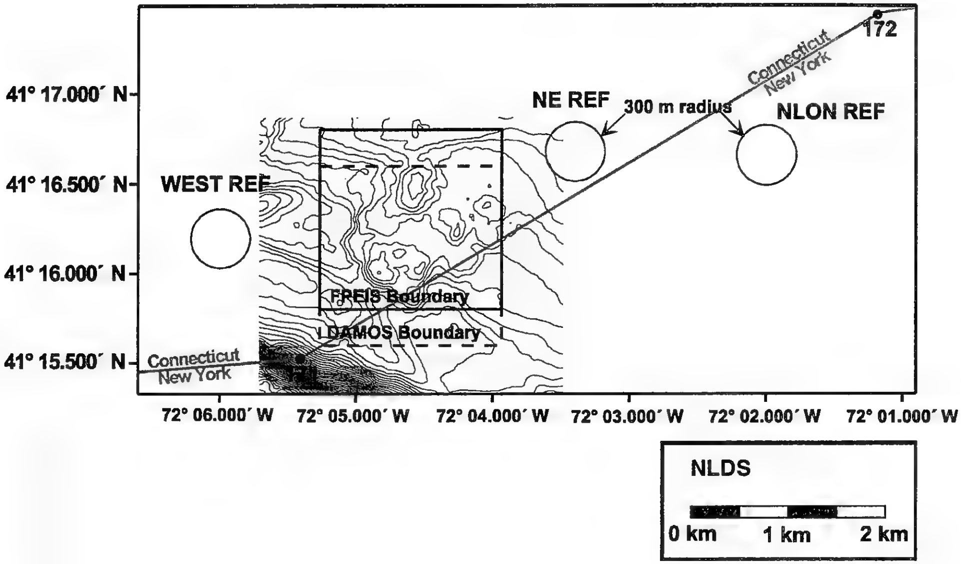
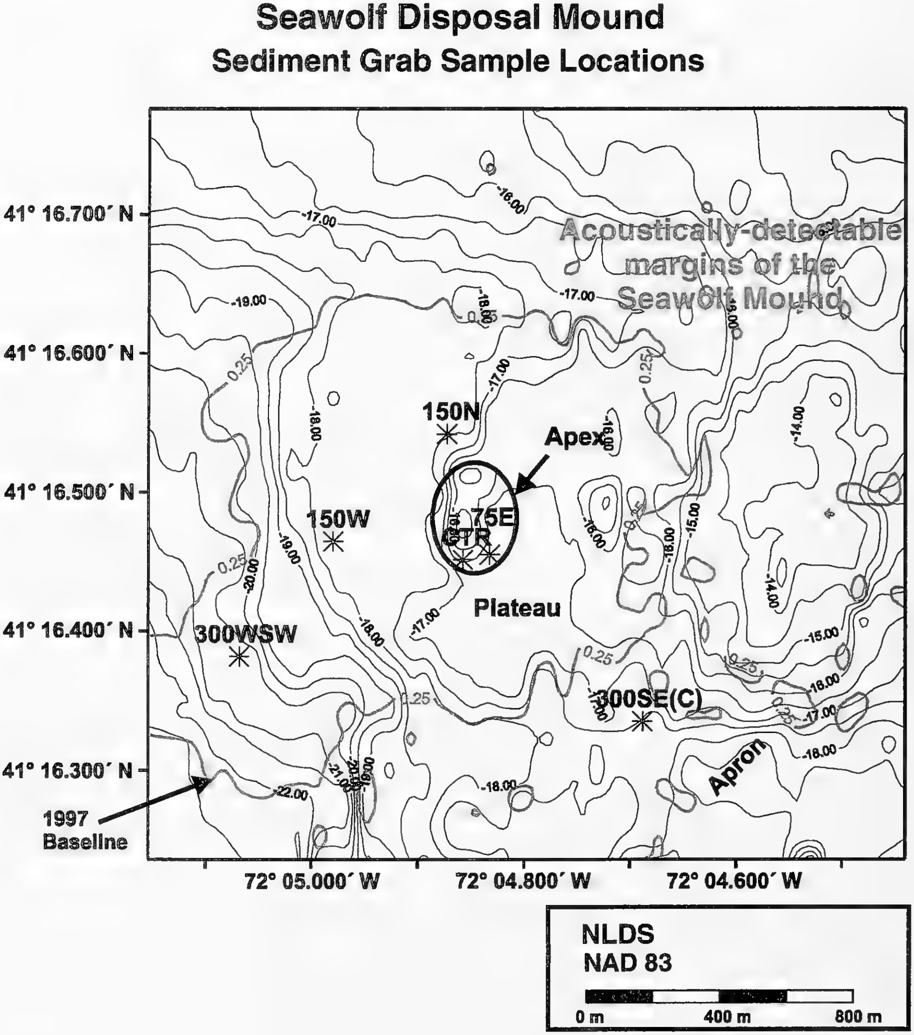


Figure 2-4. Location of the NLDS Reference areas relative to the disposal site boundary and New York-Connecticut State Line.



Seawolf Disposal Mound
Sediment Grab Sample Locations

Figure 2-5. Locations of sediment grab samples collected over the Seawolf Mound during the 1997 monitoring survey.

Table 2-5
Seawolf Disposal Mound
1997 Sediment Grab Samples

1997 NAD83			
Area	**Station**	**Latitude**	**Longitude**
	CTR	41° 16.452′ N	72° 04.858′ W
Seawolf Mound	75E	41° 16.455′ N	72° 04.833′ W
	150W	41° 16.464′ N	72° 04.979′ W
41° 16.456′ N	150N	41° 16.542′ N	72° 04.873′ W
72° 04.863′ W	300SE (C)	41° 16.335′ N	72° 04.688′ W
	300WSW	41° 16.382′ N	72° 05.068′ W

2.3.2 Laboratory Analysis

Each taxon and its number of representative individuals were recorded within a spreadsheet for each sediment sample in the order of its respective National Oceanographic Data Center (NODC) code. These data were then incorporated into a database to aid in statistical analysis. Total faunal abundance and number of species were calculated for each station, with the ten most abundant species determined and displayed within a species list. Juvenile and undeterminable organisms were included in calculations of relative density, but were excluded from diversity analyses unless no other species belonging to those taxa were present in the sample. Diversity was calculated as Shannon-Weiner index H′ and the associated evenness J′ as well as by the rarefaction method (Sanders 1968). The Shannon-Wiener index was calculated using the base $\log_2$; for the rarefaction, the number of individuals was set at defined points between 25 and 800 (Blake and Williams 1997).

2.4 Sediment Cores

Sediment cores were collected over the Seawolf Disposal Mound as part of both the 1997 and 1998 environmental monitoring surveys. The cores provided visual cross-sections of the dredged material deposited during the 1995–1996 disposal season and aided in developing sediment chemistry profiles to verify the integrity of the cap. In accordance with the U.S. Navy monitoring plan, 12 stations were placed within three separate zones established over the Seawolf Mound. These zones were designed to facilitate spatial comparison of potential contaminants on the horizontal plane, with proximity to the mound apex.

The sampling zones were based on radial distance intervals of 200 m (0–200 m, 200–400 m, 400–600 m) from the reported position of the U.S. Navy disposal buoy (41° 16.506′ N, 72° 04.797′ W; Figure 2-6). In order to assess the vertical stratification of the mound, both short and long cores were collected and strategically sampled. Three short cores, at least 50 cm in length, and one long core, not to exceed 3.0 m, were taken in each of the three designated zones: inner (0–200 m), middle (200–400 m), and outer (400–600 m). In addition, one short core was obtained from WEST REF each year to represent ambient sediment and provide information on background contaminant concentrations.

2.4.1 Field Collections

All cores were obtained with the use of Ocean Surveys Incorporated (OSI) Model 1500 pneumatic vibratory corer attached to a 1.5 m or 3 m steel barrel (9.5 cm I.D.). A chemically inert, clear Lexane® liner (8.9 cm I.D.) was fitted within the core barrel, with stainless steel core cutter and catcher assemblies secured to the end. Upon retrieval of the coring device, the internal liner containing the sediment sample was removed from the core barrel, capped, labeled, and stored at 4°C with minimal exposure to sunlight. At the conclusion of the field operations, all cores were transported to the University of Rhode Island Graduate School of Oceanography (GSO) laboratory facilities and refrigerated during storage.

A total of 15 vibracores were taken during the September 1997 survey: 14 cores collected at the Seawolf Mound, and one core obtained from the WEST REF reference area (Table 2-6). The sampling locations were labeled Station 1 through Station 13, with Stations 1 through 12 placed over the Seawolf Mound and Station 13 representing the WEST REF sampling location (Figure 2-6). During this survey, two additional cores (2B and 3B) were obtained in the outer (400–600 m) zone due to shallow penetration (less than 80 cm) of the coring device on the first sampling attempts.

The coring survey was repeated in July 1998, as a total of 15 sediment cores were collected from 12 stations over the disposal site and one station at WEST REF (Table 2-7). During this survey, sampling locations were designated Station 14 through Station 26, with Stations 14 through 25 placed over the Seawolf Mound and Station 26 representing the WEST REF sampling location (Figure 2-6). Duplicate cores were collected at two stations (14 and 20) to insure adequate core-length for sampling. The second sample was collected at Station 14 due to loss of the top portion of the sample, while an oblique angle of penetration of the first core was cause for a second attempt at Station 20.

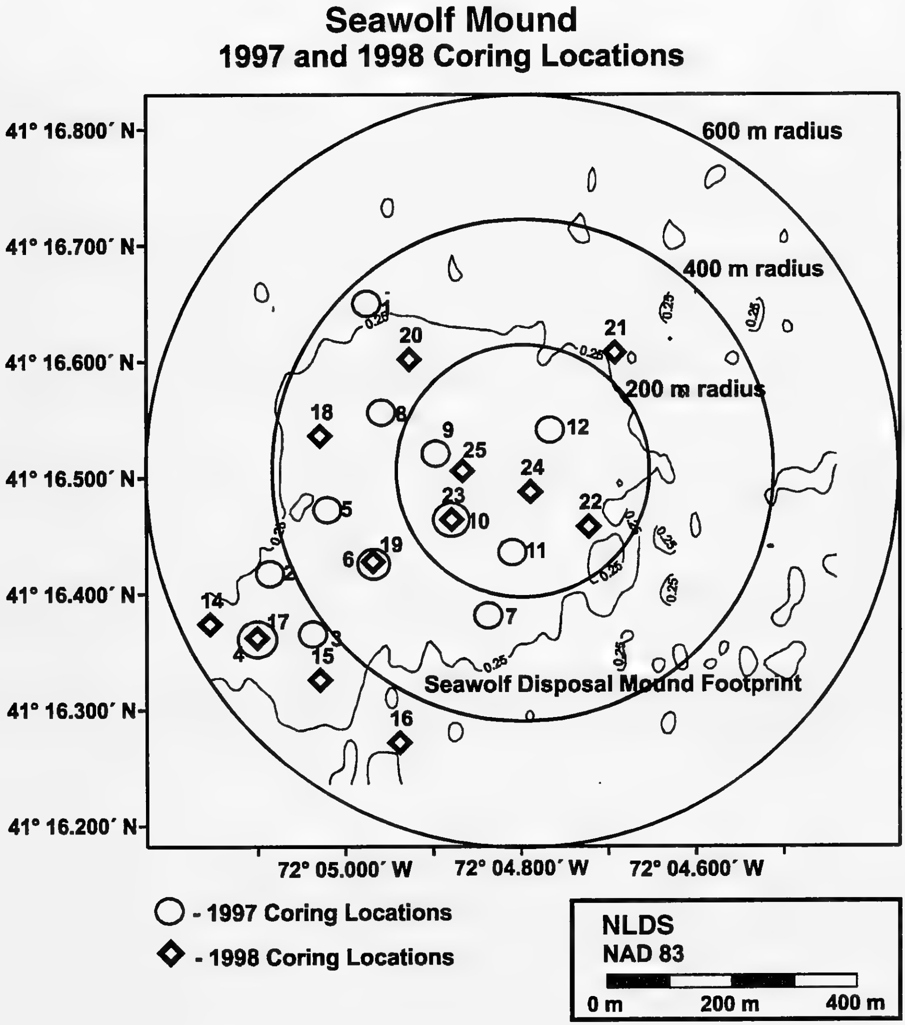


Figure 2-6. Locations of cores collected during the 1997 and 1998 NLDS monitoring surveys with respect to radial zones.

Table 2-6
Seawolf Disposal Mound
1997 Sediment Cores

Core	Latitude	Longitude	Zone	Type	Length (m)	Sampling Interval(s)
2A	41° 16.414′ N	72° 05.084′ W	Outer 400-600 m	Short	0.59	0-0.50 m
2B	41° 16.422′ N	72° 05.086′ W	Outer 400-600 m		0.82	0-0.50 m
3A	41° 16.365′ N	72° 05.027′ W	Outer 400-600 m		0.77	0-0.50 m
3B	41° 16.359′ N	72° 05.033′ W	Outer 400-600 m		1.24	0-0.50 m
1A	41° 16.641′ N	72° 04.970′ W	Middle 200-400 m		1.40	0-0.50 m
5A	41° 16.471′ N	72° 05.020′ W	Middle 200-400 m		1.45	0-0.50 m
7A	41° 16.374′ N	72° 04.832′ W	Middle 200-400 m		1.50	0-0.50 m
8A	41° 16.558′ N	72° 04.951′ W	Middle 200-400 m		1.38	0-0.50 m
9A	41° 16.520′ N	72° 04.891′ W	Inner 0-200 m		1.50	0-0.50 m
11A	41° 16.435′ N	72° 04.802′ W	Inner 0-200 m		1.08	0-0.50 m
12A	41° 16.542′ N	72° 04.756′ W	Inner 0-200 m		1.53	0-0.50 m
4A	41° 16.362′ N	72° 05.093′ W	Outer 400-600 m	Long	2.22	0-0.50 m archived 0.50-0.75 m 0.75-1.0 m 1.0-1.6 m >1.6 m archived
6A	41° 16.433′ N	72° 04.974′ W	Middle 200-400 m	Long	2.58	0-0.50 m archived 0.50-0.75 m 0.75-1.0 m 1.0-2.0 m >2.0 m archived
10A	41° 16.458′ N	72° 04.868′ W	Inner 0-200 m	Long	2.76	0-0.50 m archived 0.50-0.75 m 0.75-1.0 m 1.0-1.75 m >1.75 m archived
13A*	41° 16.203′ N	72° 05.977′ W	WEST REF	Short	1.43	0-0.50 m

* Core collected at Reference Area.

Table 2-7
Seawolf Disposal Mound
1998 Sediment Cores

Core	Latitude	Longitude	Zone	Type	Length (m)	Sampling Interval(s)
14A	41° 16.375′ N	72° 05.152′ W	Outer 400-600 m	Short	1.90	NA
14B	41° 16.375′ N	72° 05.153′ W	Outer 400-600 m		1.37	0-0.5 m
15A	41° 16.325′ N	72° 05.030′ W	Outer 400-600 m		1.83	0-0.5 m
16A	41° 16.274′ N	72° 04.937′ W	Outer 400-600 m		1.36	0-0.5 m
18A	41° 16.536′ N	72° 05.028′ W	Middle 200-400 m		0.98	0-0.5 m
20A	41° 16.604′ N	72° 04.925′ W	Middle 200-400 m		1.90	NA
20B	41° 16.601′ N	72° 04.928′ W	Middle 200-400 m		0.84	0-0.5 m
21A	41° 16.607′ N	72° 04.695′ W	Middle 200-400 m		1.29	0-0.5 m
22A	41° 16.457′ N	72° 04.715′ W	Inner 0-200 m		1.21	0-0.5 m
24A	41° 16.488′ N	72° 04.786′ W	Inner 0-200 m		0.92	0-0.5 m
25A	41° 16.506′ N	72° 04.865′ W	Inner 0-200 m		1.78	0-0.5 m
17A	41° 16.362′ N	72° 05.100′ W	Outer 400-600 m	Long	2.88	0-0.5 m archived 0.5-0.75 m 0.75-1.0 m 1.0-1.7 m 2.0-2.8 m archived
19A	41° 16.431′ N	72° 04.966′ W	Middle 200-400 m	Long	2.90	0-0.5 m archived 0.5-0.75 m 0.75-1.0 m 1.0-2.0 m 2.0-2.9 m archived
23A	41° 16.464′ N	72° 04.878′ W	Inner 0-200 m	Long	3.00	0-0.5 m archived 0.5-0.75 m 0.75-1.0 m 1.0-1.75 m 2.0-3.0 m archived
26A*	41° 16.214′ N	72° 05.967′ W	WEST REF	Short	1.03	0-0.5 m

* Core collected at Reference Area.

In order to maximize spatial coverage over the surface of the Seawolf Mound, target locations for the 1998 short cores were carefully distributed in a manner that avoided overlap with the 1997 short core sampling locations. However, the 1998 coring effort specifically targeted the reported 1997 long core locations (Stations 4, 6, and 10) for the collection of additional deep cross-sections (Figure 2-6). Stations 17, 19, and 23 were strategically placed over the reported locations of Cores 4A, 6A, and 10A. One long core was obtained from each location in 1998 to facilitate comparison of chemical concentrations between years.

2.4.2 Sediment Sampling

The Seawolf Mound cores were split, visually described, photographed, and prepared for geochemical and grain size sampling at the University of Rhode Island's Graduate School of Oceanography (GSO). In both 1997 and 1998, all the cores were split, described, and photographed. However, only one core from each station (13 cores per survey) was used for detailed analysis. Generally, the 0–50 cm sections of the short cores were used to verify the presence of the capping layer within each zone. The long cores were sampled at consistent vertical intervals to examine the depth of the capping layer and potential differences in the contaminant levels with depth.

A sampling plan for analyzing the cores was developed in 1997 based on the US Navy monitoring objectives for the Seawolf Mound (Maguire 1995). The sampling plan and analysis procedures were followed again for the July 1998 cores. The top 50 cm of sediment from each of the short cores was composited in a stainless-steel mixing bowl, sub-sampled, and placed in a series of pre-cleaned glass jars. The short core samples were analyzed for grain size, Total Organic Carbon (TOC), polycyclic aromatic hydrocarbons (PAHs), and a suite of trace metals including arsenic (As), cadmium (Cd), chromium (Cr), mercury (Hg), lead (Pb), copper (Cu), nickel (Ni) and zinc (Zn).

The three long cores collected in each of the two years, (4A, 6A, and 10A, 17A, 19A, and 23A) each were divided into five sampling intervals (Tables 2-6 and 2-7). The long core samples were composited in the same manner as the short core samples and labeled according to core and depth interval. The long core samples were analyzed for PAHs, trace metals (Zn only), TOC, and grain size. In addition, a QC sample (NLDS QCA-replicate of 11A) was included with the 1997 shipment to detect any inconsistencies in the laboratory analyses. All archived long core samples were stored at the GSO core storage facility in the event additional analyses are required.

2.4.3 Laboratory Analysis Methods

This section describes the methods used for sample preparation, extraction, and analysis of samples. The 1997 sediment samples were analyzed by MAXIM Technologies Inc. in St. Louis, MO, and also by the Woods Hole Group Environmental Laboratories (WHG), in Raynham, MA. WHG was used again in 1998 for the analysis of the geochemistry samples, while the sediment collected for grain size and moisture content were analyzed by GeoTesting Express, Incorporated in Boxborough, MA. The methods used for analysis of each type of analyte are listed in Table 2-8 and are described in detail in Test Methods for Evaluating Solid Waste EPA SW-846 (USEPA 1997). Specific information on data quality is discussed in Section 2.4.4.

Table 2-8
Methods of Physical and Chemical Analyses for NLDS Seawolf Core Subsamples

Core Subsample	Analysis	Method	Instrumentation
All samples	Grain Size	ASTM D422	Sieve/Hydrometer
All samples	Moisture Content	CLP ILMO 4.0	
		SW-846 Method* (USEPA 1997)	
All samples	Total Organic Carbon	9060	
All samples	PAHs	3550A/8270	GC/MS
Short core samples	Trace Metals:		
	Arsenic	3051/6010	ICP
	Cadmium	3051/6010	ICP
	Chromium	3051/6010	ICP
	Copper	3051/6010	ICP
	Lead	3051/6010	ICP
	Mercury	NA/7471	CVAA
	Nickel	3051/6010	ICP
All samples	Zinc	3051/6010	ICP

* First value refers to extraction method, second value refers to analysis method.
PAHs = Polycyclic aromatic hydrocarbons
NA = Not Applicable
GC/MS = Gas Chromatograph/Mass Spectrometer
ICP = Inductively Coupled Argon Plasma Emission Spectrometry
CVAA = Cold Vapor Atomic Absorption

2.4.3.1 Polycyclic Aromatic Hydrocarbons (PAHs)

The initial PAH data received from the MAXIM laboratory pertaining to the 1997 core sub-samples were deemed not acceptable for this study because the detection limits were too high. The samples were re-analyzed by a new laboratory (WHG); the methods and results presented here are from the WHG analyses. The potential impact to data quality from changing laboratories was considered to be minimal, and is further discussed in Section 2.4.4.

Sediment Extraction. According to the Woods Hole Group standard operation procedure, the sediment samples were spiked with surrogate compounds, and extracted by pressurized fluid extraction (Dionex Accelerated Solvent Extractor Model 200) using a methylene chloride: acetone solvent solution. To measure moisture content, samples were weighed, dried in an oven, and re-weighed.

Sediment Analysis. The samples were concentrated and then analyzed using a modified version of EPA SW-846 Method 8270 (USEPA 1997). Analysis of PAHs by Gas Chromatography/Mass Spectrometry with Selected Ion Monitoring Method 8270-PAH-SIM (Revision 0; GC/MS-SIM) is a WHG standard operating procedure and a more rigorous method than the standard method 8270. The sample extract containing the semi-volatile compounds was injected into a gas chromatograph (GC) with a narrow-bore fused-silica capillary column. The temperature-programmed GC_column separated the analytes, which were detected with a mass spectrometer with selected ion monitoring. In this method of analysis, qualitative identifications are confirmed by analyzing standards under the same conditions used for samples and comparing mass spectra and GC retention times. The mass spectra of the target analytes were compared with the electron-impact spectra of authentic standards for identification. Quantification was based on a multi-level initial calibration.

2.4.3.2 Metals

Sediment Digestion. Sediments require acid digestion for extraction and detection of trace metals. Both the MAXIM laboratory (1997) and WHG (1998) utilized EPA SW-846 Method 3051 (USEPA 1997), which provides a rapid multi-element acid leach of sediments. A representative sample of up to 0.5 g was placed in a fluorocarbon microwave vessel with 10 ml of concentrated nitric acid. The vessel was capped and heated in the laboratory microwave for 10 minutes. The acid digests the sample at high temperatures. After cooling, the vessel contents were filtered, centrifuged, or allowed to settle and then diluted to volume and analyzed.

Sediment Analysis. To determine concentrations of Cr, Pb, Cu, Ni, and Zn, the samples were analyzed using EPA SW-846 Method 6010 (USEPA 1997), which is inductively coupled plasma-atomic emission spectrometry (ICP-AES). Arsenic (As) (Method 7060) and Cadmium (Cd) (Method 1731) were analyzed by graphite furnace atomic absorption spectroscopy (GFAA) (USEPA 1997).

For the short core samples, EPA SW-846 Method 7471 (USEPA 1997) was used to detect Hg levels using cold vapor atomic absorption. The Hg was reduced to the elemental state and aerated from solution in a closed system. The mercury vapor passed through a cell positioned in the light path of an atomic absorption spectrometer. Absorbance (peak height) was measured as a function of mercury concentration.

2.4.3.3 Sediment Grain Size, Total Organic Carbon, and Moisture Content

Grain size analysis was conducted by both the MAXIM laboratory (1997) and GeoTesting Express (1998) using American Society for Testing and Materials (ASTM) Method D422-63. A sieve analysis was performed in which the sample was separated into size fractions of greater than 62.5 mm (<4 phi; sand and gravel), and less than or equal to 62.5 mm (>4 phi; silt and clay). The wet sieve and dry sieve fractions less than 62.5 mm (silt and clay) were combined for each sample. The silt and clay fraction was then subdivided using a pipette technique in 1997 (Plume/phi) and a hydrometer technique in 1998 (ASTM/mm). Both of these techniques are based upon differential settling rates of particles. The data on grain size were converted from their respective units (phi or mm) to units of gravel and sand, silt, and clay.

Although the reported percent of fine sediment seemed accurate in the 1997 results, the independent percentages of silt and clay did not correspond to visual observations of the core samples prior to shipment to the laboratory. In addition, the measured silt-clay percentages were also not consistent with observations of sediment cores collected in 1998 over the mound and results of the 1998 grain size analysis, which suggested a much higher percentage of clay. This may be an artifact of the two different variations employed for differentiation of the fine-grained material. Results are reported as percent fines (silt + clay).

Total organic carbon (TOC) analyses were performed using EPA SW-846 Method 9060 (USEPA 1997). In this method, organic carbon is measured using a carbonaceous analyzer that converts the organic carbon in a sample to carbon dioxide (CO_2) by wet chemical oxidation. The CO_2 formed is then measured directly by an infrared detector. The amount of CO_2 in a sample is directly proportional to the concentration of carbonaceous material in the sample. Results expressed in this report are on a dry weight basis.

Moisture content was determined gravimetrically using ASTM Method D2216. Prior to initiating grain size analysis, a sub-sample (approximately 5–20 g) was taken for determination of total solids (%). Total solids in a sediment sample is a measurement of the water content of the sediment. This value is used to normalize chemical data to the actual dry weight of the sample. Wet weights were obtained gravimetrically and recorded prior to drying the samples at 103° C. The percent moisture in each sample was calculated by the following equation:

$$\text{water content (\%)} = \frac{\text{(g sediment wet weight) - (g sediment dry weight)}}{\text{(g sediment dry weight)}} \times 100$$

2.4.4 Quality Assurance/Quality Control

The chemistry data for the Seawolf sediment cores reported here were considered acceptable for the objectives of the NLDS Survey. Data quality was assessed in relation to specified criteria for precision, accuracy, representativeness, comparability, and completeness (PARCC). Sample representativeness was ensured during the sampling survey by collecting a sufficient number of cores and subsamples from the project and surrounding areas. All cores were collected and sampled in a uniform manner and are considered to be representative (see Methods). Comparability is a qualitative parameter expressing the confidence with which one data set can be compared to another. Comparability is limited to the other PARCC parameters because precision and accuracy must be known to compare one data set with another. Data completion was ensured through sample tracking protocols (Section 2.4.4.1).

One method of assessing analytical accuracy of the laboratory was the quantitative evaluation of the percent recovery of a spiked standard compound added at a known concentration to the sample before the analysis (Section 2.4.4.2). Laboratory accuracy also was evaluated qualitatively by evaluating the laboratory QC information on method blank results, tuning and mass calibration, recovery of internal standards, laboratory quality control samples, and initial and continuing calibration results of analyses of environmental samples.

Analytical precision was expressed as the percentage of the difference between results of the replicate samples (relative percent difference [RPD] or relative standard difference [RSD]; Section 2.4.4.3). When spiked duplicates are run, the results can be expressed as an RPD to evaluate precision of the analysis of the spiked compounds. By inference, the precision of analysis of other related compounds should be similar. The following sections define the various QA/QC requirements and summarize the data quality objectives for this project. For data to be considered valid, they must have met all acceptance criteria including accuracy and precision, as well as any other criteria specified by the analytical methods used.

2.4.4.1 Sample Tracking Procedures and Holding Times

SAIC Standard Operating Procedures for sample tracking and custody were followed, and all samples from the project were analyzed except for one grain size sample (10A, 0.5–0.75) due to laboratory oversight. After placing representative composited material in clean glass jars, the containers were labeled with indelible ink and sealed with waterproof tape. Label information included the date, sample location, station number, replicate number, and type of analysis. Remaining material was placed in double-bagged, gallon-sized plastic bags which were sealed and labeled for grain size analysis. All sediment containers and bags were stored at 0–4° C prior to analysis. Chain-of-custody records were maintained for all samples.

The recommended maximum holding times between sampling and extraction for the compounds analyzed for this study are 14 days for PAHs, 28 days for Hg, and 6 months for the remaining trace metals. PAHs must be analyzed within 40 days of extraction (USEPA, 1997). The 1997 sediment cores were collected on 25–26 September 1997 and stored under refrigeration at the GSO in PVC tubing. The cores were split on 15–16 October 1997 and sectioned for sampling. The samples were stored under refrigeration until they could be shipped to the laboratory on 20 October 1997. The laboratory received the samples on 22 October 1997.

All sample holding times were met except for the re-analyzed samples for PAHs. After sample data from MAXIM were rejected, the resealed samples were sent to the WHG laboratory. The WHG personnel reported that the containers arrived in good condition and were almost full of material, supplying adequate sediment for the PAH analysis with limited oxidation. The samples were re-extracted, resulting in a total holding time of 118 days between sampling and extraction. Following extraction, the samples were re-analyzed within three days. Storage of the samples in airtight containers under refrigerated conditions; helped to preserve data quality; previous work with PAHs has shown little change in concentration in sediments held in refrigerated conditions.

The 1998 cores were collected from the 22 to 24 July 1998 and stored under refrigeration at the GSO in PVC tubing. The cores were split from 27 to 29 July 1998 and sectioned for sampling. The samples were stored under refrigeration until they could be shipped to the laboratory on 29 July 1998. The laboratory received the samples on 30 July 1998. All of the samples were extracted for PAHs on 31 July 1998 and analyzed for metals by 12 August. Therefore, all samples were processed well within the maximum holding times.

2.4.4.2 Assessment of Analytical Accuracy

Analytical accuracy is determined by the percent recovery of a known concentration of a compound that is spiked to the environmental sample before analysis. The closer that the numerical value of the measurement approaches the actual concentration of the compound, the more accurate the measurement. The percent recovery values are calculated using the following equation:

$$\frac{A_r - A_o}{A_f} \times 100$$

where:

A_r = total compound concentration detected in the spiked sample

A_o = concentration of the compound detected in the unspiked sample

A_f = concentration of the spike added to the sample

Matrix spike samples (MS) and matrix spike duplicates (MSD) are prepared by dividing a sample into multiple aliquots, spiking an aliquot with a known concentration of analyte, and proceeding with the analysis as though the spike was a sample. In 1997, samples NLDS QCA and NLDS 10A 0.75–1.0 m were selected for matrix spike and matrix spike duplicate analysis. In 1998, samples NL-14B and NL-15A were selected for matrix spike and matrix spike duplicate analysis.

Matrix spike recovery for metals should yield 75 to 125% recovery of the known value, as stated in EPA Method 6010. In 1997, the laboratory reported matrix spike recoveries for As, Cd, Cr, Cu, Pb, and Hg in NLDS QCA ranging between 97 and 122%, within Method 6010 QC acceptance criteria. However, Ni and Zn had recoveries of 138% and 203%, respectively, exceeding the criteria limits. Recovery of Zn in NLDS 10A was 156.6% of the matrix spike sample. Because the laboratory control sample recoveries for all analytes were within control limits, the elevated spike recoveries were attributed to sample non-homogeneity (typical for dredged material) or matrix effect. A laboratory QC sample was prepared with each sample batch. The recovery for the QC sample for eight metals analyzed ranged from 95 to 103%. A second QC sample for Zn had a recovery of 102%. Considering all of the QC information provided for metals, the recoveries for all metals indicated acceptable accuracy.

In 1998, WHG reported matrix spike recoveries for As, Cd, Cr, Cu, Pb, Hg, Ni, and Zn in NLDS NL-14B ranging between 87 and 120%, within Method 6010 QC acceptance criteria. A laboratory QC sample (spiked blank/laboratory control spikes) was prepared with each sample batch. The recovery for the QC sample for eight metals analyzed ranged from 71 to 97%. The recoveries for all metals indicated acceptable accuracy.

For TOC, the laboratory standard operating procedure targets a range of 75–125% recovery. In 1997, two samples were spiked for TOC (NLDS QCA and NLDS 10A 0.75–1.0 m). Recoveries were 104% and 112%, indicating acceptable accuracy for TOC data. In 1998, sample NLDS 14B was spiked for TOC and had recovery of 84%, indicating acceptable accuracy for TOC data. Prior to the analysis of the samples, the laboratory QC sample was analyzed and 99% was recovered. After the samples were analyzed, the laboratory QC sample had a recovery of 106%, within the range of acceptable recovery percentages.

Recoveries of PAH matrix spike and matrix spike duplicates must fall within the range of 35–125% as stated in EPA SW-846 Method 8270 (USEPA 1997). Using NLDS 1A for the 1997 MS/MSD analyses, recoveries ranged from 49 to 156%. Fluoranthene and pyrene recoveries exceeded these limits in the MSD analysis. Because all other analytes met both accuracy and precision limits, the analytical system was assessed to be in control and no further corrective action was implemented. Fluoranthene and pyrene were reported without laboratory qualification.

Using NLDS 15A for the 1998 MS/MSD analyses, recoveries ranged from 84 to 109% and were acceptable. The laboratory QC sample had recoveries that varied from 76 to 92%. The accuracy tests indicated that the PAHs analysis met the QC criteria.

Surrogate Recovery. Each sediment sample for PAH analysis was spiked with surrogate compounds as a measure of accuracy. Surrogate samples are analyzed as a check on the laboratory's ability to extract known concentrations of compounds not normally found in the sample, but having similar characteristics. Surrogate compounds (generally compounds labeled with stable isotopes) are the only means of checking method performance on a sample-by-sample basis. Recoveries of surrogate spikes must fall within a range of 30 to 130%, depending upon the surrogate compound, as stated in the WHG laboratory standard operating procedure. Measured recoveries of surrogate spikes for this data set ranged from 46 to 119%, indicating acceptable recovery.

Method Blanks. Method blanks are laboratory QC samples that are processed with the samples but contain only reagents. Method blanks test for contamination that may be contributed by the laboratory during sample preparation. The method blanks for PAHs, TOC, and metals were free from contamination and below the instrument detection limit.

2.4.4.3 Assessment of Analytical Precision

Analytical precision can be expressed as the relative percent difference (RPD) between two results, or the relative standard deviation (RSD) between three or more results. To prepare analytical replicates, a sample is homogenized by the laboratory and then divided into two or more subsamples. The subsamples are analyzed independently. The closer the numerical values of the measurements are to each other, the lower the RPD or RSD. Low RPD or RSD values indicate a high degree of analytical precision.

The relative percent difference (RPD) between two sample results was calculated using the following equation:

$$\text{RPD} = \frac{(\text{sample result} - \text{duplicate result})}{(\text{sample result} + \text{duplicate result}) / 2} \times 100$$

To assess the analytical precision of the laboratory in 1997, sample 11A was homogenized, divided, and sent to the laboratory as two samples: 11A and NLDS QCA. In addition, the laboratory analyzed the duplicate matrix spike samples (Section 2.4.4.2) for additional precision analyses.

The RPD for metals in the submitted blind duplicates (11A and QCA) ranged from ±2% to 19%, indicating good precision for metals. In addition, the laboratory reported RPDs of two samples, QCA and 10A (0.75–1.0 m) for both non-spiked and spiked matrices. For metal samples with values greater than ten times the instrument detection limit, the control limit is ±20% RPD. The spiked sample or spiked duplicate sample recovery must be within ±25% of the actual value or within the documented historical acceptance limits. The RPDs were between 0.7–14% for the QCA duplicates, and 0.6% for Zn for 10A. The RPDs of the QCA matrix spiked duplicates ranged from 0–5.5% for the listed metals, excluding Zn which was 20% and therefore within the limit for spiked samples. For the Zn only sample 10A (0.75–1.0 m), the spiked duplicates had an RPD of 1.6%.

For TOC analyses of samples QC and 11A, the RPDs were ±4.6% and 18.5% for the matrix spike duplicates, and ±5.6% for the duplicate RPD, indicating acceptable precision. For TOC method quality control, the laboratory selected samples NLDS7A and NLDS 12A for triplicate analyses. When there are more than two sample values to consider, the relative standard deviation (RSD) is used to assess precision. The RSD is calculated using the following equation:

$$\%\text{RSD} = \left(\frac{\text{standard deviation}}{\text{average of samples}}\right)\text{x}100$$

The RSD was 12.4% for sample 7A and 8.3% for 4A, which also indicated an acceptable level of precision.

The PAH MS/MSD sample was NLDS 1A. The RPD values ranged from 12% to 47%. Of the 16 values calculated, only one compound was outside the required range, pyrene. As stated previously, all other analytes met both accuracy and precision limits. Therefore, the analytical system was assessed to be in control and no further corrective action was implemented.

The analytical precision results for the 1998 samples indicated the RPD for metals were reported for both non-spiked and spiked matrices. The precision criteria are ±20% RPD. The metal MS/MSD RPDs were between 0–19% for NL-14B for all metals except Cd, which was

28%. However, because the Cd was reported at a concentration less than 5% the instrument detection limit, the RPD criterion does not apply. For TOC analyses of sample 14B, the RPDs were ±4.8% for the matrix spike duplicates, indicating acceptable precision. The PAH MS/MSD sample, NLDS 15A, had RPD values that ranged from 4 to 10%.

3.0 RESULTS

3.1 Seawolf Mound

3.1.1 Bathymetry

The Seawolf Disposal Mound is a flat, nearly circular capped sediment mound complex composed of an estimated barge volume of 877,500 m^3 of dredged material. This complex was formed from 862,000 m^3 of dredged material (305,200 m^3 UDM and 556,000 m^3 CDM from the Seawolf Project and 803 m^3 UDM from Mystic Seaport) deposited at the U.S. Navy buoy from 21 October 1995 through 31 January 1996. In addition, a total of 15,490 m^3 of CDM from Mystic River and Venetian Harbor were deposited at the NDA 95 buoy, which also contributed to the Seawolf Mound. In September 1997, a 1000 × 1000 m survey was performed over the Seawolf Mound, replicating the size and orientation of the surveys used to track the development of the sediment deposit. This survey was used to monitor the long-term stability of the disposal mound as well as to measure the amount of dredged material consolidation in the underlying layers since February 1996. Bathymetric results of the entire NLDS for this period are presented in Volume I of this report (SAIC 2001).

In October 1995, Gahagan and Bryant, Inc. conducted a 1500 × 1500 m survey over the northwest corner of NLDS to serve as the baseline against which all future Seawolf Mound surveys would be compared (Figure 3-1). Depths within the 1000 × 1000 m analysis area ranged from 13.5 m over the NL-RELIC Mound to 22.5 m along the southwest margin. Dredging operations around Seawolf Piers 8 and 10 and sections of the main channel commenced on 21 October and continued through 7 December 1995, producing large volumes of UDM (Appendix A). Upon the deposition of the final barge load of UDM at the U.S. Navy buoy on 7 December, a precapping survey was completed to determine the thickness and lateral extent of the UDM deposit. A distinct elevation in bottom topography was found near the center of the survey grid, between the U.S. Navy and NDA 95 buoys (Figure 3-2). Depth difference calculations based on comparisons with the baseline bathymetric dataset indicated the disposal operations had formed a discrete UDM deposit approximately 400 m wide and with a maximum height of 3.5 m (Figure 3-3). The apex of the mound was developed 75 m southwest of the Navy buoy position, and the development of the mound seemed to be strongly affected by a consistent disposal pattern (tow boat and barge approach) and the slope of the NLDS seafloor. The deposit also included 2,310 m^3 of CDM from the Venetian Harbor and Mystic River dredging projects disposed at the NDA 95 buoy prior to the precap survey (Figure 3-3).

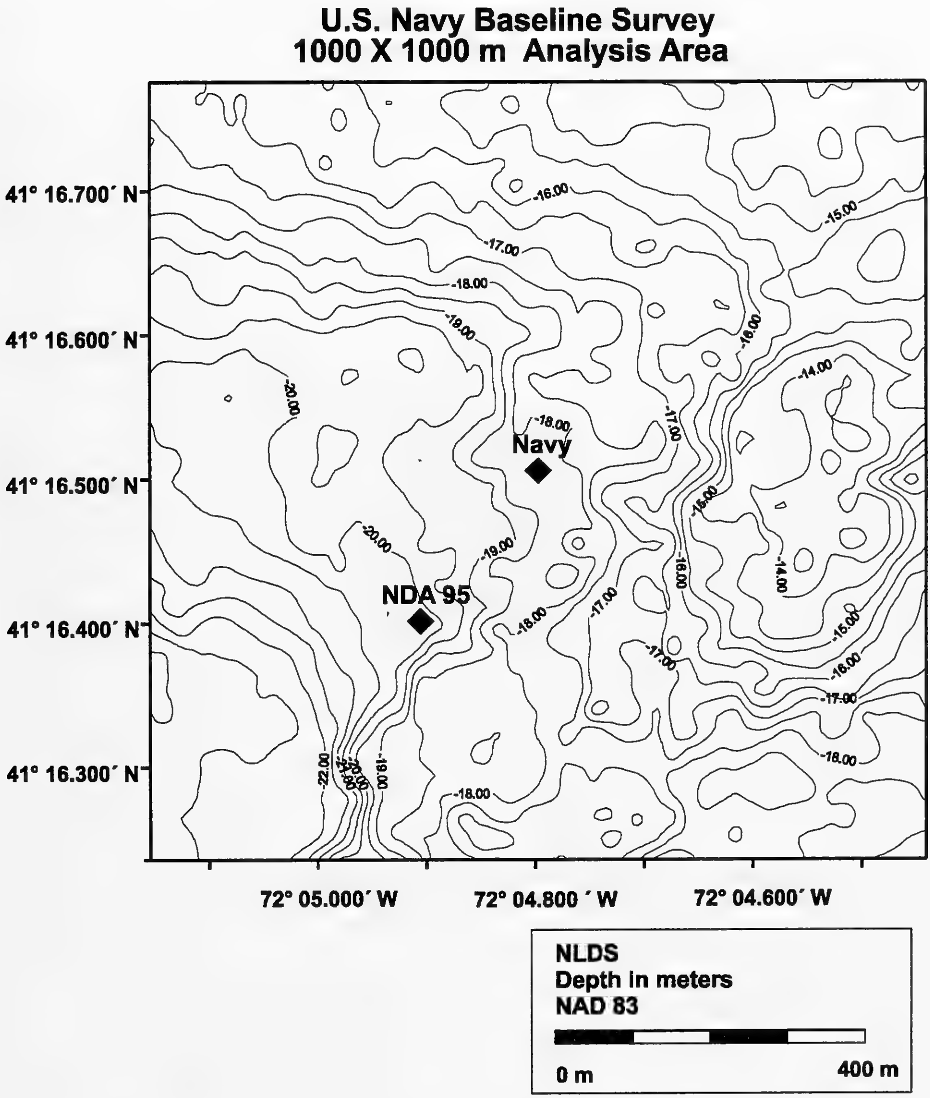


Figure 3-1. Baseline bathymetry of the Seawolf Mound area, October 1995 (Gahagan and Bryant)

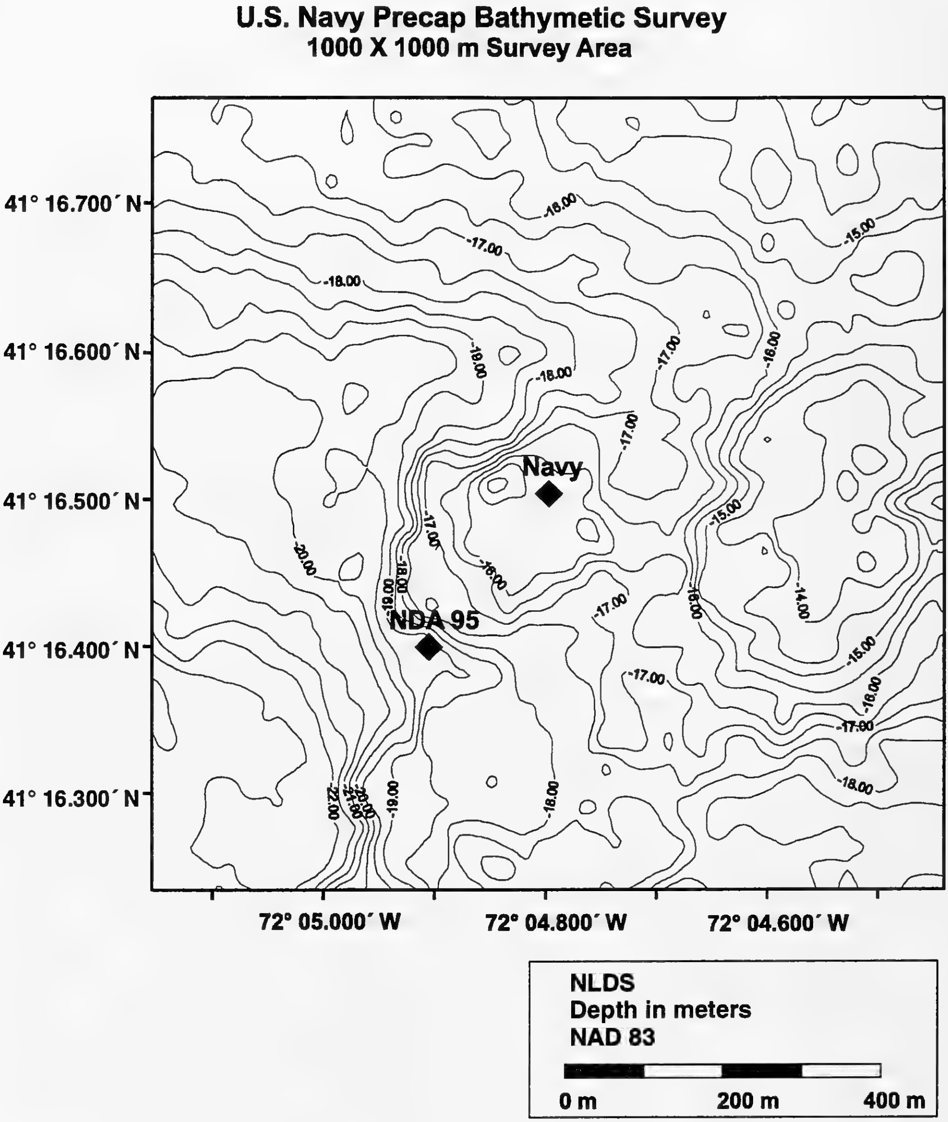


Figure 3-2. Precap bathymetric survey of the Seawolf Mound area (Gahagan and Bryant)

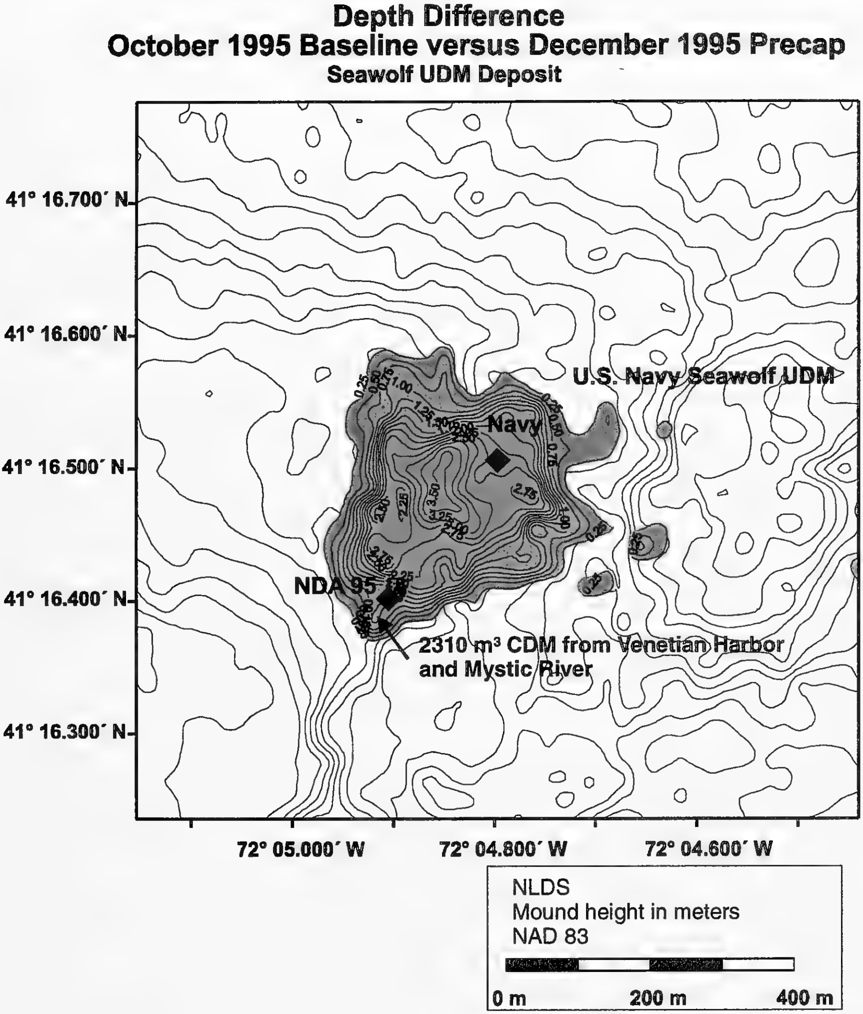


Figure 3-3. Thickness of UDM at the Seawolf Mound (contour interval = 0.25 m) overlain on baseline bathymetry.

An estimated volume of 556,000 m^3 of capping dredged material (CDM), originating from the areas of the Thames River channel that had been classified as suitable for unconfined open-water disposal (Maguire Group 1995), was dredged and placed over the UDM (Appendix A). The resulting ratio of CDM to UDM was 1.82:1. CDM placed at the NDA 95 buoy was not included in this ratio (8,280 m^3 disposed after the precap survey and another 4,900 m^3 after the postcap survey), but this material provided additional cap coverage. Gahagan and Bryant, Inc. conducted a postcap survey in late February 1996 (Figure 3-4). The overall depth difference between the baseline and postcap survey data was calculated to show the distribution and thickness of the entire deposit placed during the Seawolf project. The resulting Seawolf Mound was a flat semi-circular deposit with a diameter of approximately 600 m, with initial peak heights of 3–4 m above the pre-existing seafloor (Figure 3-5). The deposit was elongated down slope (to the southwest) and extended onto the margin of the NL-RELIC Mound to the east (Figure 3-5).

The overall apparent thickness of CDM was determined by calculating a depth difference between the precap (December 1995) and postcap (February 1996) surveys. The resulting contour plot indicates that, in the center of the mound above the thickest areas of UDM, the total mound height did not change, which would indicate substantial consolidation of the underlying dredged material due to the placement of CDM (Figure 3-6). This central area of apparent consolidation was analyzed further in the REMOTS® and core data collected in that area (Sections 3.1.2 and 3.1.3 and Appendix D). Outside of these areas of consolidation, apparent cap thickness over the UDM deposit reached up to 3 m or more, assuming some consolidation of UDM everywhere. There was an isolated area of UDM in the farthest eastern edge of the mound, which did not show coverage with CDM detectable by acoustic bathymetry. However, REMOTS® photos did show presence of cap materials (REMOTS® Station 300E), which is discussed in Section 3.1.2.1.

The September 1997 bathymetric survey, conducted 18 months following cap placement showed that the mound had a broad, flat plateau ranging from 16 to 18 m water depth, with two small peaks at the apex of the mound to the west of the Navy buoy (Figure 3-7). The Seawolf Mound was a few meters lower than the NL-Relic Mound to the east. In the September 1997 (18 months post cap) versus October 1995 (baseline) depth difference plot, the overall footprint of the Seawolf Mound was similar to that observed the previous year (February 1996 versus October 1995 depth difference; Figure 3-8). However, there were some changes in mound topography in the intervening 1.5 years, shown by a close comparison of Figures 3-5 and 3-8. In February 1996, there were two distinct peaks located just west of the Navy buoy, with the taller peak having a height above baseline of 4.25 m (Figure 3-5). In 1997, the two peaks were less distinct and the maximum height above baseline was 3.5 m (Figure 3-8). Two peaks located further to the west also were no longer as prominent in 1997 (Figures 3-5 and 3-8). A depth difference plot between the

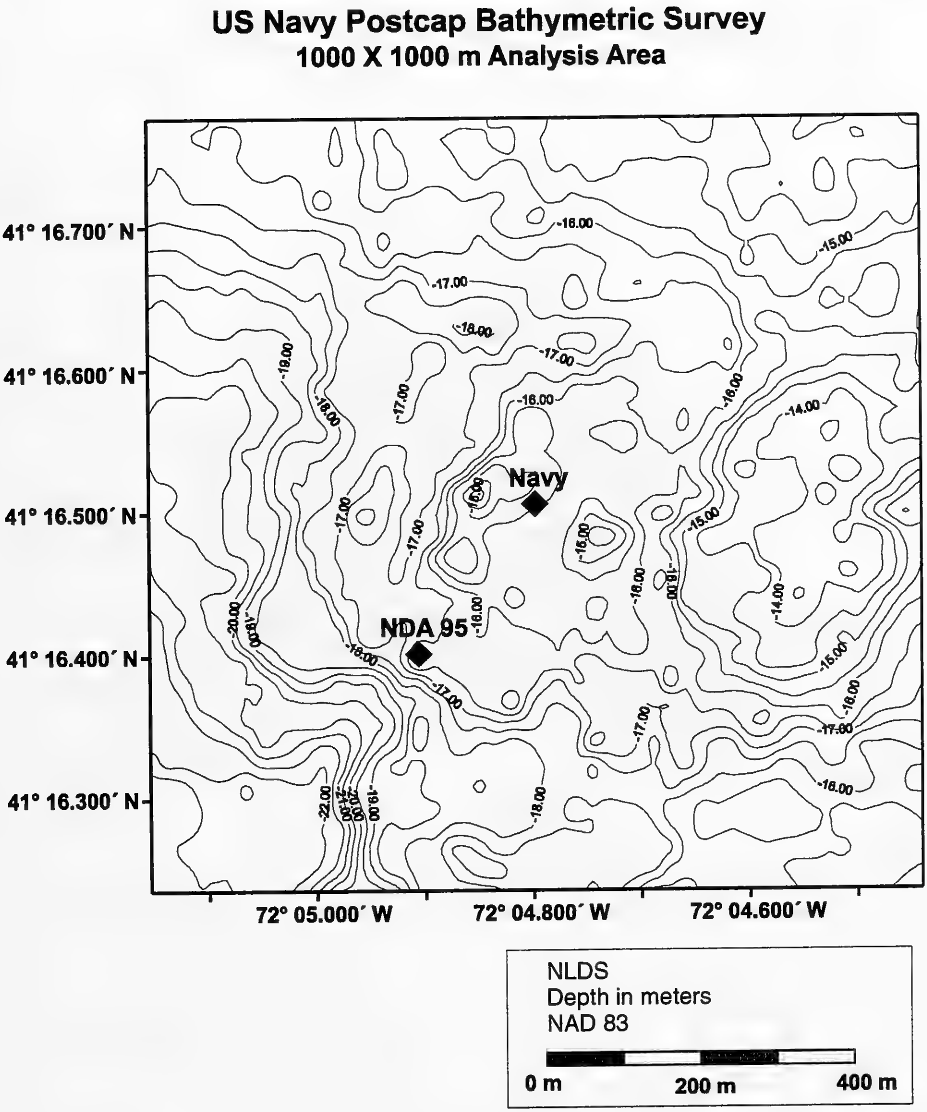


Figure 3-4. Postcap bathymetric survey of the Seawolf Mound area conducted in February 1996 (Gahagan and Bryant)

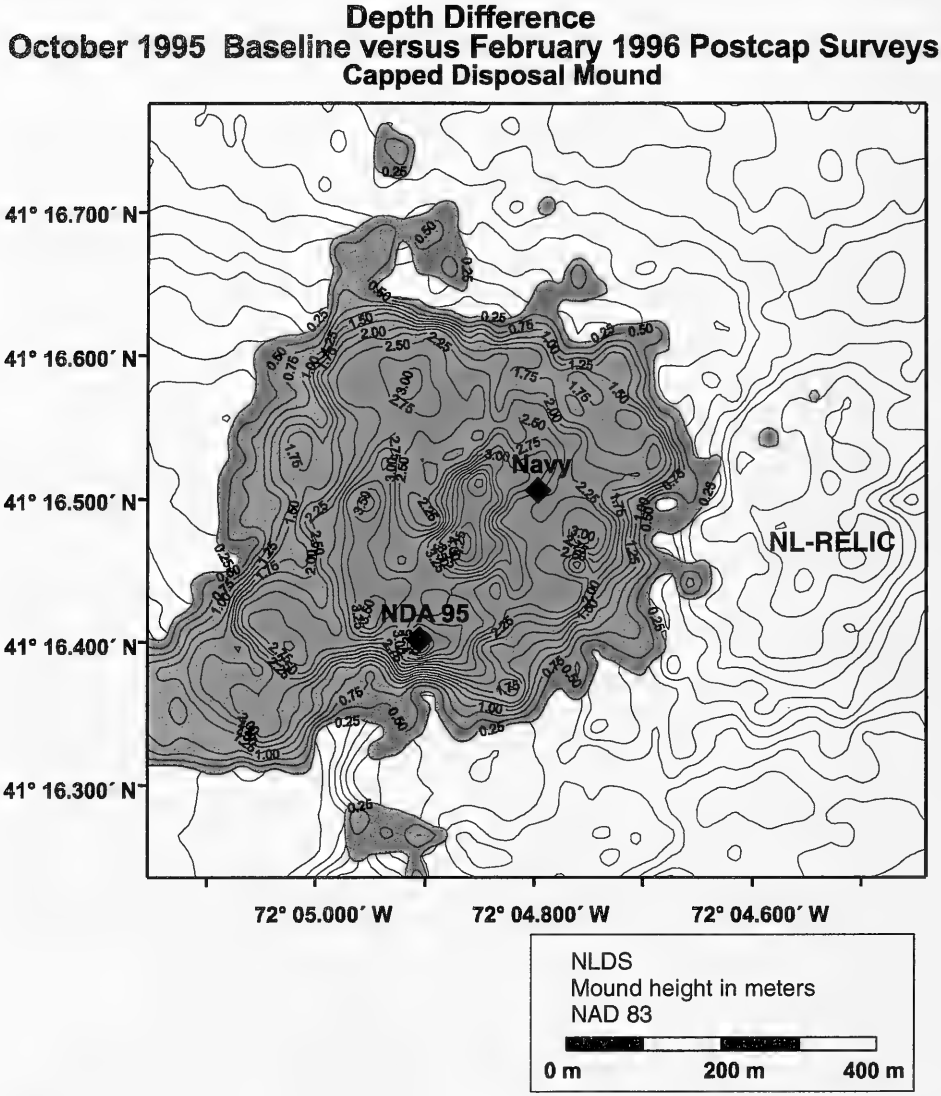


Figure 3-5. Total thickness of capped NL-RELIC Mound (contour interval = 0.25 m) overlaid on baseline bathymetry

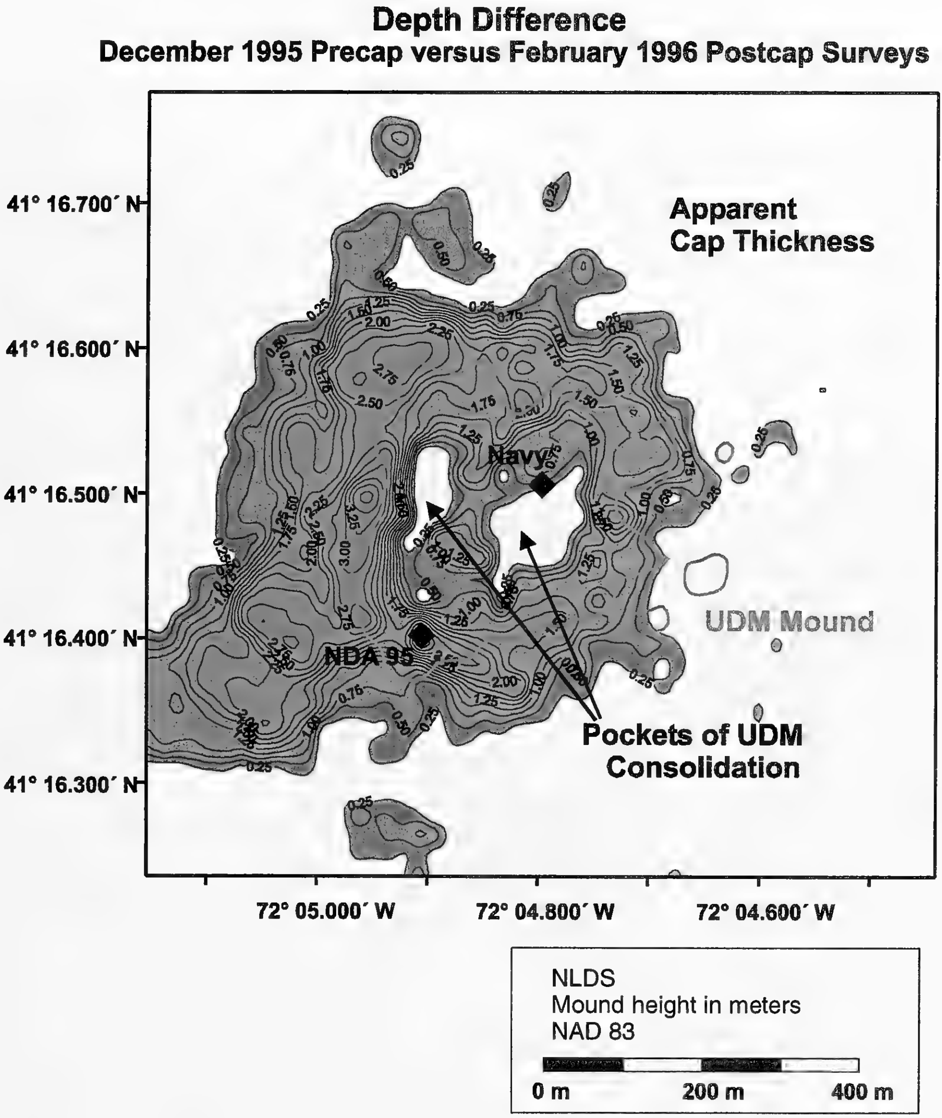


Figure 3-6. Apparent thickness of CDM at the Seawolf Mound (contour interval = 0.25 m). Red line represents extent of UDM deposit (0.25 m contour).

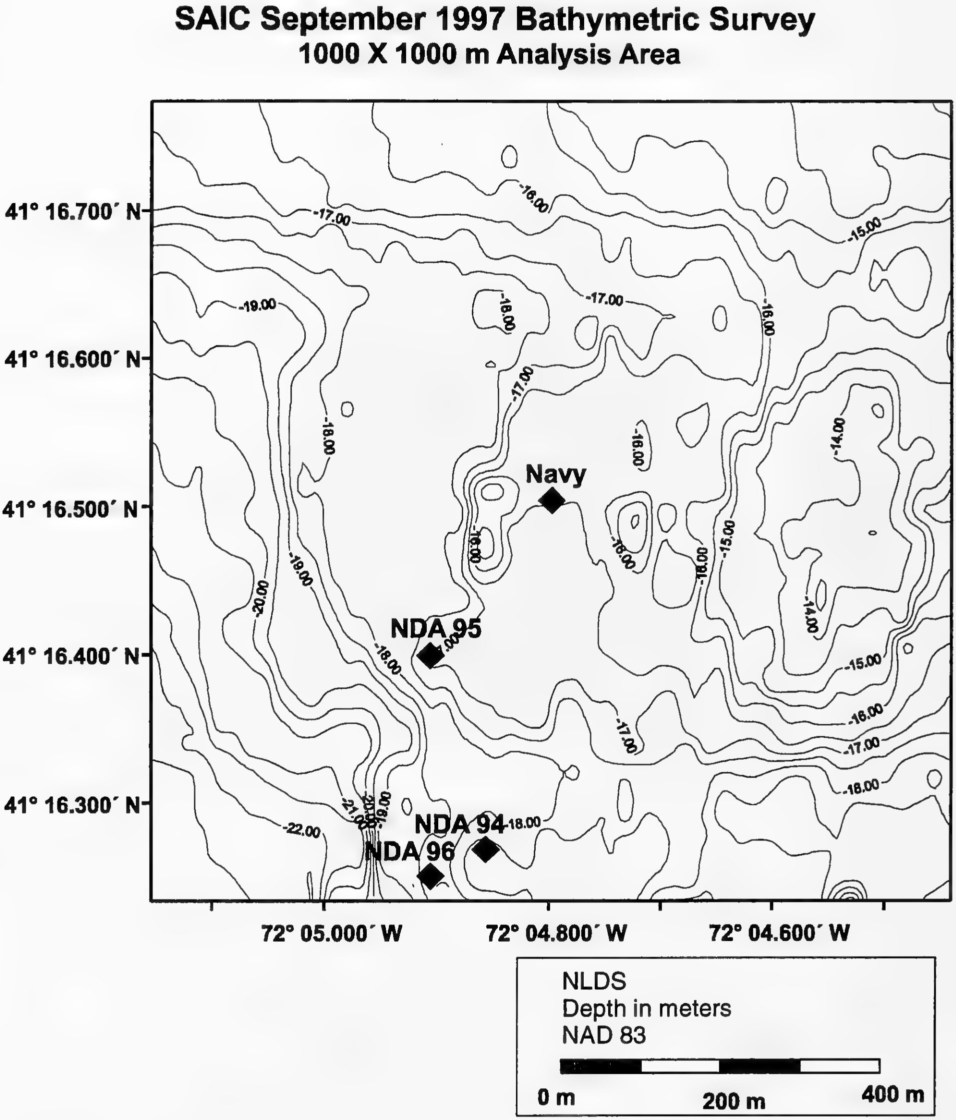


Figure 3-7. Postcap bathymetric survey of the Seawolf Mound area conducted in September 1997

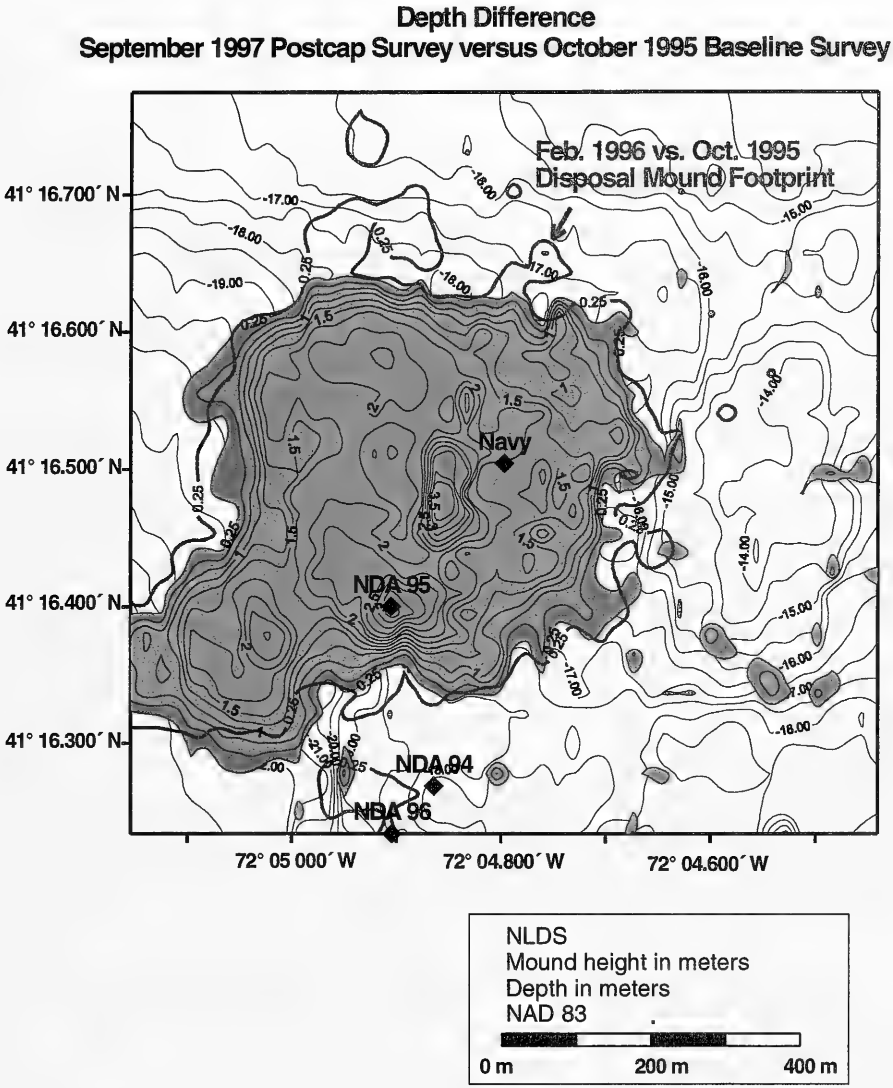


Figure 3-8. Total thickness of capped Seawolf Mound (contour interval = 0.25 m) as measured in September 1997 compared to the February 1996 footprint overlaid on baseline bathymetry.

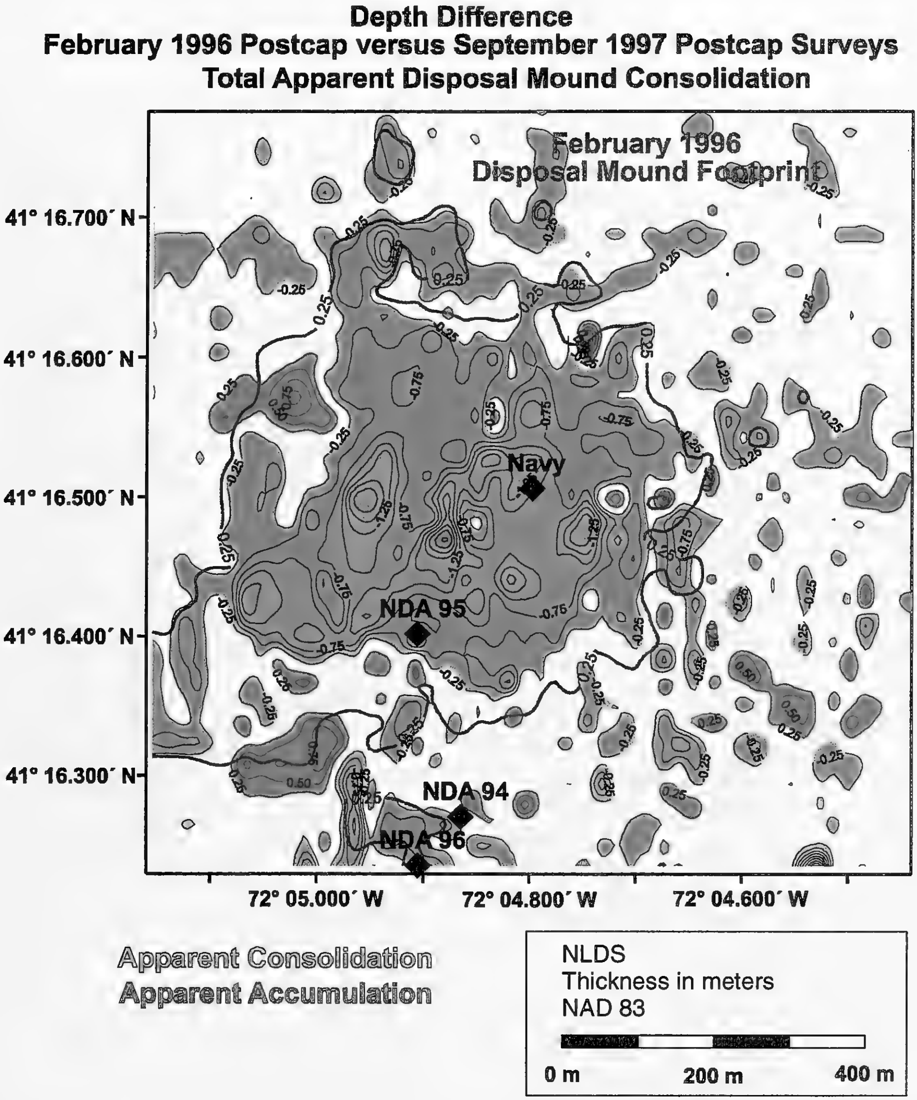
February 1996 and September 1997 surveys serves to confirm that up to 1.5 meters of presumed additional consolidation had occurred, primarily in the central, thicker portions of the mound (Figure 3-9).

A small area of apparent accumulation is visible in Figure 3-9, in the northwestern area over the naturally occurring slope. It is likely that this apparent change does not represent actual net accumulation of material but rather some settling and redistribution of cap material along the apron of the deposit (this result is discussed further in Section 4.2.1). In the southwestern region of the mound, some apparent accumulation is located in the area where additional CDM was placed after the postcap survey. CDM from the Mystic River (4,900 m^3) was placed near the NDA 95 buoy from February 1 to March 11 1996, and 3,400 m^3 material was placed near the NDA 96 buoy during the 1996-97 disposal season. The isolated areas of apparent accumulation in the eastern area of the survey are probably survey artifacts (small errors from sequential surveys, most noticeable over slopes, see Section 2.1.3). The elongated area of apparent consolidation west of NDA 96 is an artifact from the steep slope in this area (see Figure 3-8).

The July 1998 bathymetric survey over the Seawolf Mound showed depths ranging from 13.4 m over the apex of the NL-RELIC Mound to 23.0 m in the southwestern corner of the 1000 × 1000 m area (Figure 3-10). Water depths over the Seawolf Mound varied from 16 to 23 m and the mound area appeared as a flat region with a small oval apex, 50 m × 100 m. Depth difference calculations between the July 1998 survey and the October 1995 baseline survey (pre-Seawolf Project) showed a mound with peak heights of 3 to 4 m above the pre-existing seafloor, with an approximate diameter of 600 m (Figure 3-11). The overall configuration of the Seawolf Mound in 1998 was very similar to that measured in 1997 (Figure 3-8).

The apparent stability of the Mound was further shown by the minimal amount of consolidation calculated for the period between the September 1997 and July 1998 surveys (Figure 3-12). The decrease in the rate of consolidation two years after placement of the cap followed the typical pattern for dredged material mounds, with most of the consolidation occurring within the first year (Poindexter-Rollings 1990).

On the northeast side of the NDA 97 buoy location, a small isolated area of apparent accumulation appeared (Figure 3-12). The disposal logs indicated, however, that no sediment was directed to the NDA 97 buoy, but instead to the NL-91 and D/S Mound Complex (500 m east at the southeast corner of this survey, Figure 1-2). This area of apparent accumulation is located on the same steep slope that produced a survey artifact of consolidation in 1997 (see above). Survey artifacts account for the other isolated apparent increases and decreases of material throughout the survey area (see Section 2.1.3).



Depth Difference
February 1996 Postcap versus September 1997 Postcap Surveys
Total Apparent Disposal Mound Consolidation

Figure 3-9. Thicknesses of apparent consolidation and accumulation of material over the Seawolf Mound, September 1997 (contour interval = 0.25 m).

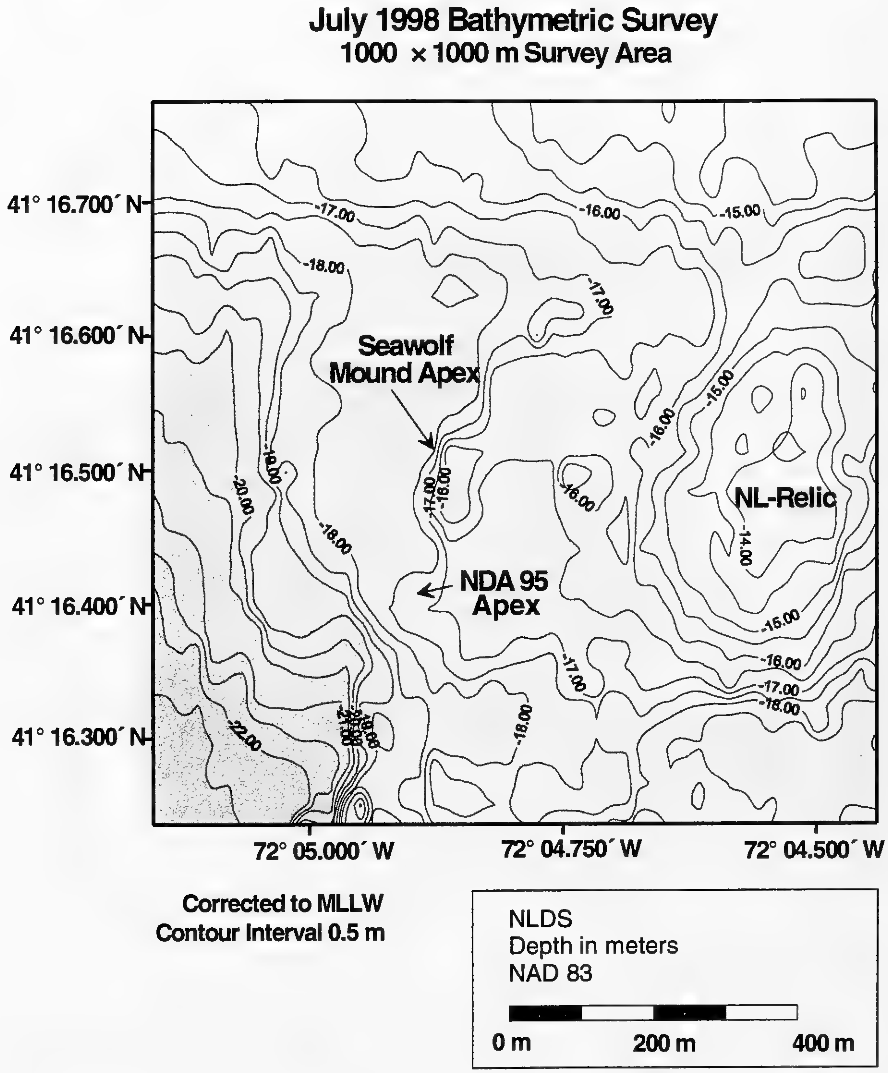


Figure 3-10. Bathymetric chart of the 1000 × 1000 m Seawolf Mound survey area, July 1998.

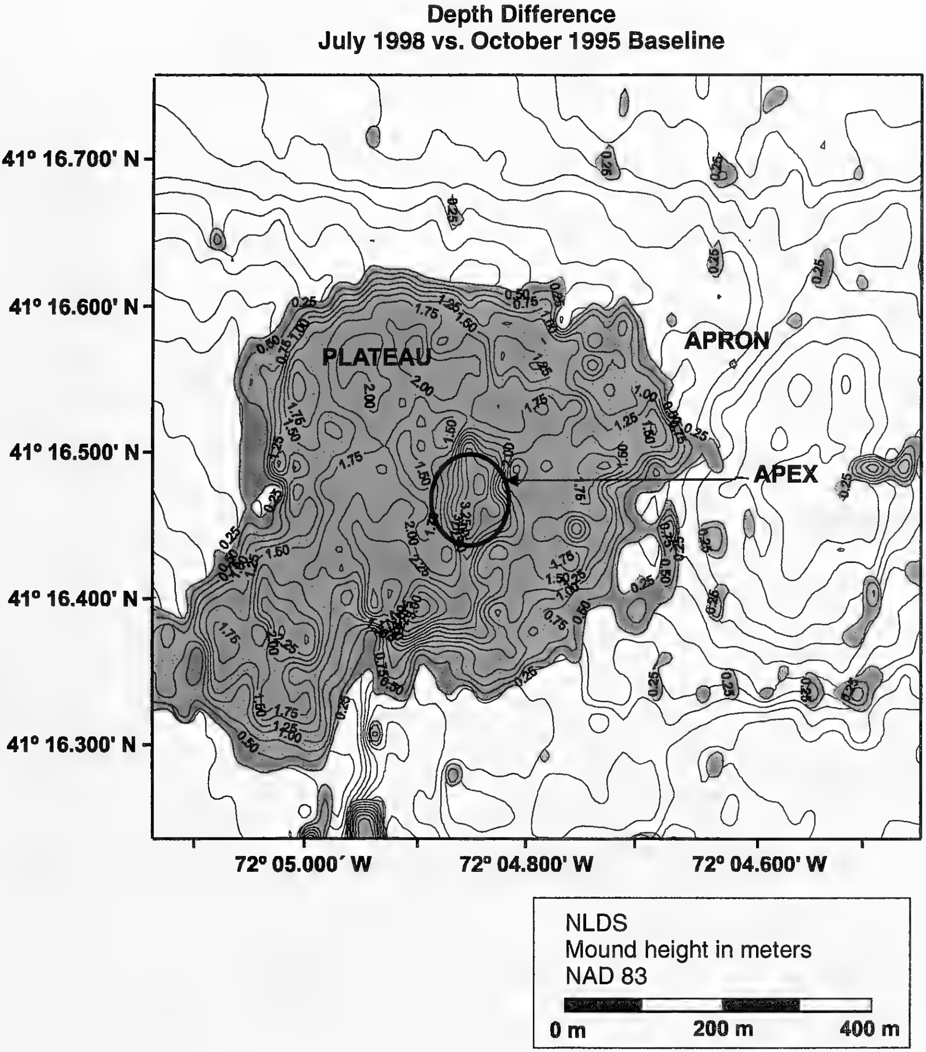


Figure 3-11. Depth difference comparison between 1998 and 1995 1000 × 1000 m bathymetric surveys showing the Seawolf Mound

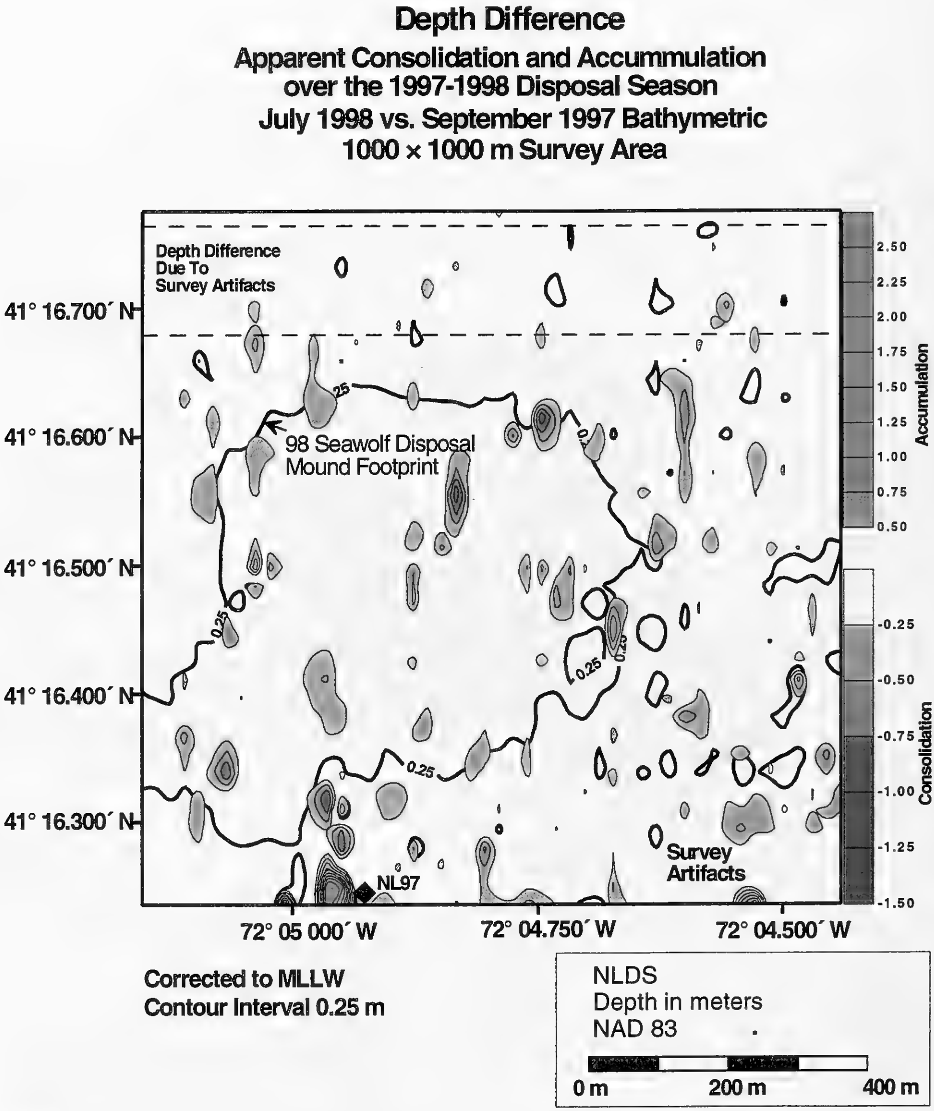


Figure 3-12. Depth difference comparison between 1998 and 1997 1000 × 1000 m bathymetric surveys showing minor consolidation and accumulation.

3.1.2 REMOTS® Sediment-Profile Photography

REMOTS® sediment profile photography was used to document benthic recolonization, map thin layers of dredged material accumulation (below acoustic bathymetric resolution), and assess the overall impact of dredged material deposition over the surface of the Seawolf Mound. Because of the distinct nature of some of the dredged material deposited during capping operations (gray clay from improvement dredging), particular attention was paid to visual evidence of sediment types and physical or biological disturbance. The sampling grid occupied in September 1997 was repeated in July 1998 (see Figure 3-13 and Section 2 for details). The results are presented separately below. Descriptive results refer to the three zones of the capped mound: a small apex; a broad, flat plateau; and a sloping apron. Zones were assigned based on the location of grid samples relative to the bathymetric profile (Figure 3-11). Complete REMOTS® results for the Seawolf Mound for both years are presented in Appendix B.

3.1.2.1 September 1997 Survey

One of the primary objectives of a sediment profile survey after a capping operation is to map the thin layers of dredged material that cannot be reliably detected with detailed bathymetric surveys (layers less than 20-15 cm thick, see Section 2.1.3). Secondly, the nature of the sediment layers near the surface and any progression towards recolonization provide a baseline to compare with reference areas and subsequent surveys.

In September 1997, dredged material was present in all profile photographs collected within 300 m of the center station except for 300W. It is notable that for all replicate stations with dredged material, the observed thickness was greater than penetration (Table 3-1, see Appendix B for replicate values). This means that the camera penetration depth did not exceed the thickness of fresh dredged material, and no ambient sediments were visible except where dredged material was not detected. A mix of silt-clay (>4 phi), more common at the inner stations (within 150 m of center), and very fine sand (4–3 phi) characterized the sediments of the surface of the Seawolf Mound (Table 3-1). Dredged material was described as gray clay in many replicates. The grain size at the inner stations was finer than at the reference areas, which were characterized as very fine sand (Table 3-2). One replicate of Station 150S had coarser grain size (fine sand 3–2 phi). Surface sand overlying fine-grained sediment (sand over mud stratigraphy) was noted for most photographs (Appendix B). Many replicate photographs also showed evidence of a shell lag deposit. The dominant grain size at slightly over half the stations was similar to that measured at the reference areas (major mode primarily 4–3 phi, Table 3-2). About 46% of the stations consisted of silt-clay.

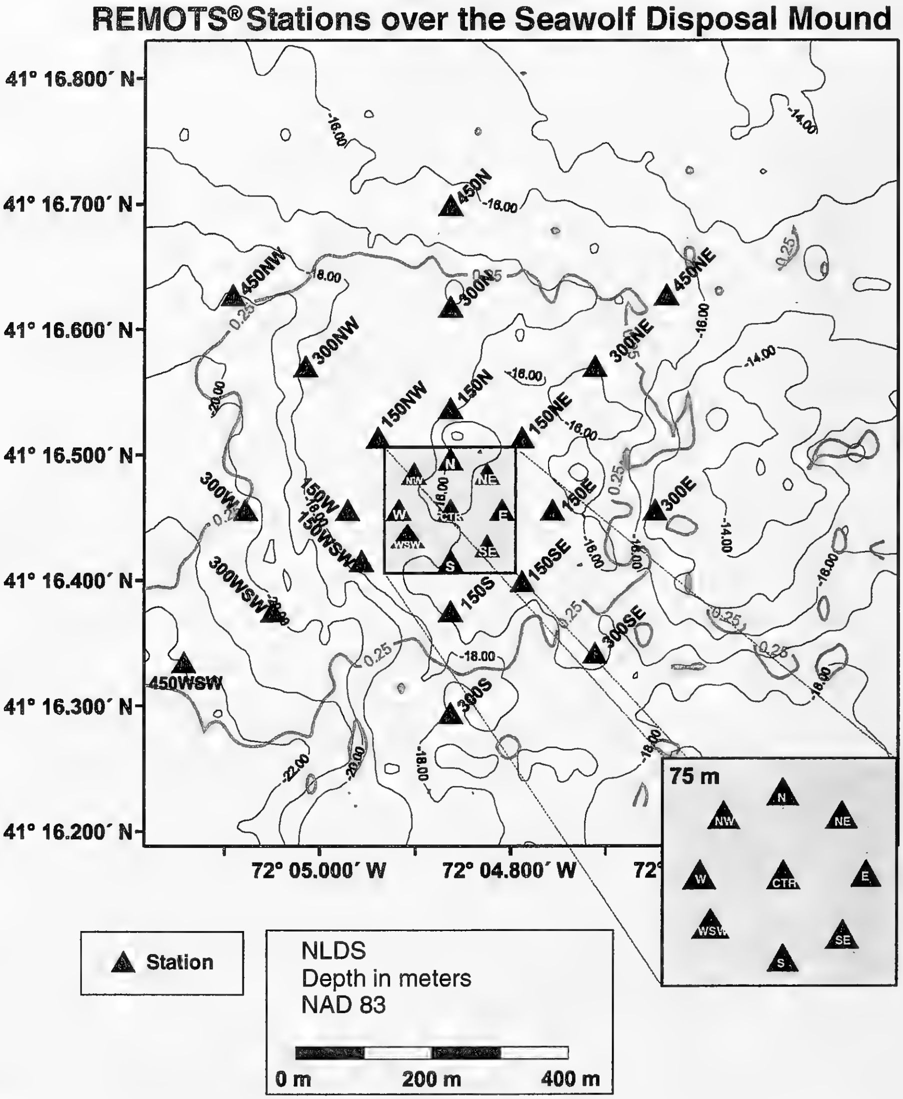


Figure 3-13. Location of Seawolf REMOTS® stations relative to areal extent (0.25 m) of Seawolf dredged material. The Center and 75 m stations are magnified to the right.

Table 3-1
REMOTS® Data Collected at the Seawolf Disposal Mound in September 1997 and July 1998

Seawolf Station	Location	Camera Penetration Mean (cm)		Dredged Material Thickness Mean (cm)**		Number of Reps w/Dredged Material		RPD Mean (cm)		Successional Stages Present		Highest Stage Present		Grain Size Major Mode (phi)		OSI Median		Boundary Roughness	
	Survey:	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998
CTR	Apex	17.02	15.42	>16.85	>15.15	3	3	NA	1.24	INDET	I,II,III	INDET	ST_I_ON_III	>4	>4	NA	6.5	1.4	0.43
75N	Apex	13.50	12.83	>13.41	>12.62	3	3	1.85	1.26	II,III	I,II	ST_III	ST_II	4 to 3	>4	8	4	1.4	1.33
75NE	Plateau	13.72	15.15	>13 66	>15.07	3	3	4.25	1.21	I,II	I,III	ST_II	ST_I_ON_III	>4	>4	9	6	0.9	0.67
75E	Plateau	14 85	14.85	>14.94	>14.64	3	3	0.71	1.63	I,II,III	II,III	ST_II_TO_III	ST_II_ON_III	>4	>4	5.5	7.5	0.8	0.83
75SE	Plateau	13.71	13.57	>13.54	>13.46	3	3	1.51	1.44	I,II,III	I,II,III	ST_III	ST_I_ON_III	4 to 3	>4	6	8	1.0	0.67
75S	Plateau	12.69	14.39	>12.70	>14.55	3	3	1.54	3.29	II,III	I,II	ST_II_ON_III	ST_II	4 to 3	4 to 3	6.5	7	1.2	1.61
75WSW	Plateau	15 23	12.80	>15.16	>12.75	3	2	1.03	0.3	II,III	I,III	ST_II_TO_III	ST_I_ON_III	>4	>4	5.5	6	0.8	1.18
75W	Plateau	16.63	14.79	>16.57	>14.71	3	3	0.98	1.66	I,II,III	I,II	ST_I_ON_III	ST_II	>4	>4	7	6	1.3	0.83
75NW	Plateau	14.24	12.24	>14.31	>12.28	3	3	1.48	1.07	II,III	I,III	ST_II_TO_III	ST_I_ON_III	>4	>4	6	5	0.9	1.9
150N	Apex	11.12	13.16	>11.19	>13.27	3	3	NA	1.76	II	AZOIC,I	ST_II	ST_I	>4	>4	NA	4	0.8	2.07
150NE	Plateau	14.65	12.08	>14.76	>12.05	3	3	1.31	0.81	III	I,II,III	ST_III	ST_II_ON_III	>4	>4	6	7	1.3	1.11
150E	Plateau	14.30	15.78	>14.16	>15.59	3	3	2.07	1.19	I,II,III	I,II,III	ST_II_TO_III	ST_II_TO_III	>4	>4	7	4	1.0	0.8
150SE	Plateau	14.52	13.01	>14.41	>12.94	3	3	5.01	1.46	I,II,III	I,II,III	ST_I_ON_III	ST_I_ON_III	4 to 3	>4	8.5	5	1.0	0.9
150S	Plateau	14.23	13.53	>14.34	>13.31	3	3	4.81	3.75	I,II,III	II,III	ST_II_ON_III	ST_II_ON_III	4 to 3	>4	11	9	0.8	0.74
150WSW	Plateau	15.40	14.38	>15.45	>14.20	3	3	2.76	0.7	I,II,III	I,III	ST_III	ST_I_ON_III	4 to 3	>4	9	6	1.1	0.55
150W	Plateau	14.14	14.47	>14.12	>14.26	3	3	1.59	1.01	I,II	I,III	ST_II	ST_I_ON_III	>4	>4	4	7	0.7	0.69
150NW	Plateau	14.81	14.52	>14.70	>14.46	3	3	NA	1.43	I,II,III	I	ST_I_ON_III	ST_I	>4	>4	NA	3.5	1.3	0.72
300N	Plateau	15.79	15.31	>15.72	>15.06	3	3	2.25	0.89	I,II	I,III	ST_II	ST_I_ON_III	4 to 3	>4	6	7	1.5	1.12
300NE	Plateau	13.54	15.75	>13.48	>15.53	3	3	5.00	0.93	II,III	I,II,III	ST_II_ON_III	ST_II_ON_III	4 to 3	>4	11	5	1.2	1.86
300E	Apron	16.21	11.73	>16.26	>11.62	3	3	NA	2.73	II	I,II,III	ST_II	ST_II_ON_III	4 to 3	4 to 3	NA	9	1.8	1.93
300SE	Apron	11.07	9.96	>11.05	>9.91	3	3	1.91	1.99	II, III	I,II	ST_II_ON_III	ST_II	4 to 3	4 to 3	8	5	1.5	0.84
300S	Apron	12.63	8.66	>12.61	>8.21	3	3	5.21	3.6	I,II,III	I,II	ST_I_ON_III	ST_II	4 to 3	4 to 3	9	8	0.9	1.8
300WSW	Plateau	15.17	14.52	>14.97	>14.45	3	3	0.47	2.06	I,II,III	I,II,III	ST_II_ON_III	ST_II_ON_III	>4	>4	3	3	1.1	1.11
300W	Apron	8.90	8.45	0.00	>8.21	0	3	1.23	1.7	II,III	I,II	ST_II_ON_III	ST_I_TO_II	4 to 3	4 to 3	6	4	0.9	1.55
300NW	Plateau	14.98	14.11	>15.11	>14.10	3	3	4.87	1.99	I,II	I,II,III	ST_II	ST_I_ON_III	>4	>4	7	8.5	0.8	1.34
450N	Apron	7.74	9.69	>6.08	>9.56	2	3	3.89	1.92	I,II,III	I,II,III	ST_II_ON_III	ST_II_ON_III	4 to 3	>4	9	5	0.9	1.13
450NE	Apron	5.38	11.99	>4.71	3.76	2	1	1.96	3.27	I,II	II,III	ST_I_TO_II	ST_II_ON_III	4 to 3	4 to 3	5	8	0.9	1.08
450WSW	Plateau	15.19	15.95	>15 08	>15.71	3	3	0.82	0.98	II,III	I,II,III	ST_II_ON_III	ST_II_ON_III	>4	>4	7	4.5	1.4	0.86
450NW	Apron	8 59	8.61	0 00	>8.72	0	3	3.96	2.61	II,III	I,II,III	ST_III	ST_II_ON_III	4 to 3	4 to 3	9	8	0 6	1.44
AVG		13.45	13.16	>12.74	>12.76	2.72	2.90	2.50	1.72							7.47	6 08	1.08	1.14
MAX		17.02	15.95	>16.85	>15.71	3 00	3.00	5.21	3.75							11	9	1.75	2.07
MIN		5.38	8.45	0.00	3.76	0.00	1.00	0.47	0.30							3	3	0.65	0 43

** Values shown are means for n=3 replicate images obtained and analyzed at each station. If dredged material exceeded the prism penetration depth in at least two replicates, then the mean value shown is a minimum estimate of dredged material layer thickness (indicated by the >sign).

Table 3-2
REMOTS® Data Collected at the NLDS Reference Areas in September 1997 and July 1998

Reference Area Station (97)*	Camera Penetration Mean (cm)		Dredged Material Thickness Mean (cm)		Number of Reps w/Dredged Material		RPD Mean (cm)		Successional Stages Present		Highest Stage Present		Grain Size Major Mode (phi)		OSI Median		Boundary Roughness	
Survey:	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998
NLON Ref																		
STA1	5.04	**6.07**	0.00	**0.00**	0	**0**	2.27	**3.29**	I,II,III	**I,II**	ST_I_ON_III	**ST_II**	4 to 3	**4 to 3**	5	**6**	0.45	**0.42**
STA2	9.90	**9.1**	0.00	**0.00**	0	**0**	2.55	**2.56**	I,II,III	**II,III**	ST_II_ON_III	**ST_II_ON_III**	4 to 3	**4 to 3**	9	**8**	0.77	**0.99**
STA3	4.64	**5.55**	0.00	**0.00**	0	**0**	2.48	**2.52**	II,III	**I,III**	ST_II_TO_III	**ST_I_ON_III**	4 to 3	**4 to 3**	7.5	**5**	0.57	**1.09**
STA4	7.43	**6.95**	0.00	**0.00**	0	**0**	1.81	**2.5**	I,II,III	**I,II**	ST_II_ON_III	**ST_I_TO_II**	4 to 3	**4 to 3**	5	**7**	0.52	**0.53**
NE Ref																		
STA5 (09)	7.25	**7.75**	0.00	**0.00**	0	**0**	1.92	**1.87**	I,II,III	**I,II**	ST_II_ON_III	**ST_II**	4 to 3	**4 to 3**	6	**5.5**	0.39	**0.58**
STA6 (10)	7.11	**8.47**	0.00	**0.00**	0	**0**	2.43	**1.85**	II, III	**II**	ST_II_TO_III	**ST_II**	4 to 3	**>4**	6.5	**6**	1.39	**0.59**
STA7 (11)	8.52	**8.56**	0.00	**0.00**	0	**0**	2.59	**2.01**	I,II	**I,II,III**	ST_II	**ST_I_ON_III**	4 to 3	**4 to 3**	7	**6**	0.58	**1.03**
STA8 (12)	8.25	**7.36**	0.00	**0.00**	0	**0**	2.65	**1.55**	I,II	**I,II,III**	ST_II	**ST_II_ON_III**	4 to 3	**>4**	7	**7**	0.60	**0.92**
STA9 (13)	8.01	**7.21**	0.00	**0.00**	0	**0**	2.07	**1.71**	I,II,III	**I,II**	ST_II_ON_III	**ST_II**	4 to 3	**4 to 3**	8	**5**	0.54	**0.96**
West Ref																		
W10 (05)	6.98	**11.66**	0.00	**0.00**	0	**0**	2.42	**3.68**	I,II	**I,II,III**	ST_II	**ST_I_ON_III**	3 to 2	**4 to 3**	6	**10**	0.77	**1.09**
W11 (06)	10.28	**8.1**	0.00	**0.00**	0	**0**	3.48	**2.9**	II,III	**I,II**	ST_II_ON_III	**ST_I_TO_II**	4 to 3	**4 to 3**	10	**7**	0.83	**1.16**
W12 (07)	5.72	**6.46**	0.00	**0.00**	0	**0**	2.10	**3.98**	II	**NA**	ST_II	**NA**	4 to 3	**3 to 2**	6	**NA**	1.19	**0.72**
W13 (08)	6.16	**8.52**	0.00	**0.00**	0	**0**	1.75	**2.74**	I,II	**II**	ST_II	**ST_II**	4 to 3	**4 to 3**	5.5	**8**	0.92	**1.7**
AVG	7.33	**7.83**	0.00	**0.00**	0.00	**0.00**	2.35	**2.55**							6.81	**6.71**	0.73	**0.91**
MAX	10.28	**11.66**	1.59	**0.00**	0.00	**0.00**	3.48	**3.98**							10	**10**	1.39	**1.70**
MIN	4.64	**5.55**	0.00	**0.00**	0.00	**0.00**	1.75	**1.55**							5	**5**	0.39	**0.42**

Note: *Reference stations were located randomly throughout each Reference area.
Stations in 1997 and 1998 were not at the same location and were numbered differently which is why 1997 stations are in parenthesis.

The penetration depth of the camera serves as a measure of sediment density or compaction. At the reference areas, the replicate-averaged mean camera penetration ranged from 4.6 to 10.3 cm (7.3 cm average; Table 3-2). The recently deposited dredged material at the Seawolf Mound was less consolidated than the reference area sediments, with deeper penetration values at mound stations ranging from 5.4 to 17.0 cm (13.5 cm average; Table 3-1). Lower values in the range were detected on the apron of the mound, where thin layers of dredged material overlaid ambient sediments.

Boundary roughness values at the Seawolf Mound ranged from 0.7 to 1.8 cm, with an average of 1.1 cm, which was higher than the average value measured at the reference areas (0.7 cm). Although there was no obvious spatial pattern of boundary roughness values, several replicates from four stations, including 150E(a), 150S(c), 300N(a and b), and 450NW (a), were identified as having winnowed relief. Shell lag deposits predominated. Boundary roughness at the surface of the Seawolf Mound was primarily attributed to physical forces, as were those at the reference areas, although some surface disturbances were indeterminate or caused by biogenic activity. Further discussion of the potential for physical disturbance of the Seawolf material is provided in Section 4.0.

The apparent redox potential discontinuity (RPD) is measured on each photograph to determine the thickness of the aerobically mixed layer of sediment. The replicate-averaged apparent RPD ranged from 0.47 to 5.2 cm (2.5 cm average; Table 3-1). Although the range of RPD values measured at the Seawolf Mound was wider relative to the replicate-averaged reference values (1.8 to 3.5 cm), the average RPD at Seawolf was close to the reference area average (2.4 cm). A low dissolved oxygen (DO) condition (thin or non-existent apparent RPD) was noted at the sediment surface in only one photograph, 150N(c). Some stations had a visible redox rebound varying between 3 and 10 cm depth.

The successional status was intermediate to advanced, showing healthy Stage II, Stage II to III, or Stage II on III communities inhabiting the sediments of the Seawolf Mound (Table 3-1). In 14 of the 86 replicate images, the infaunal successional stage could not be determined clearly (indeterminate). Stage III organisms were present in 31 replicates and at 21 of 29 stations.

Replicate-averaged OSI values ranged from +3 to +11, with an overall average of +7.1, consistent with the median OSI values (Table 3-1). Although the OSI values were more variable than those at the reference areas (range +5 to +10), the average OSI value for the Seawolf Mound was similar to the reference area average (+6.7; Table 3-2). All stations within 75 m of the center station had average OSI values of ≥+6, except 75E (+5.5) and 75WSW (+5.5). Past mapping experience has shown that OSI values <+6 tend to be associated with stressed environments or early successional populations. The OSI at

Stations CTR, 150N, and 150NW could not be calculated because of an indeterminate successional stage, partially due to smears of gray-black clay from the REMOTS® camera wiper blade obscuring the sediment surface. Outside the central area, stations with average OSI values of <+6 (indicating disturbance) were randomly located (Figure 3-14).

CDM was not detected acoustically at Station 300E (Figures 3-6 and 3-13), but CDM was detected in all three REMOTS® replicates. Figures 3-15 and 3-16 show the sediment profile photographs taken at this station as well as a replicate from the center station for comparison. Glacial gray clay was detected in two of the replicates, 300E B and C, similar to the center station (Figure 3-16). Minor surface scour and Stage II tube mats were apparent at 300E and not at the center station, due to the stations' respective locations on the mound. The color mottling in replicate 300E A (Figure 3-15) indicates multiple source areas of the CDM deposited there. The brown sand and silt is consistent with characteristics of CDM placed in other areas of the mound.

3.1.2.2 July 1998 Survey

In July 1998, dredged material was again present in all of the photographs collected within 300 m of the center station (Table 3-1). For all replicate stations with dredged material, the observed thickness was greater than penetration (Table 3-1, see Appendix B for replicate values). This means that the camera penetration depth did not exceed the thickness of the dredged material layer, and no ambient sediments were visible except in two replicate photographs on the mound apron, where dredged material was not detected.

A mix of silt and clay (>4 phi), which was more common at the inner stations (within 150 m of center), and very fine (4 to 3 phi) sand characterized the near surface sediments of the Seawolf Mound (Table 3-1). The grain size at the inner stations was finer than at the reference areas, which were characterized as very fine sand (Table 3-2). Stations 150N, 150S and 300S each had one replicate with a coarser grain size of fine sand (3 to 2 phi). Surface sand overlying fine-grained sediment (sand-over-mud stratigraphy) was noted for many photographs (Appendix B). The dominant grain size was similar to that measured at the reference areas (major mode primarily 4 to 3 phi), except for the inner stations dominated by silt/clay. Eight stations had a finer major mode size (>4 phi) in 1998 than observed in 1997 (4 to 3 phi).

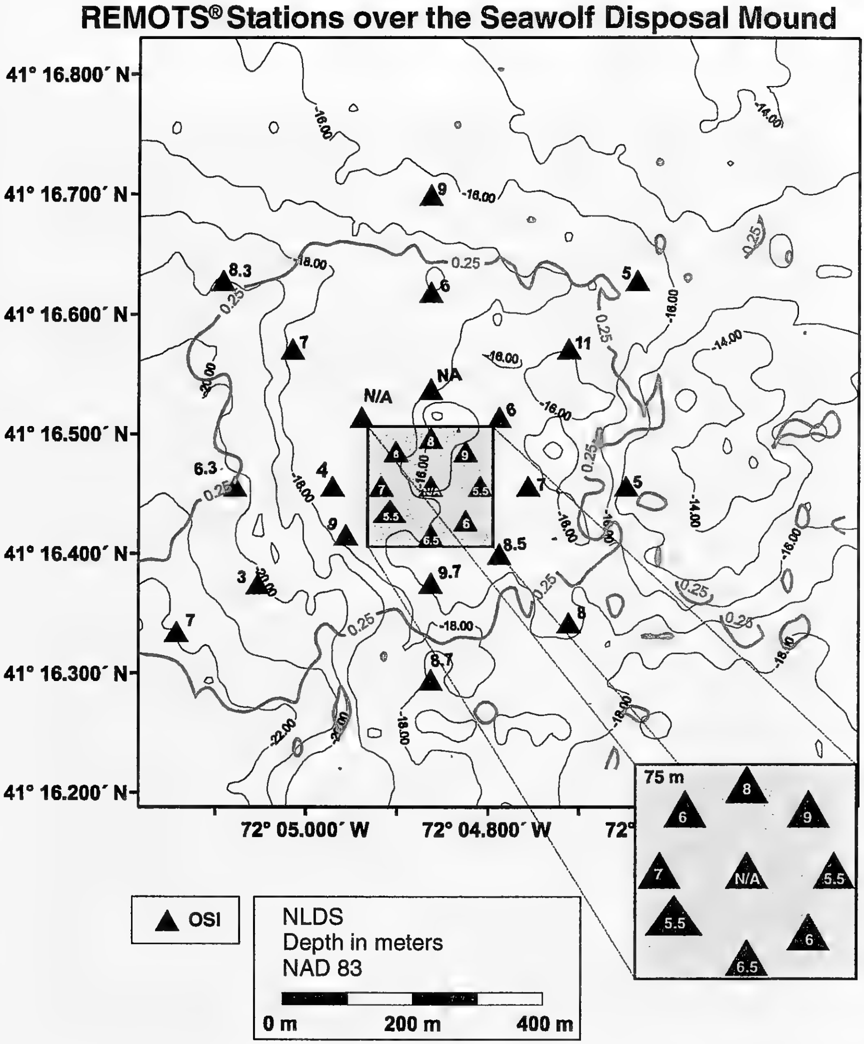


Figure 3-14. Map of average OSI values at the Seawolf Mound REMOTS® stations in 1997. Note: N/A means that the OSI value was not available or indeterminant.

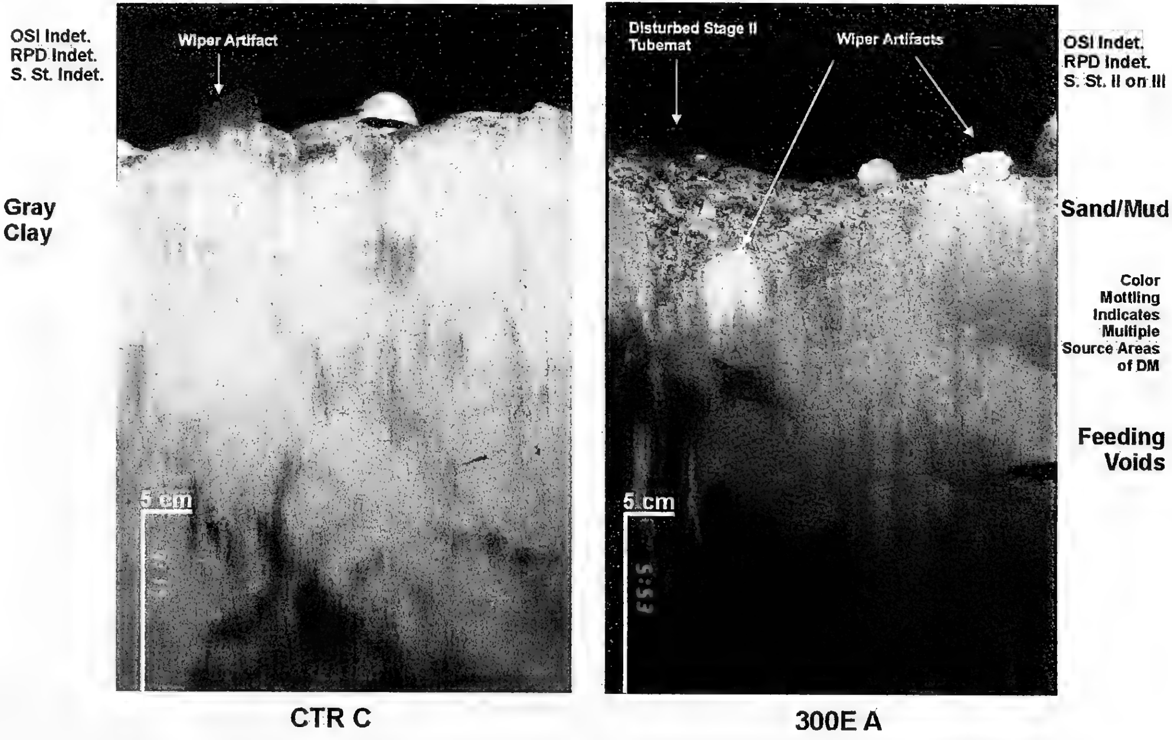
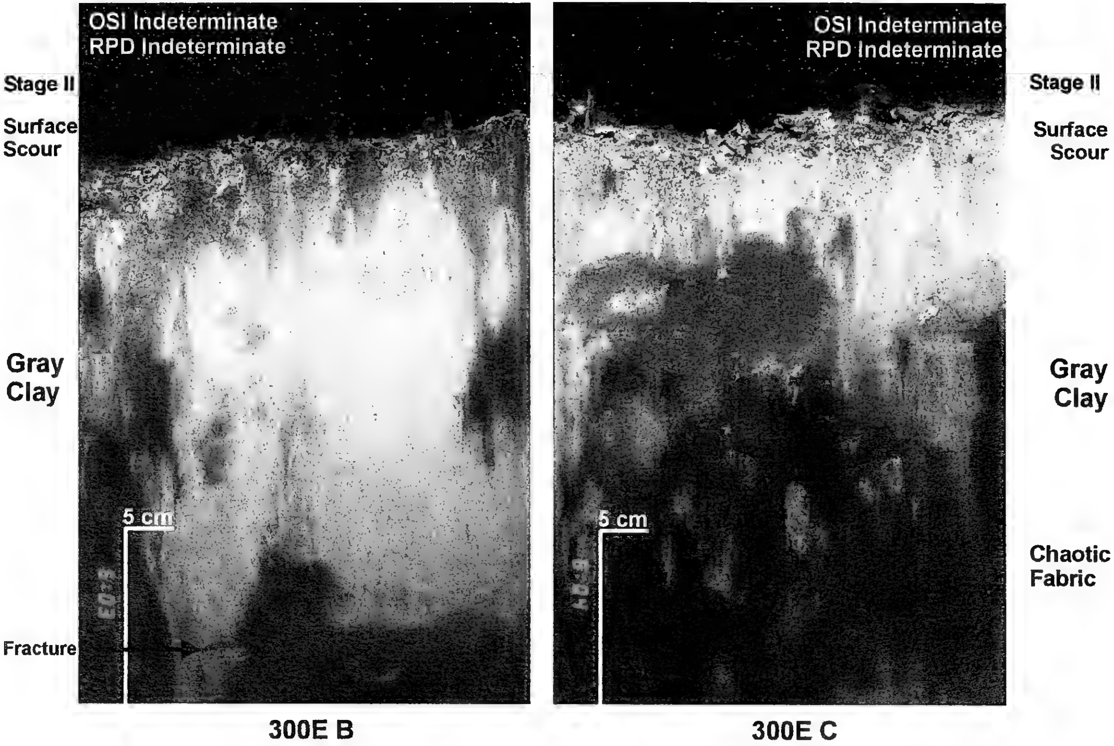


Figure 3-15. REMOTS® sediment-profile photographs from 1997 showing variation in CDM over the Seawolf Mound (glacial gray clay at the center station and brown sand and silt at Station 300E A).



300E B

300E C

Figure 3-16. Detection of glacial gray clay at Station 300E in 1997 provides evidence of capping material.

The penetration depth of the camera serves as a measure of sediment density or compaction. At the three reference areas, (NLON REF, NE REF, and WEST REF), the replicate-averaged mean camera penetration ranged from 5.6 to 11.7 cm (7.8 cm average; Table 3-2) which was similar to that observed in 1997 (7.3 cm). Penetration was shallower at the reference areas relative to the Seawolf Mound because of the presence of less compact, finer grained sediments at the disposal mound. Penetration depths at the Seawolf Mound varied from 8.45 to 15.78 cm, with an average of 13.06 cm. The average camera penetration decreased by 0.39 cm since 1997. This change may be within the range of measurement error and not significant, although the decreasing trend of camera penetration may suggest increased compaction of the dredged material at the surface.

The boundary roughness at the Seawolf Mound ranged from 0.4 to 2.1 cm, with an average of 1.1 cm, which was higher than the average value measured at the reference areas (0.9 cm). There was no obvious spatial pattern of boundary roughness values. Shell lag and surface scour were predominant (Figure 3-4). Shell armoring of the surface was also evident. It is expected that the sand and shell "lag" deposits (large sediment particles that "lag" behind as the finer materials are washed away) would be resistant to further winnowing on the scale experienced regularly. This process is called "textural armoring". Several replicates were also identified as winnowed: 75SE (c), 150SE (a), 150NW (a and b), 300NW (c), and 450NW (c). The 1998 results have similar winnowed areas (which also includes scour lag and surface scour) compared with those observed in 1997. Varieties of surface types were observed across the mound (Figure 3-17). Surface scour and shell lags also were apparent in some of the photographs of the reference areas. Further discussion of the potential for physical disturbance of the Seawolf Mound material is provided in the Discussion (Section 4.0).

The replicate-averaged RPD for each station ranged from 0.30 to 3.75 cm (1.72 cm average; Table 3-1). This value was less than the average calculated for the stations in 1997 (2.5 cm). The implications of the change between 1997 and 1998 are discussed further in Section 4.0. The Seawolf Mound average RPD measured in 1998 also was below the reference area average of 2.6 cm. No low dissolved oxygen (DO) conditions were observed in 1998, compared to one replicate in 1997. Some stations had a visible redox rebound varying in depth between 3 and 10 cm. The shallowest RPDs (<1.2 cm) were observed in replicates on the plateau and apex of the mound, although the station average RPD values had a high spatial variability (Figure 3-18).

The successional status was advanced, with Stage II, Stage II to III, or Stage II on III communities inhabiting the sediments of the Seawolf Mound (Table 3-1). Only two of the 86 replicates were indeterminate, in contrast to the higher number classified as

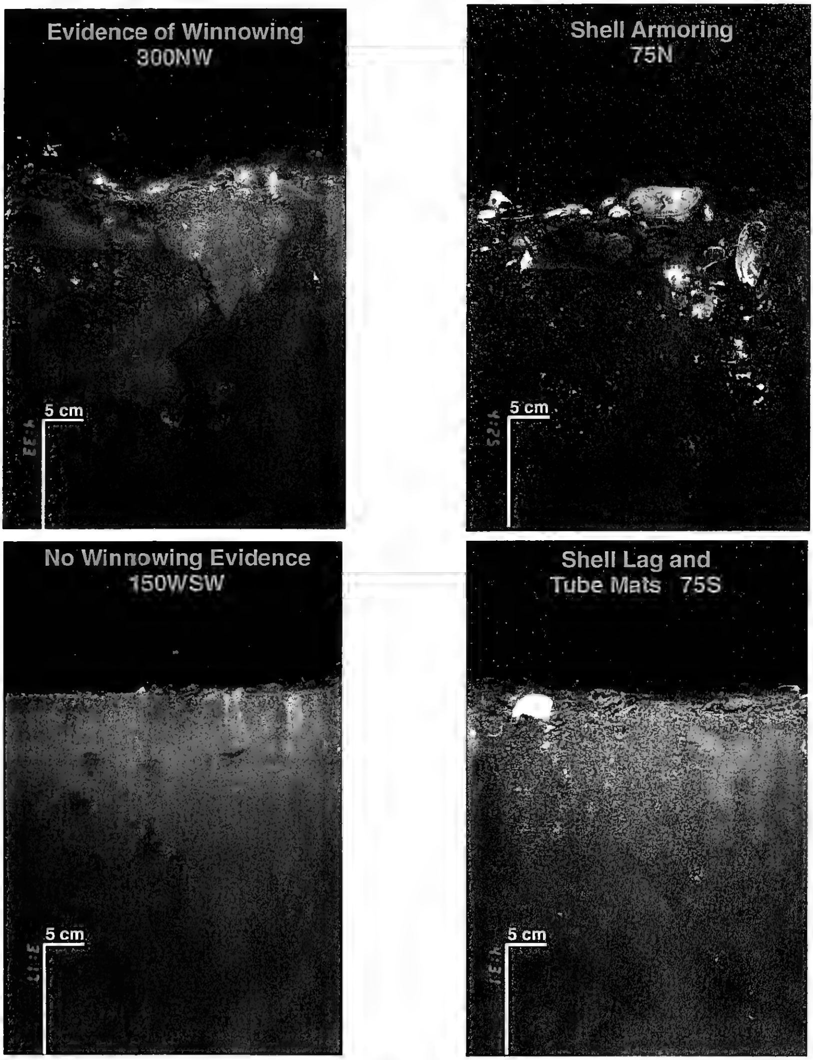


Figure 3-17. Seawolf Mound REMOTS® stations showing variable surface conditions

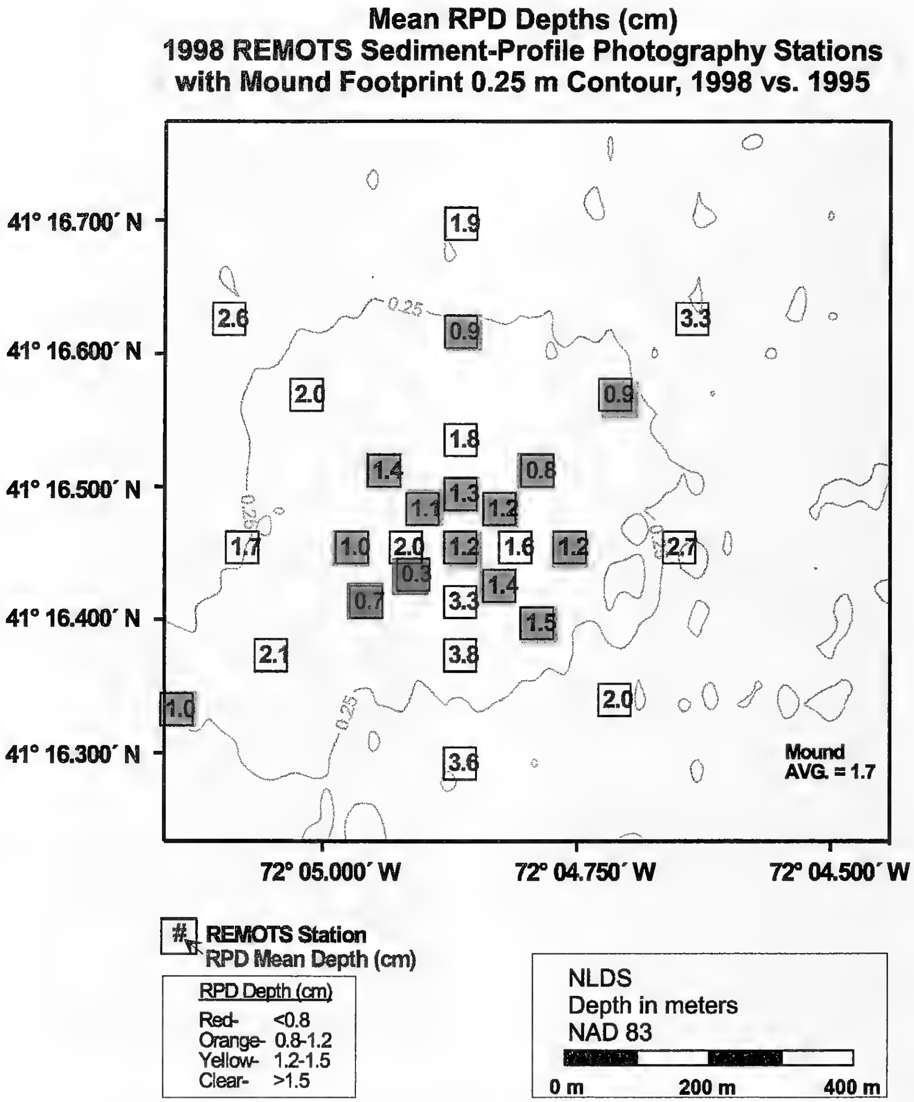


Figure 3-18. Mean RPD depths (cm) over the Seawolf Mound in 1998

indeterminate in 1997 (Figure 3-14). Consistent with 1997 results, Stage III organisms were present at many stations of the 1998 survey (21 of 29 stations). One replicate at 150N, located on the apex of the mound, was classified as azoic. Many of the Stage II amphipod tube mats appeared to be disturbed. However, large chaetopterid tubes with hydroids were visible in several replicates, suggesting advanced recolonization over the Seawolf Mound dredged material with limited winnowing (Figure 3-19). These replicates also showed the widespread distribution of gray clay over the Seawolf Mound.

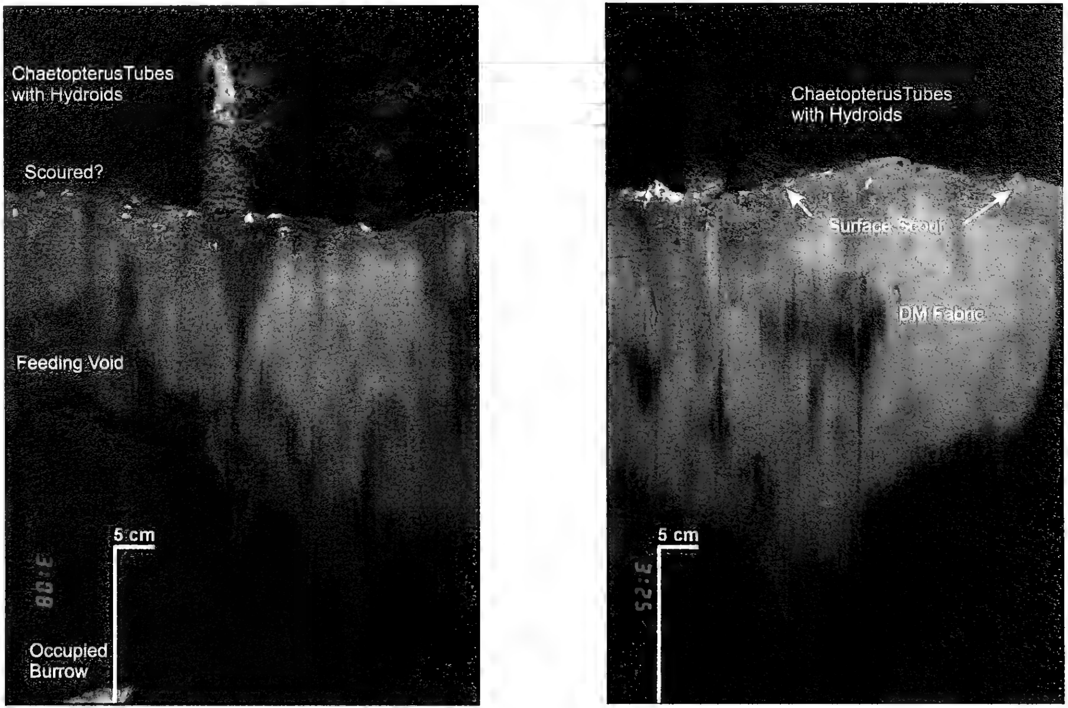
The presence of gray clay may affect the successional status and the measured RPD, both of which are used to calculate the OSI values (Volume I, SAIC 2001). Gray clay was detected only on the apex and plateau region of the mound (Figure 3-20). Sulfidic, organic-rich sediments may also affect recolonization rates and dissolved oxygen levels. Patchy sulfidic sediments were observed in sediment-profile photographs collected over the apex and plateau of the mound. Some sulfidic sediment was also seen on the apron of the mound and was similar to sediments seen in some of the replicates from NE REF.

The median of replicate OSI values ranged from +3 to +9, with an overall average of +6.1 (Table 3-1, Figure 3-21). The Seawolf Mound median OSI values were slightly below those of the reference area, which varied between +5.0 to +10.0 (+6.7 average), and the 1997 Seawolf average of +7.5.

3.1.3 Benthic Community Analysis

Analysis of benthic grab samples collected in September 1997 indicated that the Seawolf Mound was in the intermediate stages of recolonization, with abundances of organisms increasing with distance from the center of the mound. The total number of individuals sorted from the six Seawolf benthic grab samples was 2,600, of which 100 taxa were identified (Blake and Williams 1997; Appendix C). Of the species used for all analyses, nearly half were polychaetes (39 species). Additional taxa included, (in order of number of species present): amphipods, bivalves, gastropods, decapods, isopods, one mysid, a small number of nemerteans, oligochaetes, phoronids, echinoderms, hemichordates, and chordates (treated as one taxon each).

The center (CTR) station (Figure 2-5) had the lowest faunal abundance, with only 50 individuals belonging to 17 taxa. Station 75E had 200 individuals belonging to 26 taxa. Two stations were sampled 150 m from the center station, and both had nearly twice the number of species as measured at 75E. At 150N, 50 taxa were counted, with twice as many animals, notably *Nucula annulata* (301 individuals), relative to 150W (46 taxa). Faunal abundances were greatest at the two stations sampled 300 m from the center: at 300WSW, 518 animals belonging to 54 taxa were counted, and at 300SE, 1118 animals belonging to 66 taxa were counted. The trend of increasing faunal abundance with distance from the



A. 400WSW

B. 75W

Figure 3-19. Evidence of advanced benthic recolonization and limited winnowing in 1998.

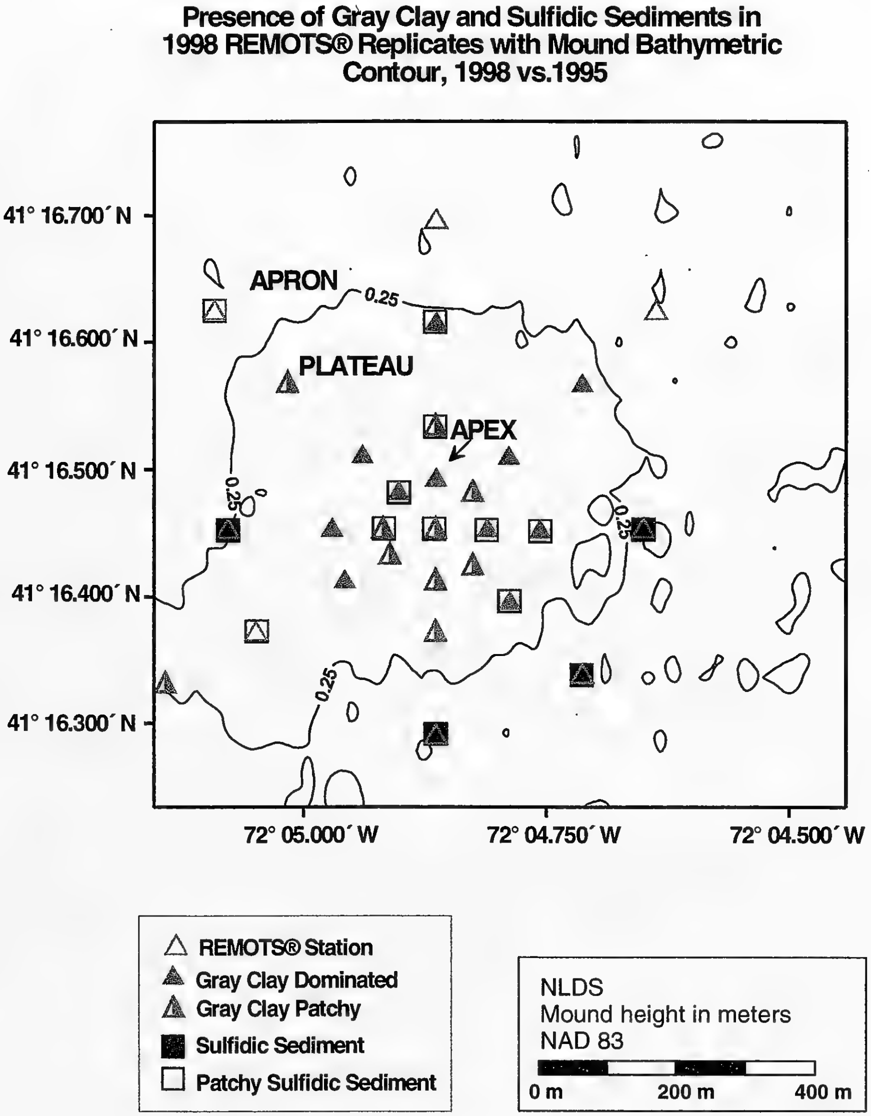


Figure 3-20. Presence of gray clay and sulfidic sediments (at depth) in 1998 REMOTS® replicates

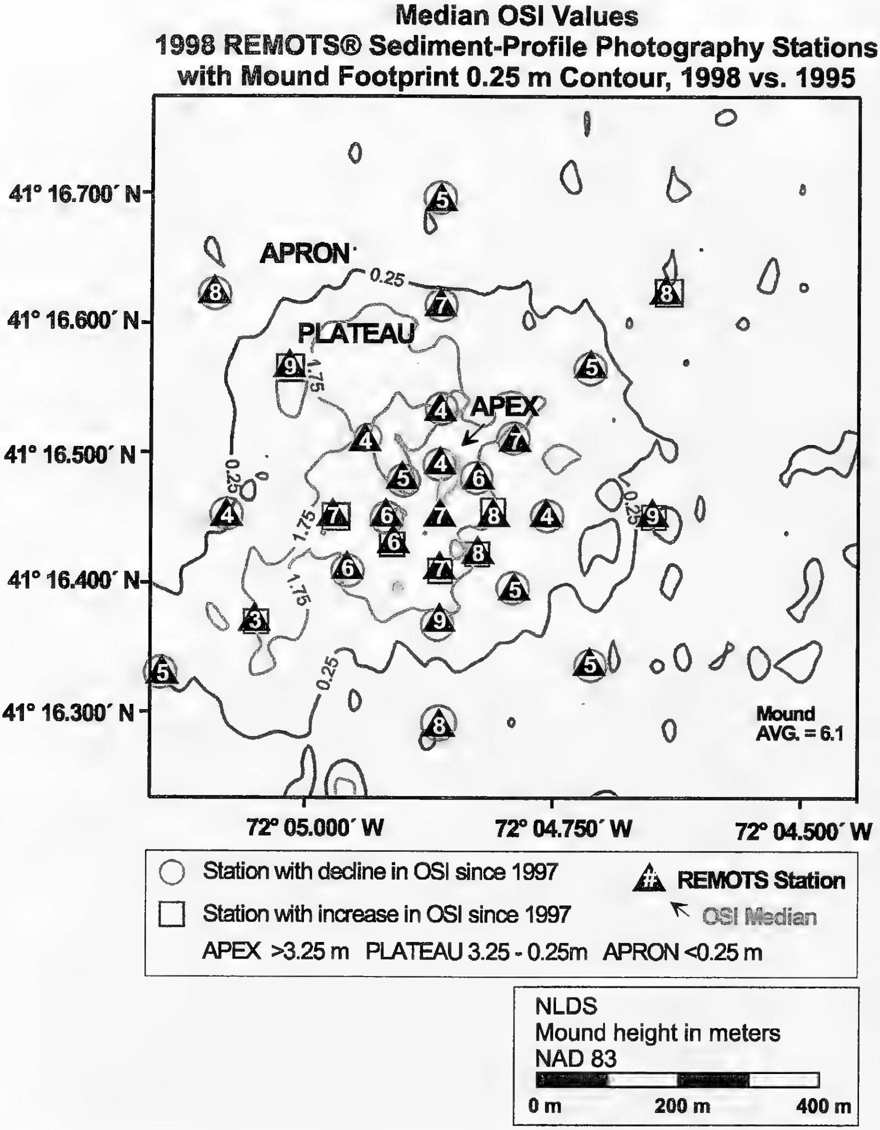


Figure 3-21. Median OSI values over the Seawolf Mound and changes relative to 1997 survey

center of the mound also was apparent in density calculations, ranging from 1.25×10^3 individuals/m^2 at CTR to 2.75×10^4 individuals/m^2 at 300SE.

Polychaetes, with 12 species belonging to nine different families, constituted the largest taxonomic group among the top ten dominant species from each station (Appendix D; Tables 2, 3, 4). The second largest groups were bivalves (four species), with *Nucula annulata* extremely abundant, and amphipods (genus *Ampelisca*). Two gastropod taxa, one decapod, and one oligochaeta spp. complete the list of the dominant taxa (Williams and Blake 1997).

The most dominant species was the bivalve *Nucula annulata,* which was among the top ten dominants at all six stations. The polychaetes *Mediomastus ambiseta* and *Prionospio steenstrupi* were among the most abundant species at all stations, ranking with the top three species at four stations. The polychaete *Tharyx acutus* and the gastropod genus *Crepidula* were represented among the top ten dominants at four and five stations, respectively.

Species diversity, as calculated by the Shannon-Wiener index H' (Section 2.0, Methods), ranged from a low of 2.65 at Station 150N to 4.10 and 3.91 at Stations 150W and 300WSW, respectively (Table 3-3). The low diversity value at Station 150N was attributed to the dominant presence of *Nucula annulata*. These Stage II deposit feeders physically stir up the surficial sediment thereby decreasing the availability of suitable benthic habitat for colonization by other species (Section 4). The diversity at Station CTR was relatively high considering the low abundance of individuals. The high diversity relative to low species abundance is indicative of an early stage of succession (Pearson and Rosenberg 1978). The Shannon-Wiener index J', calculated for species evenness (Section 2.0, Methods), ranged from 0.48 at Station 150N to 0.82 at Station CTR (Table 3-3).

Rarefaction curves, showing the relative effect of species density and diversity, were developed for the Seawolf samples (Figure 3-22, see Section 4.2.2.3 for discussion of rarefaction curves). Samples collected at the center and 75 m from the center had relatively lower species abundances and lower to moderate diversity values. The stations 150 and 300 m away from the center had two to three times as many taxa as the two more central stations. Stations 150N and 300SE had lower to moderate diversity values; lower evenness values, and therefore followed a similar rarefaction curve. Station 75E had similar diversity and evenness values as 150N and 300SE, but the low species abundance depressed the rarefaction curve. The westerly stations had the highest diversity values, with moderately high evenness, and therefore were aligned along a similar rarefaction curve (Table 3-3 and Figure 3-22). The implication of the abundance and diversity information relative to the REMOTS® results is discussed in Section 4.

Table 3-3
Benthic Community Parameters at the NLDS Seawolf Disposal Mound

Station	Number of Species (0.04 m^2)	Number of Individuals (0.04 m2)	Diversity (Hurlbert's Rarefaction) spp./10 ind.	spp./25 ind.	spp./50 ind.	spp./100 ind.	spp./200 ind.	spp./400 ind.	spp./800 ind.	Shannon-Wiener H'	Evenness J'
Center	16	49	7	13	-	-	-	-	-	3.27	0.82
75E	25	196	6	10	14	19	-	-	-	3.16	0.68
150N	47	493	4	8	14	22	31	42	-	2.65	0.48
150W	42	206	7	14	22	31	41	-	-	4.1	0.76
300WSW	49	496	7	12	19	27	38	46	-	3.91	0.7
300E	57	1093	7	11	16	24	34	45	53	3.66	0.63

\- Sample too small to measure this parameter.

Species excluded from the calculation of H'

Center	75E	150N	150W	300WSW	300SE
Ampharetidae spp. - 1 ind.	Ampharetidae spp. - 4 ind.	Ampharetidae spp. - 9 ind.	Ampharetidae spp. - 3 ind.	Ampharetidae spp. - 11 ind.	Lumbrineridae spp. - 7 ind
		Tharyx spp. - 1 ind.	Tharyx spp. - 1 ind.	Maldanidae spp. - 5 ind.	Tharyx spp. - 5 ind.
			Glycera spp. - 1 ind.	Polycirrus spp. - 3 ind.	Ampharetidae spp 4 ind.
				Glycera spp. - 2 ind.	Pagurus spp. - 3 ind
				Odostomia spp. - 1 ind.	Polycirrus spp. - 2 ind.
					Eunicidae spp. - 1 ind.
					Terebellidae spp. - 1 ind.
					Crepidula spp. - 1 ind.
					Astarte spp. - 1 ind

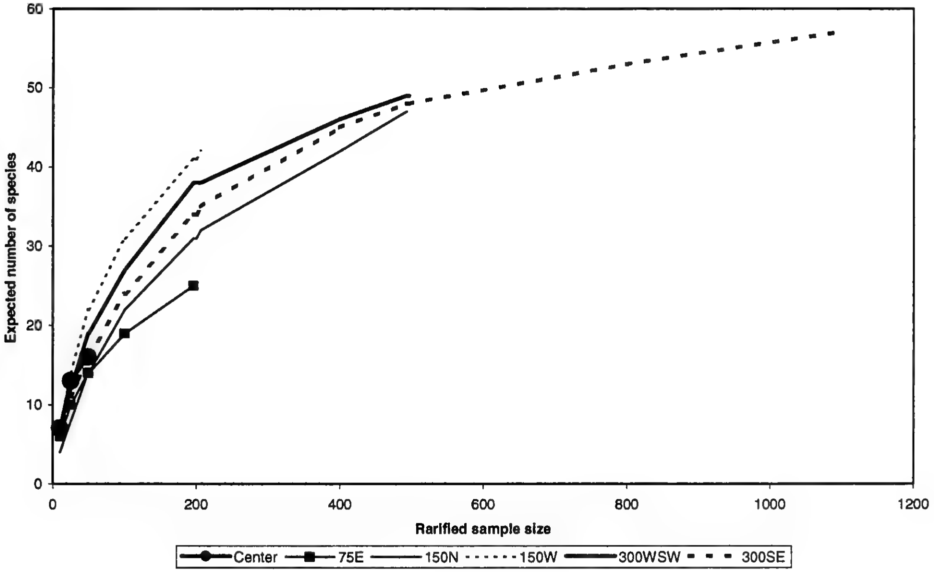


Figure 3-22. Rarefaction curves showing the relative effect of species density and diversity.

3.1.4 Sediment Coring

Sediment cores were collected in 1997 and 1998 in a sampling pattern of concentric zones defined by the monitoring plan (see Section 2, Figure 2-6). The objectives of this sampling were to assess the physical and chemical composition of the sediments near the surface of the mound and to verify the presence of at least 50 cm of cap material.

The physical and geochemical measurements from the cores are reported in comparison to the following: a core collected simultaneously at the reference area (WEST REF); historic NLDS reference area values used as guidelines in permitting for NLDS (Murray 1995); and samples collected from the dredging area (Maguire Group 1995). Data from the dredging area were classified, based upon location within the Thames River, as "UDM" and "CDM," assuming that the dredging sequence followed the project design (Appendix E). For the Seawolf project, sediments were dredged from the Thames River channel between the I-95 Bridge and Navy Pier 33. The sediments from Piers 31 to 33 and the central channel were classified as UDM, while sediments from the northern and southern regions of the channel were classified as CDM based on chemical and biological testing. Sediments were tested in 1990, 1992, and 1994 (Maguire Group 1995). There were some discrepancies between the three sediment chemistry datasets used for comparison. The samples collected from sediment cores, tested in 1990, represented sediments planned to be dredged to a depth of -43 feet mean low water (MLW). The regulatory agencies reviewed the data and determined that further testing was required. In 1992, surface layer (0 to 3 feet) and deeper sediment (>3 feet) samples were collected using a clamshell bucket. Because of the different sampling techniques employed, the samples from 1992 and 1990 could not be statistically compared.

The 1992 data did reveal that the near-surface sediments contained higher contaminant levels than deeper sediments. In 1994, the required dredging depth was reduced to –41 feet because the submarines were shown to be capable of transiting in a water depth of 39 feet. The regulatory agencies conducted further testing for the revised dredging depth using the same coring method as 1990. Although some differences in detection limits were observed, the 1990 and 1994 sediment chemistry data were generally comparable. The grain size analyses varied significantly in samples taken from nearby locations in 1990 and 1994. In 1990, the average fraction reported as "percent silt or finer" was 46.6% with reasonable variation around the mean. All of the samples collected in 1994 were reported as 100% silt or finer. No grain size data were reported in 1992. For comparison purposes, only grain size data from 1990 were reported.

3.1.4.1 September 1997

1997 Visual Descriptions

The lengths of the twelve short cores collected in 1997 ranged from 59 cm (2A) to 153 cm (12A), and the length of the three long cores ranged from 222 to 276 cm (Table 2-6). All cores were comprised predominantly of olive gray silty clay, with common darker black olive gray sediment (Appendix D). Shell hash, black mottling, and streaks were common throughout many of the cores. Discrete gravel and sand layers were present deeper (generally >100 cm) in several short cores (1A, 5A, 7A) and in the deepest intervals of long cores 4A (>160 cm) and 10A (178–276 cm). The deep unit in 10A (178–276 cm) described as black and "oily," was the only apparent indication of recovery of UDM. The olive gray silty sand layers found deep in the other cores (1A, 4A, 5A, and 7A) were similar to the sediment recovered in the reference core (13A) from WEST REF.

There were strong odors emitted from the sediment in several of the cores. Core 5A had an odor best described as a "sewer" or "septic-system" smell in the middle to lower section. Core 9A also had a sewer odor and "rotten egg" (hydrogen sulfide) odor in the upper section. Below 73 cm, Core 9A had an unidentifiable industrial (petroleum or chemical solvent) odor, as did Cores 2A and 2B throughout and Core 1A below 100 cm. Core 3A and 8A emitted a hydrogen sulfide odor. The lowest section of Core 10A had a distinct petroleum odor. Such observations are obviously limited by subjectivity and the dulling of the sense of smell that occurs with prolonged exposure during core processing. In general, strong sulfide odors are associated with high organic content sediments typically found in embayments, salt marshes and harbors, they are not necessarily associated with sewage. Industrial and petroleum odors are associated with sediments that have been deposited in association with anthropogenic discharges from point and non-point sources. Both sets of smells are indicative of dredged material in the context of the NLDS (ambient sediments at NLDS are not highly sulfidic or enriched in petroleum or industrial compounds).

1997 Physical Parameters

Moisture Content. The moisture content was nearly uniform throughout the core samples, ranging from 48 to 56% (Table 3-4). The average moisture content of samples collected from the upper sediment (0–50 cm; short cores) in all three zones was uniformly 52– 54%, while the average of samples collected below this interface (>50 cm) in the long cores was slightly lower (49.6%). All of the values of moisture content from the Seawolf cores were significantly higher than measured in the core from the WEST REF reference area (28.6%), primarily due to the difference in sediment grain size (see below).

Grain Size. The balance between the gravel/sand (coarse fraction) and silt/clay (fine fraction) content of the Seawolf Mound core samples was quite consistent among all of the samples from all of the cores. The fine fraction ranged from 63 to 95%, with an average of 81% and a narrow standard deviation of 9.5% (Table 3-4). Comparing the average silt/clay concentration of samples collected in the upper 50 cm of the three zones around the Seawolf Mound, the inner and outer zones were most similar (80%) with the lowest occurrence (69%) in the middle zone. On average, the long cores had the highest fine fraction (88.6%). It appears that sediments sampled in the middle zone were enriched in sand compared to the other zones and that the long cores had consistently high silt and clay content throughout their lengths (Table 3-4).

The grain size of the Seawolf Mound cores was clearly different from the WEST REF core which was dominated by sand (72%). The average silt and clay fraction of the core samples (81%) was markedly higher than the average of both the pre-dredge UDM (43%) and CDM (47%) samples collected in 1990 (Maguire Group). The reported fine-grained fraction (silt and clay) measured in 1994, however, was 100%.

TOC. Concentrations of total organic carbon (TOC) measured in all of the cores ranged from 1.1 to 2.9%, with an average of 2.1% (Table 3-4). The majority of values were greater than 1.8%, except for one short core sample from the outer zone (2A). The averaged TOC values from the surface samples (0–50 cm) in each zone were higher in the inner zone (2.23%) and lower in the middle and outer zones (2.1%). The sediment collected below the upper 50 cm in the long cores had the highest average TOC concentration (2.26%). Consistent with the grain size data, the measured TOC values in the core samples from the Seawolf Mound were all higher than the value of 0.5% measured at WEST REF. No TOC data were reported for the pre-dredge samples.

1997 Geochemistry

Metals. Arsenic and cadmium were not detected in any sample, at detection limits ranging from 14–15 ppm (As) and approximately 0.6 ppm (Cd; Table 3-5). Of the other measured metals, the average concentrations were consistently highest in the short cores of the inner zone for all metals, and lowest in the outer zone for copper (Cu), nickel (Ni), and zinc (Zn). Zone-averaged Cu values ranged from 24.4 mg/kg (outer zone) to 28.1 mg/kg (middle zone) to 34.6 mg/kg (inner zone), although there was much intra-zone variability (Table 3-5). Similarly, zone-averaged Ni ranged from 20.7 mg/kg (outer zone) to 21.5 mg/kg (middle zone) to 25.4 mg/kg (inner zone), and Zn ranged from 82.7 mg/kg (outer zone) to 103.6 mg/kg (middle zone) to 131.0 mg/kg (inner zone).

Table 3-4
Results of Physical Analysis of Samples Collected from the Seawolf Mound Cores – September 1997

CORE/ZONE	Depth (m)	Radius (m)	Core Type	TOC (%)	Solids (%)	Moisture (%)	Gravel/ Sand (%)	Fines (%)
Inner zone, core top								
9A	0-0.5	0-200	Short	1.82	48.4	51.6	33.0	67.0
11A	0-0.5	0-200	Short	2.48	46.6	53.5	13.5	86.5
12A	0-0.5	0-200	Short	2.38	48.6	51.4	12.0	88.0
Average				**2.23**	**47.9**	**52.2**	**19.5**	**80.5**
Middle zone, core top								
1A	0-0.5	200-400	Short	1.95	45.4	54.6	26.0	74.0
5A	0-0.5	200-400	Short	1.97	48.3	51.7	28.0	72.0
7A	0-0.5	200-400	Short	1.98	47.6	52.4	33.0	67.0
8A	0-0.5	200-400	Short	2.30	44.3	55.7	37.0	63.0
Average				**2.08**	**46.4**	**53.6**	**31.0**	**69.0**
Outer zone, core top								
2A	0-0.5	400-600	Short	1.09	45.7	54.3	14.0	86.0
2B	0-0.5	400-600	Short	2.18	45.5	54.5	15.0	85.0
3A	0-0.5	400-600	Short	1.90	48.7	51.3	24.0	76.0
3B	0-0.5	400-600	Short	2.20	47.8	52.2	26.0	74.0
Average				**2.09**	**46.9**	**53.1**	**19.8**	**80.3**
All zones, long cores								
4A	0.5 - 0.75	400-600	Long	2.89	50.7	49.3	13.0	87.0
4A	0.75 - 1.00	400-600	Long	2.49	51.3	48.7	18.0	82.0
4A	1.0 - 1.60	400-600	Long	2.40	52.1	47.9	14.0	86.0
6A	0.5 - 0.75	200-400	Long	2.44	51.6	48.4	11.0	89.0
6A	0.75 - 1.00	200-400	Long	2.11	50.9	49.1	11.0	89.0
6A	1.0 - 2.00	200-400	Long	1.87	52.0	48.0	11.0	89.0
10A	0.5 - 0.75	0-200	Long	1.92	47.0	53.0	N/A	NA
10A	0.75 - 1.00	0-200	Long	2.09	50.1	49.9	8.0	92.0
10A	1.0 - 1.75	0-200	Long	2.17	48.1	51.9	5.0	95.0
Average				**2.26**	**50.4**	**49.6**	**11.4**	**88.6**
All Data Summary								
Average				**2.13**	**48.5**	**51.5**	**18.6**	**81.4**
Std. Dev.				**0.36**	**2.4**	**2.4**	**9.5**	**9.5**
Maximum				**2.89**	**52.1**	**55.7**	**37.0**	**95.0**
Minimum				**1.09**	**44.3**	**47.9**	**5.0**	**63.0**
References								
WEST REF				**0.49**	**71.4**	**28.6**	**72.0**	**28.0**
Pre-dredge UDM average (1990 only)							**57.5**	**42.5**
Pre-dredge CDM average (1990 only)							**52.7**	**47.3**

N/A Grain size data not available for this sample.

Table 3-5
Trace Metal Concentrations in Samples Collected from the Seawolf Cores – September 1997. (Note: Units are mg/kg dry weight. For data below detection, one half of the reported detection limit was used.)

CORE/ZONE	Depth (m)	Radius (m)	Core Type	As ppm	Cd ppm	Cr ppm	Cu ppm	Pb ppm	Hg ppm	Ni ppm	Zn ppm
Inner zone											
9A	0-0.5	0-200	Short	<14.5	<0.62	36.2	17.8	16.7	0.16	21.9	76.6
11A	0-0.5	0-200	Short	<15.1	<0.65	45.6	31.3	29.25	0.14	24.5	101.5
12A	0-0.5	0-200	Short	<14.4	<0.62	41.2	54.6	50.3	0.15	29.8	215.0
Average				**7.33**	**0.32**	**41.0**	**34.6**	**32.1**	**0.15**	**25.4**	**131.0**
Middle zone											
1A	0-0.5	200-400	Short	<15.4	<0.66	29.5	14.8	13	0.04	18.9	74.2
5A	0-0.5	200-400	Short	<14.5	<0.62	41.2	28.6	27.5	0.14	22.7	98.0
7A	0-0.5	200-400	Short	<14.7	<0.63	34.3	17.8	15.2	0.06	19.8	140.0
8A	0-0.5	200-400	Short	<15.8	<0.68	44.9	51.2	25.7	0.12	24.6	102.0
Average				**7.55**	**0.32**	**37.5**	**28.1**	**20.4**	**0.09**	**21.5**	**103.6**
Outer zone											
2A	0-0.5	400-600	Short	<15.3	<0.66	32.5	14.9	11.3	0.04	20.4	70.7
2B	0-0.5	400-600	Short	<15.4	<0.66	32.2	16	13.7	0.06	20.6	71.7
3A	0-0.5	400-600	Short	<14.4	<0.62	51.5	40.2	41.6	0.28	20.1	95.9
3B	0-0.5	400-600	Short	<14.6	<0.63	39.0	26.4	26.1	0.12	21.6	92.5
Average				**7.46**	**0.32**	**38.8**	**24.4**	**23.2**	**0.13**	**20.7**	**82.7**
Average, short cores				**7.46**	**0.32**	**38.9**	**28.5**	**24.6**	**0.12**	**22.3**	**103.5**
All zones, long cores											
4A	0.50 - 0.75	400-600	Long								85.5
4A	0.75 - 1.00	400-600	Long								84.1
4A	1.00 - 1.60	400-600	Long								116.0
6A	0.50 - 0.75	200-400	Long								82.7
6A	0.75 - 1.00	200-400	Long								84.3
6A	1.00 - 2.00	200-400	Long								79.4
10A	0.50 - 0.75	0-200	Long								76.4
10A	0.75 - 1.00	0-200	Long								78.4
10A	1.00 - 1.75	0-200	Long								70.6
Average											**84.0**
All Data Summary											
Average				**7.5**	**0.32**	**38.9**	**28.5**	**24.6**	**0.12**	**22.3**	**95.3**
Std. Dev.				**0.2**	**0.01**	**6.7**	**14.5**	**12.5**	**0.07**	**3.1**	**33.9**
Maximum				**7.9**	**0.34**	**51.5**	**54.6**	**50.3**	**0.28**	**29.8**	**215.0**
Minimum				**7.2**	**0.31**	**29.5**	**14.8**	**11.3**	**0.04**	**18.9**	**70.6**
References											
WEST REF	13A			<9.8	<0.42	12.6	7.8	8.5	0.04	7.7	40.4
Pre-dredge	UDM average (1992)			12.6	2.90	108.3	138.5	126.0	0.40	64.6	235.4
Pre-dredge	UDM average (1990, 94)			7.8	1.20	39.8	32.2	43.6	0.20	17.2	79.4
Pre-dredge	CDM average (1990, 94)			6.3	0.70	38.9	21.6	26.5	0.09	17.8	68.2

The difference in metals concentrations was partially a function of grain size. To provide accurate comparisons between different sediment types, metal concentrations are typically normalized to grain size (percent fines) or to one of the dominant metals in crustal rocks (Al or Fe). After normalizing the metals data to the percent of fine-grained sediments (the only consistent analyte available), the inner cores still had the highest average concentrations of lead (Pb), mercury (Hg), Ni, and Zn (Table 3-6).

Only Zn was measured in both the short and long cores (Table 3-5). The range of Zn measurements in the long cores was narrow (70.6 to 85.5 mg/kg), except for one higher measurement from the 1 to 1.6 m interval in core 4A (116 mg/kg). The short cores from the inner zone had the highest average Zn level (131.0 mg/kg), while the long cores had the lowest average Zn concentration (84.0 mg/kg).

All the averaged metals concentrations in the short cores were higher than the reference values measured at WEST REF (Table 3-5) but this was a function of grain size differences (see below). Because of the difference in sampling methods of the pre-dredge samples, the average of 1990 and 1994 data, representing the entire depth of the channel to be dredged, was reported separately from the 1992 data (Maguire Group 1995). The 1992 data were more influenced by the concentrated contaminants in the upper 3 feet (Appendix E).

Comparing raw metals concentrations to the pre-dredge samples, the core average value of the metals As, Cr, Cu, and Hg fell between the average values measured for UDM and CDM in 1990 and 1994 (Table 3-5; Figure 3-23). The average Cd and Pb concentrations measured in the short cores were less than all of the pre-dredge values. Overall, the raw Ni and Zn values were greater than measured in the 1990 and 1994 samples collected in the UDM and CDM, but still significantly less than measured in the most contaminated surface sediments (Figure 3-23).

Because there were no grain size data available for the samples collected in 1992 from the project area, only the 1990 and 1994 data were normalized for comparison to the normalized metals concentrations measured in the Seawolf cores (Table 3-6). Normalized to the fine-grained fraction, zone-averaged Cr, Cu, Pb, and Ni were all less than or similar to the average normalized value measured in the CDM of the project area. Zone-averaged Hg and Zn values fell between the averaged pre-dredge UDM and CDM values. Arsenic and Cd were not compared because of the values below detection. In addition, all of the zone-averaged concentrations were less than that calculated for WEST REF. Plotting the average normalized concentrations of all metals in the short cores (short and long cores for Zn) shows the similarity of the Seawolf cores to UDM, CDM and WESTREF (Figure 3-24).

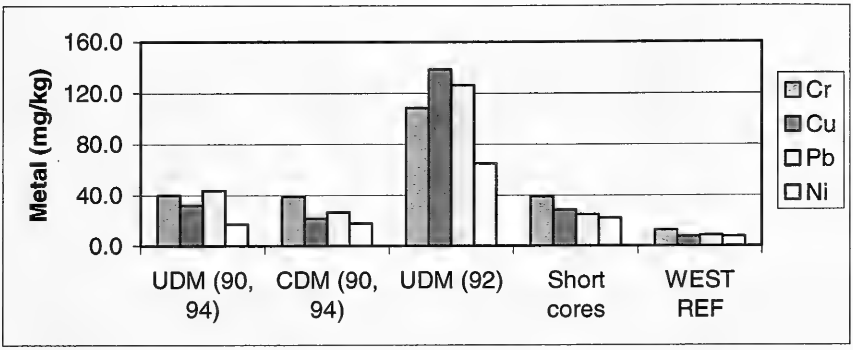
Table 3-6
1997 Results of Trace Metals Normalized to the Fine-Grained Fraction in Samples Collected from the Seawolf Cores

CORE/ZONE	Depth (m)	Radius (m)	Core Type	Cr	Cu	Pb	Hg	Ni	Zn
Inner zone									
9A	0-0.5	0-200	Short	54	26.6	24.9	0.24	32.7	114.3
11A	0-0.5	0-200	Short	52.7	36.2	33.8	0.16	28.3	117.3
12A	0-0.5	0-200	Short	46.8	62	57.2	0.17	33.9	244.3
Average				**51.2**	**41.6**	**38.6**	**0.19**	**31.6**	**158.6**
Middle zone									
1A	0-0.5	200-400	Short	39.9	20	17.6	0.05	25.5	100.3
5A	0-0.5	200-400	Short	57.2	39.7	38.2	0.19	31.5	136.1
7A	0-0.5	200-400	Short	51.2	26.6	22.7	0.09	29.6	209
8A	0-0.5	200-400	Short	71.3	81.3	40.8	0.19	39	161.9
Average				**54.9**	**41.9**	**29.8**	**0.13**	**31.4**	**151.8**
Outer zone									
2A	0-0.5	400-600	Short	37.8	17.3	13.1	0.05	23.7	82.2
2B	0-0.5	400-600	Short	37.9	18.8	16.1	0.07	24.2	84.4
3A	0-0.5	400-600	Short	67.8	52.9	54.7	0.37	26.4	126.2
3B	0-0.5	400-600	Short	52.7	35.7	35.3	0.16	29.2	125
Average				**49.1**	**31.2**	**29.8**	**0.16**	**25.9**	**104.5**
All zones, long cores									
4A	0.50 - 0.75	400-600	Long						98.3
4A	0.75 - 1.00	400-600	Long						102.6
4A	1.00 - 1.60	400-600	Long						134.9
6A	0.50 - 0.75	200-400	Long						92.9
6A	0.75 - 1.00	200-400	Long						94.7
6A	1.00 - 2.00	200-400	Long						89.2
10A	0.50 - 0.75	0-200	Long						N/A
10A	0.75 - 1.00	0-200	Long						85.2
10A	1.00 - 1.75	0-200	Long						74.3
Average									**96.5**
All Data Summary									
Average				**51.7**	**37.9**	**32.2**	**0.2**	**29.5**	**119.6**
Std. Dev.				**11.1**	**20.2**	**14.9**	**0.1**	**4.6**	**44.2**
Maximum				**71.3**	**81.3**	**57.2**	**0.4**	**39.0**	**244.3**
Minimun				**37.8**	**17.3**	**13.1**	**0.0**	**23.7**	**74.3**
All Data Summary									
Average									
Std. Dev.									
Maximum									
Minimum									
References									
WEST REF	13A			70.0	43.3	47.22	0.2	42.8	244.4
Pre-dredge	UDM average (1990 only)			83.8	74.9	101.8	0.35	37.1	161.7
Pre-dredge	CDM average (1990 only)			58.8	37.8	58.6	0.08	30.7	109.1

Units are mg/kg dry weight normalized by the fine-grained fraction.

For data below detection, one half of the reported detection limit was used for statistical calculations.

N/A Grain size not available for this sample.



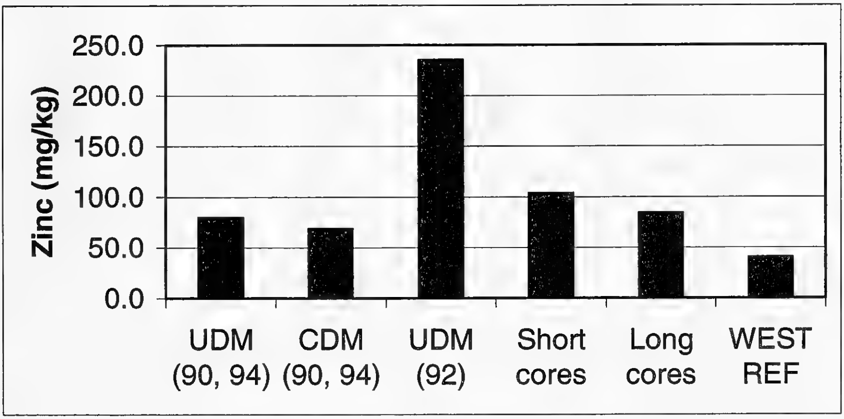


Figure 3-23. Metal concentrations measured in predredge surveys and 1997 postcap cores.

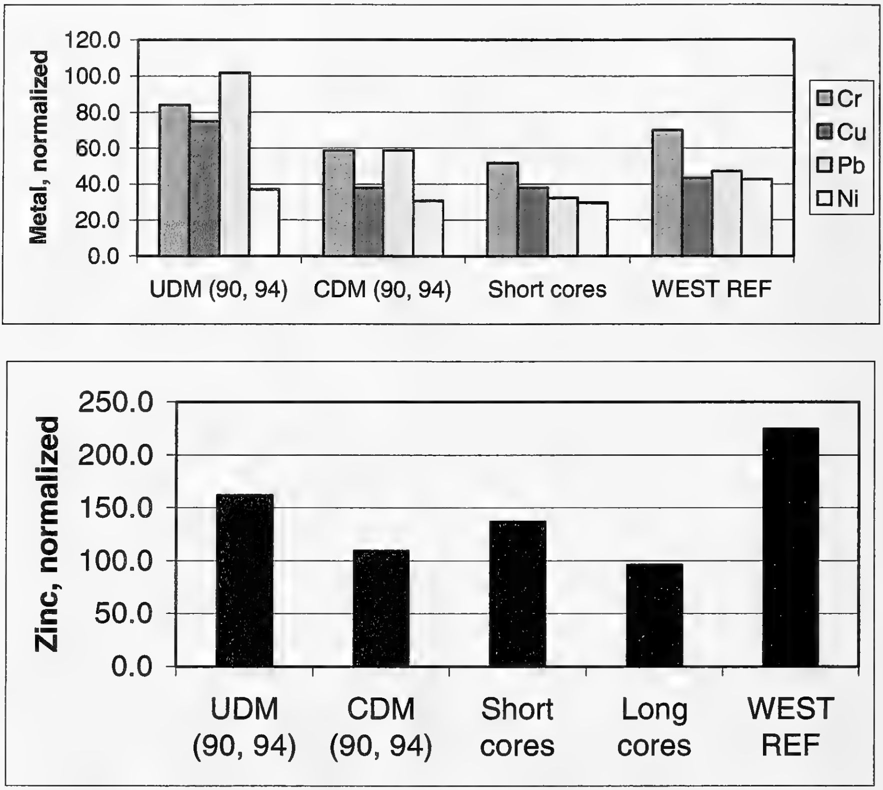


Figure 3-24. Metal concentrations normalized to grain size from predredge surveys and 1997 postcap cores.

While there are variations between metals and locations across the mound, data normalized for grain size show no distinct metal signature for CDM, UDM, mound sediments or the reference area.

PAHs. Polycyclic aromatic hydrocarbons were measured in both the short cores (Table 3-7) and the long cores (Table 3-8). In the short cores, several compounds were reported as below the detection limit or estimated (J=below the detection limit, but a value is provided as estimated by the laboratory) in all samples, including naphthalene, 2-methylnaphthalene, acenaphthene, fluorene, dibenz(a,h)anthracene, and dibenzofuran (Table 3-7). Overall, there were fewer low molecular weight (LMW) PAHs detected than high molecular weight (HMW). Values of total LMW PAHs ranged from 29–85 μg/kg, and HMW PAHs ranged from 78–648 μg/kg (Table 3-7).

In the long cores, several compounds were below the detection limit or estimated (J) in all samples, including 2-methylnaphthalene, acenaphthene, fluorene, dibenz(a,h)anthracene, and dibenzofuran (Table 3-8). Overall, there were fewer low molecular weight (LMW) PAHs detected than high molecular weight (HMW). Values of total LMW PAHs ranged from 36–82 μg/kg, and HMW PAHs ranged from 162–632 μg/kg (Table 3-8).

In the short cores, the highest LMW PAH concentration measured was 39 μg/kg (phenanthrene), and the highest HMW PAH measured was 130 μg/kg (pyrene; Table 3-7). Both of these samples were collected from short core 12A (inner zone). In the long cores, the maximum LMW PAH concentration was 36 μg/kg (phenanthrene in 6A [0.75–1.0 m]), and the maximum HMW PAH concentration was 120 μg/kg pyrene (in 4A [0.75–1.0 m]).

To compare the PAH results from the Seawolf Mound to samples collected at the dredge site, PAH values were averaged from samples classified as UDM and CDM collected in the Thames River (Appendix E; Maguire Group 1995). As with the metals, the values measured in 1992 were much higher (by an order of magnitude) than in 1990 and 1994, so these data are presented separately. Five individual compounds most commonly analyzed and detected were selected for comparison (fluoranthene, pyrene, benzo(a)anthracene, chrysene, and phenanthrene). This comparison shows that the PAHs measured in the short and long cores were higher than WEST REF, but overall less than at the pre-dredge site (Figure 3-25). Note in Figure 3-19 that the 1992 data are all divided by 10 so as to appear to be on a similar scale. In addition, PAH concentrations in the long core 10A decreased slightly with depth or remained fairly constant in the case of pyrene and phenthracene (Figure 3-26). An increase in pyrene and phenanthrene was apparent in both Cores 4A and 6A, between the 0.5 to 0.75 m sample and the 0.75 to 1.0 m sample. However, the measured total PAH concentrations

Table 3-7

PAH Concentrations in Samples Collected from the Short Seawolf Cores (0-0.5 m), September 1997

Radial Zone:	Outer (400-600 m)		Middle (200-400 m)				Inner (0-200 m)							WEST-REF
NLDS Core Name:	**2B**	**3B**	**1A**	**5A**	**7A**	**8A**	**9A**	**11A**	**12A**	**Min**	**Max**	**Mean**	**Std Dev**	**13A**
PAH Compound														
Low Molecular Weight														
Naphthalene	8 U	5 J	8 U	5 J	6 J	8 U	5 J	6 J	5 J	4	6	4.9	0.8	4 J
2-Methylnaphthalene	8 U	8 U	8 U	8 U	8 U	8 U	8 U	8 U	8 U	4	4	4.0	0.0	5 U
Acenaphthylene	8 U	9	8 U	6 J	8 U	6 J	8 U	7 J	13	4	13	6.3	3.0	3 J
Acenaphthene	8 U	8 U	8 U	8 U	8 U	8 U	8 U	8 U	8 U	4	4	4.0	0.0	5 U
Fluorene	8 U	8 U	8 U	8 U	8 U	8 U	8 U	8 U	8 U	4	4	4.0	0.0	5 U
Phenanthrene	21	27	5 J	17	7 J	16	22	22	39	5	39	19.6	10.2	9
Anthracene	7 J	12	8 U	8 J	8 U	6 J	5 J	9	16	4	16	7.9	4.0	4 J
Sum of LMW PAHs	**48**	**65**	**29**	**48**	**33**	**44**	**48**	**56**	**85**	**29**	**85**	**50.7**	**16.8**	**35**
High Molecular Weight														
Fluoranthene	37	82	12	46	19	42	33	57	110	12	110	48.7	30.8	21
Pyrene	35	95	15	50	21	43	37	67	130	15	130	54.8	37.1	25
Benzo(a)anthracene	17	47	7 J	26	8	20	15	32	71	7	71	27.0	20.7	14
Chrysene	21	42	7 J	22	8	19	14	30	58	7	58	24.6	16.6	12
Benzo(b)fluoranthene	14	45	6 J	25	8	25	15	35	72	6	72	27.2	21.0	14
Benzo(k)fluoranthene	16	29	6 J	16	6 J	14	9	20	39	6	39	17.2	10.9	8
Benzo(a)pyrene	18	48	8 J	26	8	23	17	33	68	8	68	27.7	19.6	14
Dibenz[a,h]anthracene	8 U	5 J	8 U	8 U	8 U	8 U	8 U	4 J	7 J	4	7	4.4	1.0	5 U
Benzo[g,h,i]perylene	13	30	5 J	17	6 J	17	11	23	43	5	43	18.3	12.2	9
Indeno[1,2,3-cd]pyrene	13	30	4 J	18	6 J	18	11	23	46	4	46	18.8	13.0	9
Dibenzofuran	8 U	8 U	8 U	8 U	8 U	8 U	8 U	8 U	8 U	4	4	4.0	0.0	5 U
Sum of HMW PAHs	**192**	**457**	**78**	**254**	**98**	**229**	**170**	**328**	**648**	**78**	**648**	**273**	**182**	**131**
Total PAHS	**240**	**522**	**107**	**302**	**131**	**273**	**218**	**384**	**733**	**107**	**733**	**323**	**199**	**166**

Units are ug/kg dry weight.
U = Below detection; one half of the reported detection limit was used for statistical calculations.
J = Estimated value, full reported value was used for statistical calculations.
Statistical calculations do not include WEST-REF 13A.

Table 3-8

PAH Concentrations in Samples Collected from the Long Seawolf Cores, September 1997

Radial Zone	Outer (400-600 m)			Middle (200-400 m)			Inner (0-200 m)							WEST-REF
NLDS Core Name:	4A	4A	4A	6A	6A	6A	10A	10A	10A	Min	Max	Mean	Std Dev	13A
Depth in Core (m):	0.5-.75	0.75-1.0	1.0-1.6	0.5-0.75	0.75-1.0	1.0-2.0	0.5-0.75	0.75-1.0	1.0-1.75					0-0.5
PAH Compound														
Low Molecular Weight														
Naphthalene	5 J	7 J	5 J	10	10	11	7 J	8 U	5 J	4	11	7	2.6	4 J
2-Methylnaphthalene	8 U	7 U	7 U	6 J	6 J	6 J	8 U	8 U	8 U	3.5	6	5	1.1	5 U
Acenaphthylene	8	11	11	7 J	10	9	6 J	8 U	5 J	4	11	8	2.6	3 J
Acenaphthene	8 U	7 U	7 U	7 U	7 U	7 U	8 U	8 U	8 U	3.5	4	4	0.3	5 U
Fluorene	8 U	7 U	7 U	7 U	7 U	7 U	8 U	8 U	8 U	3.5	4	4	0.3	5 U
Phenanthrene	23	36	28	19	36	28	13	11	12	11	36	23	9.8	9
Anthracene	12	16	14	8	13	10	5 J	5 J	4 J	4	16	10	4.4	4 J
Sum of LMW PAHs	**60**	**80.5**	**68.5**	**57**	**82**	**71**	**43**	**36**	**38**	**36**	**82**	**60**	**17.5**	**27.5**
High Molecular Weight														
Fluoranthene	56	110	78	49	90	76	36	34	28	28	110	62	28.2	21
Pyrene	61	120	89	59	100	80	44	37	32	32	120	69	30.1	25
Benzo(a)anthracene	38	71	44	31	48	39	24	16	14	14	71	36	17.7	14
Chrysene	45	58	44	25	39	34	20	16	14	14	58	33	15.0	12
Benzo(b)fluoranthene	43	69	38	31	50	40	24	15	17	15	69	36	17.0	14
Benzo(k)fluoranthene	23	39	35	16	26	22	13	8	10	8	39	21	10.8	8
Benzo(a)pyrene	38	69	49	27	47	37	25	14	15	14	69	36	17.7	14
Dibenz[a,h]anthracene	4 J	7 J	4 J	7 U	6 J	4 J	8 U	8 U	8 U	3.5	7	5	1.2	5 U
Benzo[g,h,i]perylene	23	42	31	17	30	25	16	9	12	9	42	23	10.5	9
Indeno[1,2,3-cd]pyrene	25	43	30	18	32	28	16	10	12	10	43	24	10.7	9
Dibenzofuran	8 U	7 U	7 U	7 U	7 U	7 U	8 U	8 U	8 U	3.5	4	4	0.3	5 U
Sum of HMW PAHs	**360**	**631.5**	**445.5**	**280**	**471.5**	**388.5**	**226**	**167**	**162**	**162**	**632**	**348**	**156**	**131**
Total PAHS	**420**	**712**	**514**	**337**	**553.5**	**459.5**	**269**	**203**	**200**	**200**	**712**	**408**	**172**	**158.5**

Units are ug/kg dry weight.

U = Below detection; one half of the reported detection limit was used for statistical calculations.

J = Estimated value, full reported value was used for statistical calculations.

Statistical calculations do not include WEST-REF 13A.

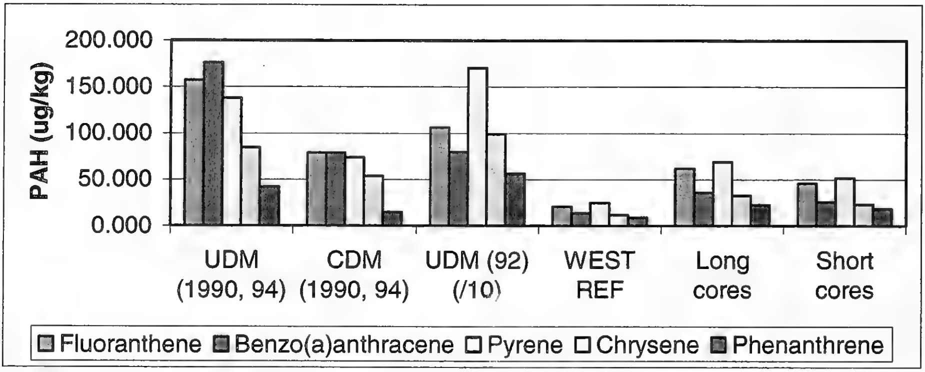


Figure 3-25. Average concentrations of five individual PAH compounds from the dredge site (UDM and CDM) and the Seawolf cores. Note the different scale of the 1992 UDM averages which have been divided by ten.

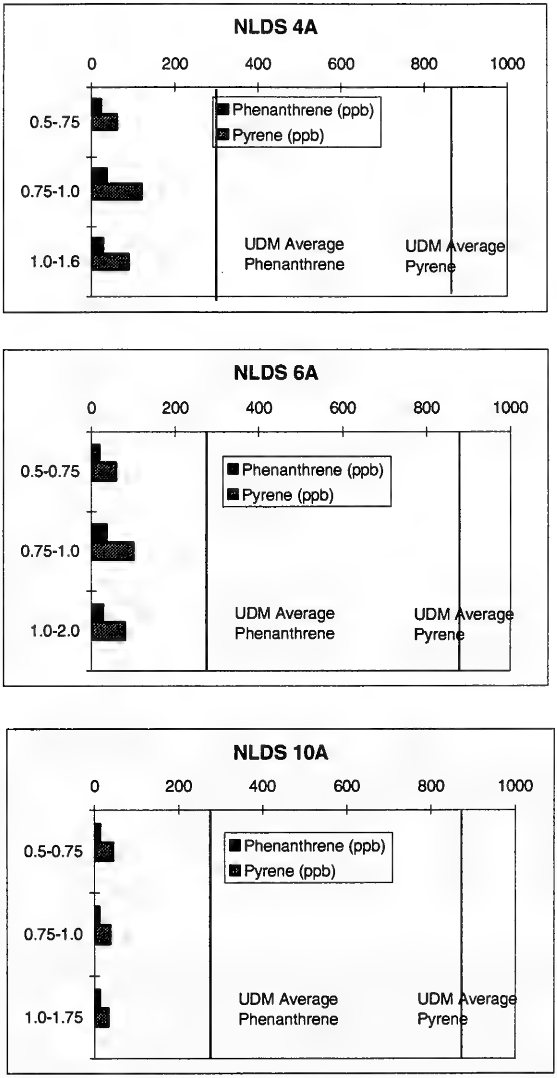


Figure 3-26. Phenanthrene and pyrene concentrations measured in the long cores shown with respect to the average predredge UDM samples.

are not positively correlated with increasing depth in the long cores (Table 3-8). The deep section of 10A was not analyzed, but was re-sampled in 1998 (see below).

3.1.4.2 July 1998

1998 Visual Descriptions

Cores were collected in the same areas using the same zonation scheme as in 1997 (Figure 2-6) and sampled for physical characteristics, geochemical analyses and cap verification. Digital photographs of the cores were compiled and are presented in Appendix D.

The reference core (26A), collected at WEST REF, was 103 cm in length. The top 5 cm consisted of olive gray-brown, silty fine sand, with an intact tube mat on the surface and wood and plant fibers throughout this top section. Below the surface layer, there was gray, sandy silt mottled with black. From 29 to 73 cm, the sediments contained gray clayey, fine sand. Shell fragments were abundant throughout the core and a few intact shells were identified at 60 cm and 85 cm. Below 73 cm, the clayey, shell-rich fine sand was mottled with cohesive clay patches lacking shell fragments.

The July 1998 short cores ranged in length from 84 to 183 cm, while the long cores ranged from 288 to 300 cm (Table 2-7). Similar to the 1997 results, all cores were comprised dominantly of olive gray silty clay, with common darker black olive gray sediment. Shell hash and black marbling and streaks were common throughout many of the cores. Discrete gravel and sand layers were present in a few short cores (14A and B and 21A (18–36 cm), 25A (>175 cm), and in the deepest intervals of long cores 17A (100–135cm, >170 cm), 19A (>260 cm), and 23A (>105 cm). The olive gray, clayey fine sand layers found deep in the other cores (14A [>140 cm], 17A [>217 cm], 25A [>175 cm]) were similar to the ambient sediment recovered in the reference core (26A) from WEST REF. The CDM/UDM boundary was not easily identifiable based on visual analysis alone. Long Core 23A (>110 cm) from the inner zone contained black oily sandy material with some gravel, possibly indicative of UDM.

During core processing, odors from the cores were noticeable and recorded. Almost all of the cores collected from the mound emitted a hydrogen sulfide odor upon being split. In contrast, the core at the reference area had only a faint marine smell. Core 14B had a stronger marine odor, with a fishy smell. A hydrocarbon odor was apparent throughout long core 23A and in the lower sections of 15A, 17A (100-220 cm), and 20A, which seemed to increase in areas of black mottling and blackish sediments. These sulfide and hydrocarbon odors are consistent with the interpretation that these sediments were dredged material and distinct from ambient NLDS sediments.

1998 Physical Parameters

Both physical and chemical parameters are reported in comparison to the reference core (26A) collected at WEST REF. In addition, the data are compared to the 1997 data presented above. Finally, the physical and chemical data are evaluated relative to samples collected from the dredging area as described above (Maguire Group 1995).

Moisture Content. The moisture content was fairly uniform throughout the core samples, ranging from 38–56% (Table 3-9). The average moisture content of samples collected from the upper sediment (0–50 cm; short cores) in the inner and outer zones was uniformly 52%, while the middle zone was slightly lower at 48%. The average of samples collected in the long cores was similar (47%), with the lowest value occurring in the deep sample (1.0–2.0 m) of Core 23A. With the exception of the middle zone, all moisture content zone averages were within 2% of the 1997 averages. The middle zone was 6% less than the 1997 average, due to higher percent gravel and sand values in Core 21A. All of the moisture content values from the Seawolf Mound cores were significantly higher than those measured at the WEST REF reference area (28.4%) due to differences in grain size (see below).

Grain Size. Most of the samples collected from the Seawolf Mound consisted of silty clay, containing less than 13% sand and gravel (Table 3-9). Notable exceptions included short Core 21A, which had a high sand component (51%) and only 44% silt/clay, and long Core 23A (1.0–2.0 m), which was predominantly (57%) sand and gravel. Comparison of samples collected from the top 50 cm of the short sediment cores in the three zones of the Seawolf Mound indicated consistently low mean levels of gravel (1.0%, 1.7%, 0.7%, for inner, middle, and outer zones, respectively). The mean percentages of sand increased with distance from the mound center (3.7% to 5.5% to 7.0%), excluding core sample 21A. Core 21A was collected on the northeastern apron of the Seawolf Mound (Figure 2-6), suggesting the incorporation of ambient sandy sediment in this sample. The other cores were collected well within the 0.25-m bathymetric footprint on the western and southwestern sides of the mound (Figure 2-6).

The vertical stratification of the mound was assessed with respect to each zone (Table 3-9). The short core samples and long core sample 23A (0.5–0.75 m) collected from the inner zone had consistent grain size distributions. The sand content increased with depth in the inner zone long core from 4% (0.5–0.75 m) to 11% within the 0.75–1.0 m interval. The 1.0–2.0 m sample had a significantly higher gravel (20%) and sand (37%) content than any other sample analyzed. This sample was collected in apparent UDM, according to core descriptions, because of its oily appearance.

Table 3-9
Results of Physical Analysis of Samples Collected from the Seawolf Mound Cores, July 1998

Core/Zone	Depth (m)	Radius (m)	Core Type	TOC (%)	Solids (%)	Moisture (%)	Gravel (%)	Sand (%)	Fines (%)
Inner zone, core top									
22A	0-0.5	0-200	Short	2.20	45.6	54.4	0	4	96
24A	0-0.5	0-200	Short	5.10	50.7	49.3	2	3	95
25A	0-0.5	0-200	Short	5.50	47.0	53.0	1	4	95
Mean				**4.27**	**47.8**	**52.2**	**1**	**4**	**95**
Middle zone, core top									
18A	0-0.5	200-400	Short	2.20	49.3	50.7	0	6	94
20B	0-0.5	200-400	Short	2.30	48.8	51.2	0	5	95
21A	0-0.5	200-400	Short	2.00	58.9	41.1	5	51	44
Mean				**2.17**	**52.3**	**47.7**	**2**	**21**	**78**
Outer zone, core top									
14B	0-0.5	400-600	Short	2.10	44.8	55.2	2	12	86
15A	0-0.5	400-600	Short	2.00	44.2	55.8	0	2	98
16A	0-0.5	400-600	Short	1.80	55.7	44.3	0	7	93
Mean				**1.97**	**48.2**	**51.8**	**1**	**7**	**92**
All zones, long cores									
23A	0.50-0.75	0-200	Long	2.40	49.2	50.8	1	4	95
23A	0.75-1.00	0-200	Long	6.70	48.7	51.3	1	11	88
23A	1.00-2.00	0-200	Long	5.50	62.4	37.6	20	37	43
19A	0.50-0.75	200-400	Long	2.00	51.4	48.6	1	8	91
19A	0.75-1.00	200-400	Long	2.00	52.8	47.2	1	8	91
19A	1.00-2.00	200-400	Long	1.80	51.8	48.2	1	8	91
17A	0.50-0.75	400-600	Long	2.20	52.3	47.7	0	6	94
17A	0.75-1.00	400-600	Long	2.00	51.0	49.0	5	8	87
17A	1.00-1.70	400-600	Long	2.30	53.7	46.3	0	7	93
Mean				**2.99**	**52.6**	**47.4**	**3**	**11**	**86**
All Data Summary									
Mean				**2.89**	**51.0**	**49.0**	**2**	**11**	**87**
Std. Dev.				**1.58**	**4.7**	**4.7**	**5**	**13**	**15**
Maximum				**6.70**	**62.4**	**55.8**	**20**	**51**	**98**
Minimum				**1.80**	**44.2**	**37.6**	**0**	**2**	**44**
1997 Data Summary Mean*				2.13	48.5	51.5	N/A	19	81
References									
WEST REF 26A				1.60	71.6	28.4	3	65	32
Pre-dredge UDM Mean (1990 only)								58	43
Pre-dredge CDM Mean (1990 only)								53	47

N/A% gravel and sand combined in 1997 analysis.

* Methods of silt/clay analyses defined between 1997 and 1998; see text for explanation.

The middle zone short Cores 18A and 20A had similar grain size percentages as middle zone long Core 19A, which had remarkably consistent distributions of gravel, sand, and fine sediments with depth. All of these samples were dominated by the fine-grained fraction (>90%). Both the short and long outer zone cores also contained mostly silt and clay (Table 3-9).

The cores collected from the Seawolf Mound overall consisted of a much higher fine-grained fraction compared to the reference core (26A). The exception was the grain size distribution of 21A (5%: 51%: 44% for gravel, sand, silt/clay, respectively), which resembled the reference WEST REF sample (3%: 65%: 32%). Again, these data suggested this core consisted primarily of ambient material, consistent with the bathymetric footprint (Figure 2-6).

Comparing the 1998 core results with those from the previous year indicated a slight increase in the percentage of fine-grained sediments (87.2%) on the Seawolf Mound than observed in 1997 (81.4%). This is a relatively modest change given the high inherent variability of dredged material. Finally, both of the long cores collected from approximately the same location of the inner zone in 1997 (Core 10A) and in 1998 (23A), indicated patches of black, oily sediment with sand and gravel in deeper intervals. Below 2.4 m, Core 10A was described as an oily gravel, which was the only visual indication of UDM apparent in the 1997 coring survey. Core 23A (Appendix D) showed a black, gravelly sand region from 1.1 to 1.9 m. The oily gravel was not sampled for chemical parameters in 1997, but was sampled in 1998 (see below).

TOC. Concentrations of total organic carbon (TOC) measured in the core samples showed a bimodal distribution, with one group of values ranging from 1.8 to 2.4%, and a second group ranging from 5.1 to 6.7%. Overall, TOC ranged from 1.8 to 6.7%, with an average of 2.9% (Table 3-9). The higher TOC values were all in cores from the inner zone, resulting in the highest mean TOC value of the surface samples (0–50 cm) in the inner zone (4.27%) relative to the middle and outer zones (2.17 and 1.97%, respectively). The Seawolf Mound mean TOC value was higher than that measured at WEST REF, (1.6%). The overall mean for the 1998 mound data (2.9%) was greater than the 1997 mean TOC (2.13%). No TOC data were reported for the pre-dredge samples (Maguire Group 1996).

1998 Geochemistry

Metals. Trace metals (As, Cd, Cr, Cu, Pb, Hg, Ni and Zn) were analyzed from the top 0–0.5 m of the short cores (Table 3-10). Mercury (Hg) was detected in only two of ten samples at levels barely above the detection limit, with the remaining samples below the detection limit of 0.10 mg/kg. Uniformity of concentrations was apparent in all cores for As (4.1–9.4 mg/kg), Cd (0.12–0.25 mg/kg), and Cr (23–51 mg/kg), with standard deviations of

1.8, 0.04, and 7.6 mg/kg, respectively (for data below detection, ½ the detection limit was used for statistical calculations).

Concentrations of Cu, Pb, and Ni also were consistent in the short core samples, except for Core 14B in the outer zone. Excluding 14B, Cu ranged from 11 to 29 mg/kg (14B was 120 mg/kg), Pb ranged from 17 to 29 mg/kg (14B was 88 mg/kg), and Ni ranged from 12 to 23 mg/kg (14B was 71 mg/kg). Of the measured metals, the zone-averaged concentrations were highest in the outer 400–600 m for all metals except Cd and Hg, primarily due to Core 14B. Core 21A generally had the lowest concentrations of measured metals.

Similarly, Zn, which was measured both in the short and long cores, was relatively consistent with depth and across the mound in both short and long cores. Zinc ranged from 40 to 95 mg/kg, with the exception of Core 14B (340 mg/kg) and the deepest sample from Core 23A (1.0–2.0m, 130 mg/kg). The range of Zn in the long cores was variable (62–130 mg/kg) and did not appear to correlate with the depth of the sample.

The difference in metals concentrations, primarily for Core 21A, was in part a function of grain size. After normalizing the metals data to the percent of fine-grained sediments, the outer cores still had the highest concentrations of Pb, Ni, Zn, and Cr, although the inner and middle zones had similar normalized concentrations of Ni, As, and Cd (Table 3-11). Core 14B contained the maximum normalized values for Cr, Cu, Pb, Ni, and Zn.

The mean values of the trace metals detected at the mound were consistently higher than at the reference area, WEST REF 26A (Table 3-10; Figure 3-27). For raw metal values, the data for Core 21A tended to be closer to WEST REF than the mean for the Seawolf Mound cores. The normalized data (Table 3-11; Figure 3-28) indicated that the Seawolf Mound metal values were similar to WEST REF. The 1997 short and long core data were very similar to the data collected in 1998 (Figures 3-27 and 3-28).

The metals data from the sediment cores were also compared to samples taken from the dredging site prior to dredging operations (Tables 3-10 and 3-11; Figures 3-27 and 3-28). Because of the difference in sampling methods of the pre-dredge samples, the average of 1990 and 1994 data, representing the entire depth of the channel to be dredged, was reported separately from the 1992 data (Maguire Group 1995). The 1992 data were more influenced by the concentrated contaminants in the upper 3 feet (see above). In addition, the grain size data were not consistent for the 1990 and 1994 data sets and not available for the 1992 data set. The 1990 and 1994 data did not show significant differences in metals concentrations for the UDM and CDM designated areas. The 1992 UDM metals values were more representative of the most contaminated sediments.

Table 3-10
Trace Metal Concentrations in Samples Collected from the Seawolf Mound Cores, July 1998

CORE/ZONE	Depth (m)	Radius (m)	Core Type	As ppm	Cd ppm	Cr ppm	Cu ppm	Pb ppm	Hg ppm	Ni ppm	Zn ppm
Inner zone											
22A	0-0.5	0-200	Short	9.0	0.18	38	18	21	<0.10	22	67
24A	0-0.5	0-200	Short	5.1	0.14	33	13	17	<0.10	20	57
25A	0-0.5	0-200	Short	7.2	0.15	37	15	21	<0.10	22	65
Mean				**7.1**	**0.16**	**36**	**15**	**20**	**<0.10**	**21**	**63**
Middle zone											
18A	0-0.5	200-400	Short	7.9	0.21	40	23	26	0.21	22	74
20B	0-0.5	200-400	Short	8.8	0.25	39	22	29	0.11	23	76
21A	0-0.5	200-400	Short	4.1	0.16	23	11	17	<0.10	12	40
Mean				**6.9**	**0.21**	**34**	**19**	**24**	**0.16**	**19**	**63**
Outer zone											
14B	0-0.5	400-600	Short	6.6	0.16	51	120	88	<0.10	71	340
15A	0-0.5	400-600	Short	9.4	0.12	34	14	21	<0.10	21	61
16A	0-0.5	400-600	Short	6.6	0.18	31	20	21	<0.10	18	59
Mean				**7.5**	**0.15**	**39**	**51**	**43**	**<0.10**	**37**	**153**
Mean, short cores				**7.2**	**0.17**	**36**	**28**	**29**	**0.07**	**26**	**93**
All zones, long cores											
23A	0.50-0.75	0-200	Long								58
23A	0.75-1.00	0-200	Long								72
23A	1.00-2.00	0-200	Long								130
19A	0.50-0.75	200-400	Long								65
19A	0.75-1.00	200-400	Long								73
19A	1.00-2.00	200-400	Long								62
17A	0.50-0.75	400-600	Long								95
17A	0.75-1.00	400-600	Long								70
17A	1.00-1.70	400-600	Long								78
Mean											**78**
All Data Summary											
Mean				**7.2**	**0.17**	**36**	**28**	**29**	**0.07**	**26**	**86**
Std. Dev.				**1.8**	**0.04**	**8**	**35**	**22**	**0.05**	**17**	**93**
Maximum				9.4	0.25	51	120	88	0.21	71	340
Minimum				4.1	0.12	23	11	17	0.05	12	40
All Data, except 14A (and 23A 1.0-2.0 m for Zn)											
Mean				**7.3**	**0.17**	**34.38**	**17.00**	**21.63**	**0.07**	**20.00**	**66.46**
Std. Dev.				**1.9**	**0.04**	**5.55**	**4.41**	**4.10**	**0.05**	**3.59**	**12.64**
Maximum				9.4	0.25	40	23	29	0.21	23	95
1997 Data Summary Mean				**7.5**	**0.32**	**39**	**29**	**25**	**0.12**	**22**	**95**
References											
WEST REF	26A			4.0	0.08	14	8.5	11	<0.10	6.9	35
Pre-dredge	UDM Mean (1992)			12.6	2.90	108	139	126	0.40	65	235
Pre-dredge	UDM Mean (1990, 94)			7.8	1.20	40	32	44	0.20	17	79
Pre-dredge	CDM Mean (1990, 94)			6.3	0.70	39	22	27	0.09	18	68

Units are mg/kg dry weight.

For data below detection, one half of the reported detection limit was used for statistical calculations.

Table 3-11
Results of Trace Metals Normalized to the Fine-Grained Fraction in Samples Collected from the Seawolf Mound Cores, July 1998

Core/Zone	**Depth** (m)	**Radius** (m)	**Core** **Type**	**As** ppm	**Cd** ppm	**Cr** ppm	**Cu** ppm	**Pb** ppm	**Hg** ppm	**Ni** ppm	**Zn** ppm
Inner zone											
22A	0-0.5	200	Short	9.4	0.19	40	19	22	*0.05	23	70
24A	0-0.5	200	Short	5.4	0.15	35	14	18	*0.05	21	60
25A	0-0.5	200	Short	7.6	0.16	39	16	22	*0.05	23	68
Mean				**8.0**	**0.17**	**38**	**16**	**21**	***0.05**	**22**	**66**
Middle zone											
18A	0-0.5	400	Short	8.4	0.22	43	24	28	0.22	23	79
20B	0-0.5	400	Short	9.3	0.26	41	23	31	0.12	24	80
21A	0-0.5	400	Short	9.3	0.36	52	25	39	*0.11	27	91
Mean				**8.9**	**0.27**	**45**	**24**	**32**	**0.13**	**25**	**83**
Outer zone											
14B	0-0.5	600	Short	7.7	0.19	59	140	102	*0.06	83	395
15A	0-0.5	600	Short	9.6	0.12	35	14	21	*0.05	21	62
16A	0-0.5	600	Short	7.1	0.19	33	22	23	*0.05	19	63
Mean				**8.2**	**0.17**	**42**	**58**	**49**	**0.05**	**41**	**174**
All zones, long cores											
23A	0.50-0.75	0-200	Long								61
23A	0.75-1.00	0-200	Long								82
23A	1.00-2.00	0-200	Long								302
19A	0.50-0.75	200-400	Long								71
19A	0.75-1.00	200-400	Long								80
19A	1.00-2.00	200-400	Long								68
17A	0.50-0.75	400-600	Long								101
17A	0.75-1.00	400-600	Long								75
17A	1.00-1.70	400-600	Long								90
Mean											**103**
All Data Summary											
Mean				**8.2**	**0.21**	**42**	**33**	**34**	**0.17**	**29**	**106**
Std. Dev.				**1.4**	**0.07**	**9**	**40**	**26**	**0.07**	**20**	**91**
Maximum				**9.6**	**0.36**	**59**	**140**	**102**	**0.22**	**83**	**395**
Minimum				**5.4**	**0.12**	**33**	**14**	**18**	**0.12**	**19**	**60**
1997 Data Summary Mean						52	38	32	0.16	29	120
References											
WEST REF	26A			12.5	0.25	44	27	34	*0.15	22	109
Pre-dredge	UDM Mean (1990 only)					84	75	102	0.35	37	162
Pre-dredge	CDM Mean (1990 only)					59	38	59	0.08	31	109

* Data below detection 1/2 MDL was used for statistical calculations.

Units are mg/kg dry weight normalized by the silt + clay fraction.

The Seawolf Mound core data from 1998 were consistent with the values obtained from the 1990 and 1994 in-place UDM and CDM samples. The only average metal core values that were higher than those calculated from the 1990/94 UDM/CDM data were Ni and Zn (Table 3-10); both values were lower than the 1992 UDM averages (Ni 64.6 mg/kg and Zn 235.4 mg/kg). All other 1998 detected metal values were lower than those detected in the 1992 UDM, including 1998 samples from Core 14B and 23A (1.0–2.0 m). Normalized to the fine-grained fraction, zone-averaged values were slightly lower than 1990/94 CDM values, which were lower than the 1990/94 UDM values.

PAHs. Polycyclic aromatic hydrocarbons were measured in both the short cores (Table 3-12) and the long cores (Table 3-13). For all short core samples, the following compounds were reported as below the detection limit or estimated ("J") in all samples: 2-methylnaphthalene, acenaphthene, fluorene, and dibenz(a,h)-anthracene (Table 3-12). Values of total LMW PAHs ranged from 35–127 µg/kg, and total HMW PAHs ranged from 65–519 µg/kg (values below detection were included in the summed parameters at ½ the detection limit).

The mean sums of LMW PAHs (83 µg/kg) and HMW PAHs (304 µg/kg) measured in the short cores were virtually the same as the values detected at the reference area, WEST REF 26A (85 and 382 µg/kg, respectively). However, there was some variation within the PAH levels measured. The lowest PAH values among the short cores, with almost all PAHs reported as below detection, were measured at Core 24A collected from the Seawolf Mound apex near the Navy buoy location. The highest LMW PAH concentration measured, 41 µg/kg (phenanthrene), and the highest HMW PAH measured, 120 µg/kg (pyrene), were both detected in short Core 20B (middle zone). Overall, the middle zone had higher mean PAH values, including almost twice the concentration of total HMW PAHs (448 µg/kg), compared to the inner (240 µg/kg) and outer (225 µg/kg) zones.

In the long cores, two compounds were below the detection limit or estimated (J) in all samples: acenaphthene and fluorene (Table 3-13). Again, the mean values for mound cores were similar to, although generally higher than, measured values at WEST REF. High molecular weight (HMW) PAHs were predominant in all cores. Values of total LMW PAHs ranged from 63–211 µg/kg, and HMW PAHs ranged from 137–849 µg/kg (Table 3-13). In the long cores, the maximum LMW PAH concentration was 58 µg/kg (phenanthrene in 17A [1.0–1.7 m]), and the maximum HMW PAH concentration was 180 µg/kg pyrene (in both 17A [1.0–1.7 m] and 23A [1.0–2.0 m]). Total PAH values increased with depth in outer

Table 3-12

Results of PAH Analyses of Samples Collected from the Short Seawolf Mound Cores (0-0.5 m), July 1998

Radial Zone	Outer (400-600 m)			Middle (200-400 m)			Inner (0-200 m)							WEST-REF
NLDS Core Name	14B	15A	16A	18A	20B	21A	22A	24A	25A	Min	Max	Mean	Std Dev	26A
PAH Compound														
Low Molecular Weight														
Naphthalene	11 U	11 U	11	21	16	8 J	18	10 U	9 J	5	21	**11**	6	8
2-Methylnaphthalene	11 U	11 U	5 J	9 J	8 J	8 U	11 U	10 U	5 J	4	9	**6**	2	4 J
Acenaphthylene	12	8 J	18	19	25	18	10 J	10 U	27	5	27	**16**	8	13
Acenaphthene	11 U	11 U	9 U	10 U	5 J	8 U	6 J	10 U	11 U	4	6	**5**	1	4 J
Fluorene	11 U	11 U	9 U	5 J	6 J	8 U	11 U	10 U	11 U	4	6	**5**	1	4 J
Phenanthrene	22	14	25	37	41	30	23	10 U	28	5	41	**25**	11	38
Anthracene	11 J	10 J	14	22	26	17	13	10 U	19	5	26	**15**	6	14
Sum of LMW PAHs	**67**	**54**	**82**	**118**	**127**	**85**	**81**	**35**	**99**	**35**	**127**	**83**	**29**	**85**
Zone Mean Sum LMW	68			110			72							
High Molecular Weight														
Fluoranthene	35	25	37	72	73	49	47	8 J	51	8	73	**44**	21	65
Pyrene	42	36	63	110	120	85	63	13	90	13	120	**69**	35	88
Benzo[a]anthracene	22	15	27	44	51	32	25	6 J	41	6	51	**29**	14	32
Chrysene	27	17	32	52	66	38	29	7 J	46	7	66	**35**	18	41
Benzo[b]fluoranthene	19	13	21	33	37	33	19	5 J	28	5	37	**23**	10	34
Benzo[k]fluoranthene	22	13	22	36	44	29	20	5 J	33	5	44	**25**	12	29
Benzo[a]pyrene	26	16	31	46	54	39	26	6 J	42	6	54	**32**	15	37
Indeno[1,2,3-cd]pyrene	16	10 J	19	29	32	25	15	10 U	24	5	32	**19**	9	25
Dibenz[a,h]anthracene	11 U	11 U	9 U	6 J	6 J	5 J	11 U	10 U	5 J	4.5	6	**5**	1	4 J
Benzo[g,h,i]perylene	20	11	21	32	36	29	18	10 U	28	5	36	**22**	10	27
Sum of HMW PAHs	**235**	**162**	**278**	**460**	**519**	**364**	**268**	**65**	**388**	**65**	**519**	**304**	**144**	**382**
Zone Mean Sum HMW	225			448			240							
Total PAHs	**302**	**216**	**360**	**578**	**646**	**449**	**349**	**100**	**487**	100	646	**387**	173	467
Zone Mean Total PAHs	292			558			312							
TOC(%)	2.1	2	1.8	2.2	2.3	2	2.2	5.1	5.5					**1.6**

Units are µg/Kg dry weight.

U= Below detection; one half of the reported detection limit was used for statistical calculations.

J= Estimated value; full reported value was used for statistical calculations.

Average values do not include 26A (WEST REF).

Table 3-13

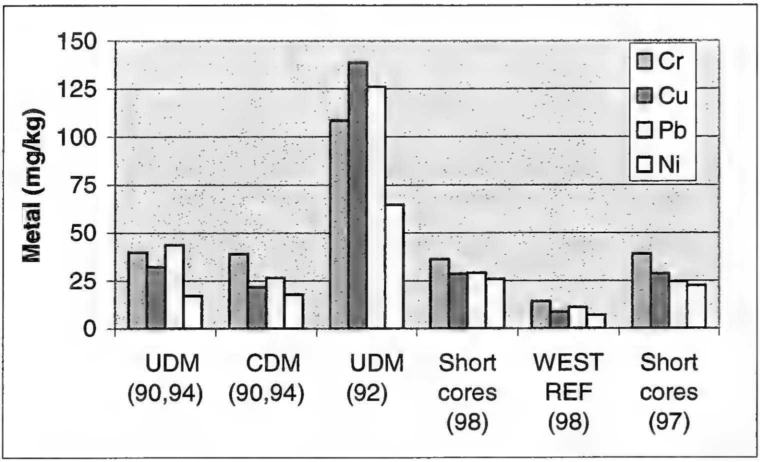
Results of PAH Analyses of Samples Collected from the Long Seawolf Mound Cores, July 1998

Radial Zone	**Outer (400-600 m)**			**Middle (200-400 m)**			**Inner (0-200 m)**							**WEST-REF**
NLDS Core Name:	**17A**	**17A**	**17A**	**19A**	**19A**	**19A**	**23A**	**23A**	**23A**	**Min**	**Max**	**Mean**	**Std Dev**	**26A**
Depth in Core (m)	0.5-0.75	0.75-1	1-1.7	0.5-0.75	0.75-1	1.0-2.0	0.5-0.75	0.75-1	1.0-2.0					**0-0.5 m**
PAH Compound														
Low Molecular Weight														
Naphthalene	13	22	32	17	18	8 J	5 J	8 J	20	5	32	**16**	8	8
2-Methylnaphthalene	6 J	7 J	15	7 J	7 J	10 U	10 U	10 U	9	5	15	**7**	3	4 J
Acenaphthylene	13	19	46	26	21	7 J	8 J	14	22	7	46	**20**	12	13
Acenaphthene	10 U	5 J	9 J	10 U	5 J	10 U	10 U	10 U	6 J	5	9	**6**	1	4 J
Fluorene	10 U	6 J	8 J	5 J	6 J	10 U	10 U	10 U	7 J	5	8	**6**	1	4 J
Phenanthrene	35	33	58	42	43	13	12	26	56	12	58	**35**	17	38
Anthracene	16	26	43	33	25	8 J	8 J	16	33	8	43	**23**	12	14
Sum of LMW PAHs	**103**	**118**	**211**	**140**	**125**	**66**	**63**	**94**	**153**	**63**	**211**	**119**	**46**	**85**
High Molecular Weight														
Fluoranthene	56	56	120	100	74	25	20	55	130	20	130	**71**	39	65
Pyrene	85	86	180	160	120	38	31	94	180	31	180	**108**	56	88
Benzo[a]anthracene	29	62	81	70	43	12	11	40	55	11	81	**45**	25	32
Chrysene	36	66	98	79	50	16	15	45	69	15	98	**53**	28	41
Benzo[b]fluoranthene	23	44	69	54	32	11	11	35	46	11	69	**36**	19	34
Benzo[k]fluoranthene	28	40	66	53	39	12	11	36	46	11	66	**37**	18	29
Benzo[a]pyrene	32	51	98	73	47	14	14	48	53	14	98	**48**	27	37
Indeno[1,2,3-cd]pyrene	22	27	59	42	29	10 J	9 J	27	34	9	59	**29**	15	25
Dibenz[a,h]anthracene	10 U	5 J	12	8 J	6 J	10 U	10 U	6 J	6 J	5	12	**6**	2	4 J
Benzo[g,h,i]perylene	25	29	66	48	33	11	10	33	37	10	66	**32**	17	27
Sum of HMW PAHs	**341**	**466**	**849**	**687**	**473**	**146.4**	**135**	**419**	**656**	**137**	**849**	**465**	**239**	**382**
Total PAHs	444	584	1060	827	598	212	198	513	809	200	1060	**584**	283	467
TOC%	2.2	2.0	2.3	2.0	2.0	1.8	2.4	6.7	5.5	1.8	6.7	**2.99**	1.8	1.60

Units are μg/Kg dry weight.

U= Below detection; one half of the reported detection limit was used for statistical calculations.

J= Estimated value; full reported value was used for statistical calculations.



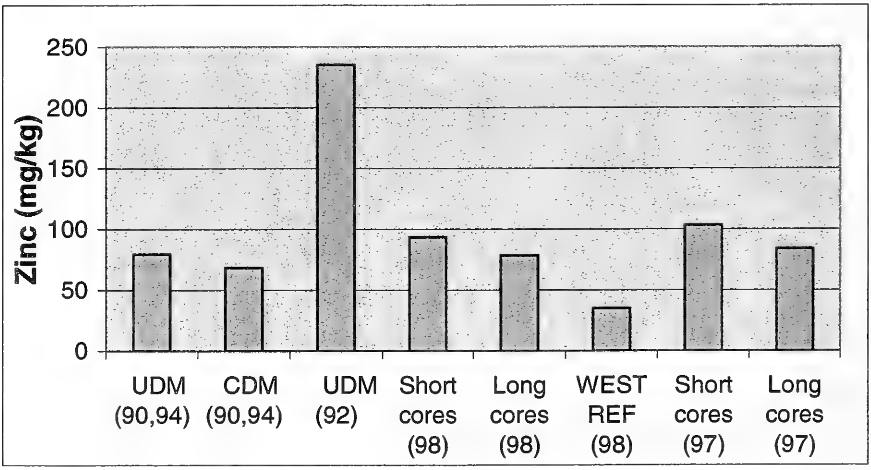
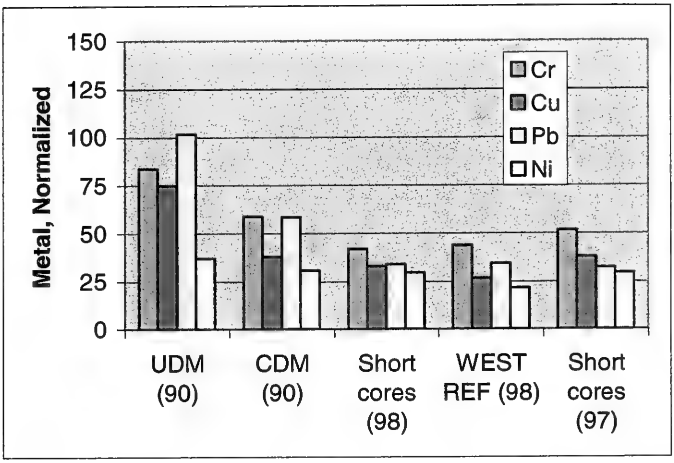


Figure 3-27. Trace metal concentrations in sediment from the Seawolf Mound designated dredging areas (classified as UDM or CDM), the Seawolf Mound 1998 and 1997 cores, and the WEST REF reference area (1998).



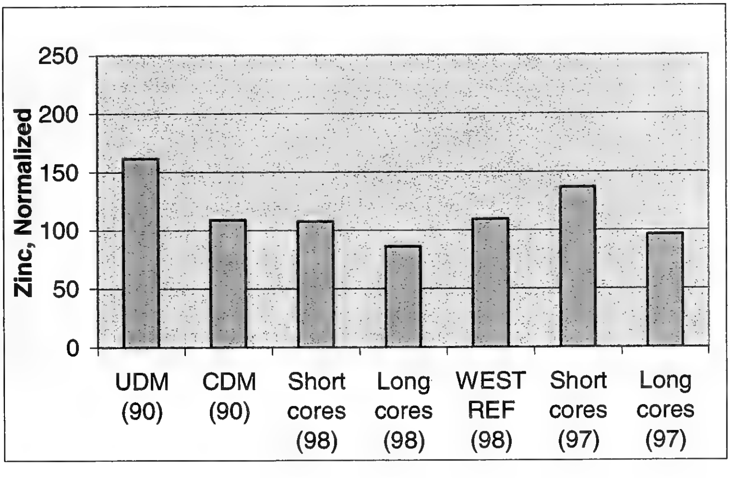


Figure 3-28. Normalized trace metal concentrations in sediment from the Seawolf Mound designated dredging areas (classified as UDM or CDM), the Seawolf Mound 1998 and 1997 cores, and the WEST REF reference area (1998).

zone Core 17A and inner zone Core 23A; the values marginally exceeded the WEST REF values for some compounds below 0.75 m in these two zones. In contrast, in the middle zone (Core 19A) the highest total PAH levels occurred within the top (0.5 to 0.75-m) depth interval and decreased with depth.

The 1998 short and long core data were compared with the 1997 results. All of the tested analytes were the same, except for dibenzofuran, which was not tested in 1998 and was below detection levels in 1997. The 1998 reference area core contained over double the concentration of total PAHs (457 µg/kg) compared to those detected in 1997 (166 µg/kg). For the short cores taken at the Seawolf Mound, the mean value of total PAHs in 1998 (387.2 µg/kg) was higher than observed in 1997 (166 µg/kg). The range of values for the total PAHs in the short cores was narrower in 1998 (100–646 µg/kg) than in 1997 (107–733 µg/kg). The 1998 long cores were taken from the same stations used in 1997, however, the results were more variable. The 1998 long core data also indicated higher concentrations of PAHs than observed in 1997. Trends and comparisons are described in more detail in the Discussion (Section 4.0).

3.2 NLDS Reference Areas

Three reference areas for NLDS (NLON REF, NE REF and WEST REF) were surveyed with the REMOTS® sediment-profile camera in September 1997 and July 1998. These reference areas provide a basis for comparison with the images collected over the NLDS project mounds and aid in determining the health of the benthic community within the disposal site. The conditions at NLON REF, NE REF, and WEST REF are presumed to reflect seasonal and annual variations in environmental conditions. In each year a total of 13 randomly selected stations were surveyed with the REMOTS® sediment-profile camera at NLON REF, NE REF and WEST REF reference areas. Four stations were surveyed in NLON REF, four at WEST REF, and five in the NE REF. Three replicate photographs were collected at each reference area station and subjected to the identical series of measurements and criteria used to characterize benthic habitat conditions within the disposal site. These data were used as the basis for comparison in assessing benthic habitat quality over the Seawolf Mound. A complete set of REMOTS® image analysis results for each reference area and each survey are presented in Appendix B.

3.2.1 September 1997 Survey

No dredged material was present in any of the replicate photographs obtained from the three reference areas. Replicate averaged camera penetration depth ranged from 4.6 cm to 10.3 (Table 3-2). The shallow to moderate camera penetration reflected limited sand-over-mud layering at several stations within each reference area. All of the reference areas showed some evidence of physical reworking or erosion/winnowing of sediment as shown by the following characteristics: poor sediment sorting, shell layers near the surface (shell lag), hydroids, or disturbed amphipod tube mats. WEST REF showed the most widespread evidence of physical reworking, with shell lag at 4 out of 6 stations.

All of the reference areas were similar in sediment grain size distributions with a predominant major mode of 4 to 3 phi (very fine sand). Station 10 in the WEST REF was an exception to this and exhibited a predominant grain size major mode of 3 to 2 phi (medium to fine sand; Table 3-2).

Each of the three reference areas showed relatively low intra- and inter-station mean boundary roughness thickness values, ranging from 0.39 cm to 1.39 cm (Table 3-2). The overall average boundary roughness was 0.73 cm, with the majority of replicates displaying physical disturbances.

The replicate averaged RPD ranged from 1.75 cm to 3.48 cm, with an overall mean of 2.35 cm within the three areas (Table 3-2). Redox rebound layers approximately 5 cm deep were identified in two replicates obtained from NE REF.

The NE REF and WEST REF reference areas exhibited primarily Stage II populations, with several stations having Stage III present (Table 3-2). The reference area NLON REF showed primarily Stage II organisms progressing to Stage III (three of four stations) and one station in which Stage I organisms were present at the sediment surface over Stage III deposit feeders. The images from NLON REF and NE REF showed dense amphipod tube mats (Stage II). The mats at NE REF appeared to be in the process of being eroded during the survey, while those at NLON REF were largely intact.

Median OSI values for the reference area REMOTS® stations ranged from +5 to +10, with an overall average of +6.8 (Table 3-2). Once again, the reference areas in 1997 showed a small improvement in benthic habitat conditions relative to previous years (1992 and 1995). No low DO conditions or methane gas was detected in any replicate image.

3.2.2 July 1998 Survey

Camera penetration ranged from 5.6 cm to 11.7 cm, with an average of 7.8 cm, which was comparable with 1997 results (Table 3-2). No evidence of dredged material was apparent in any of the photographs. Sand or sandy silt over mud stratigraphy was observed in many of the photographs. Sediments at NE REF and NLON REF were moderately sorted, whereas WEST REF sediments were primarily poorly sorted. Organic detritus, surface scour, and/or shell fragments were present at the surface in many of the replicates.

Fine to very fine sands (4 to 3 phi) characterized most of the sediment at the reference areas (Table 3-2). Two stations within NE REF were composed primarily of fine-grained sediments (>4 phi) while WEST REF displayed several stations with a significant fine sand component (3 to 2 phi).

Boundary roughness values were generally low (<1 cm), except at WEST REF Station W13 (STA 08), which had a replicate average value of 1.7 cm. Disturbances within the surface sediments at the reference areas were primarily attributed to physical forces. However, evidence of biological activity causing the surface disturbance was present in approximately 33% of the reference area photographs.

The RPD depths ranged from 1.55 cm to 3.98 cm, with an overall average of 2.55 cm (Table 3-2). In general, the RPD depths at both NLON REF and WEST REF tended to be deeper than those at NE REF. Redox rebound layers were apparent roughly 4 cm below the sediment-water interface at two stations within NE REF (Stations 10 and 12).

Amphipod tube mats were common at the reference areas; some of these mats appeared to be disturbed at NE REF and WEST REF. Stage II was considered the dominant successional stage. Stage I was found at multiple stations in all three reference areas, but only seven replicates had active feeding voids at depth to indicate the presence of Stage III individuals.

The OSI median values ranged from +5 to +10, with an overall average of +6.7. These were very similar to values observed in 1997 (+6.8). No replicates had low dissolved oxygen conditions, although a few replicates from NE REF did portray dark, sulfidic sediments. No methane gas pockets were detected in the images obtained from the reference areas in July 1998.

4.0 DISCUSSION

The New London Disposal Site (NLDS) was monitored over four time intervals during the period 1995-1998 and received dredged material from five distinct episodes of disposal associated with the U.S. Navy Seawolf Mound (Figure 1-3). The specific patterns of disposal leave clear results on the seafloor; the monitoring surveys provide an indication of the processes that produce those results and tests of explicit predictions of potential outcomes of disposal. This report presents details of the placement, capping and monitoring of the U.S. Navy Seawolf Mound. It is the second of a two-volume report devoted to disposal and monitoring at NLDS from 1991-1998. The first volume presents monitoring results for three disposal mounds on the NLDS seafloor (NL-91 and D/S, USCGA, and NL-94), as well as the baseline survey activity over the Northern Region of NLDS (SAIC 2001). The first volume also presents a detailed analysis of recorded changes in the disposal site bathymetry over a ten-year period (1986-1997) and reviews physical and biological response to disposal activity at NLDS based on sediment profile surveys.

The results of the long-term monitoring efforts are important for evaluating the context of individual disposal mounds. The following section summarizes findings discussed in Volume I and provides some perspective on survey results (Section 4.1). The history and monitoring results of the U.S. Navy Seawolf Mound are then discussed (Section 4.2).

4.1 Historical Disposal and Biological Response at the NLDS

The 1997 master bathymetric survey showed several key features important for the future management of NLDS. First, the spatial distribution and topography of the dredged material mounds coincided well with the known buoy locations and mound growth over time (SAIC 2001). Most significantly, the NL-RELIC Mound has been a prominent and unchanging feature at the site since DAMOS bathymetric surveys began in 1977 (NUSC 1979, SAI 1980). The presence of discrete disposal mounds with consistent heights and shapes provides evidence that dredged material placed on the seafloor at the NLDS has been stable for at least twenty years. The importance of these results should be emphasized. Despite clear evidence of surface winnowing of fine-grained material across the disposal site and a potential for active bedload transport, the consolidated mass of disposal mounds measured in bathymetric depth-difference calculations has been stable over a period of at least twenty years (Knebel et al. 1999, Waddell et al. 2001).

The REMOTS® sediment profile data collected from reference areas and within the disposal site from 1991-1998 provide an opportunity to compare and contrast the biological response to disposal activity over a six year period (SAIC 2001). Throughout this period, the fresh and recent (1-6 years old) dredged material showed a rapid recovery from a disturbed surface to a healthy benthic assemblage. Areas of historical dredged material (over 6 years old) all supported a healthy mature benthic community. All reference areas experienced some limited patches of disturbance (presence of recolonizing Stage I organisms, eroded tube mats, shallow RPDs) at various times within the survey period. None of the individual reference stations exhibited consistent disturbance, that is, the patches were in different places each year. Overall, the reference areas supported a healthy benthic assemblage and displayed typical features of seasonal settlement and disturbance (see below).

Assessment of the health of the benthic community at NLDS requires the ability to separate site-specific characteristics from regional environmental characteristics. During this time, historical dredged material and reference areas experienced very limited direct physical disturbance, whereas areas that received fresh dredged material experienced a short period of physical disturbance followed by recovery. In some areas, dredged material was placed two or three times during the six years. All of the monitoring surveys were conducted in late summer (July 30-September 6), a period with elevated water temperatures and the potential for ecological stress or seasonal senescence of settling organisms (see below).

The most consistent biological characteristic observed over the monitoring period was the widespread presence of tube building amphipods in surface sediments. These organisms collect fine-grained sediments to construct their tubes, and the presence of the tubes enhances trapping and deposition of fine sediments (Mills 1967). The mats can become very dense and restrict bioturbation and circulation in sediments below the tubes (the result is a relatively thin redox potential discontinuity or RPD). In both disposal areas and reference areas, a mixed layer of fine sand and coarse shells was present beneath the tubes, but this layer is often difficult to see. Clumps of mussels also were seen and widely reported from the area within and around the disposal site. In areas with shells or pebbles on the surface, hydroids and mussels were seen attached to the hard substrate.

When the amphipod tubes are physically disturbed or abandoned (due to natural seasonal decline, senescence or environmental stress), they are easily eroded, and the sand or shell surface is again exposed to bottom currents. As a result, summer periods (when the tube mats are present and widespread in and around the NLDS) may represent active deposition of fine sediment, with subsequent die-off or thinning of the tubes and sediment reworking in the winter.

The surface sediment characteristics are a combination of the material deposited and processes of physical and biological reworking. The DAMOS monitoring results reported both here and in Volume II serve to demonstrate that the surface sediment characteristics throughout NLDS and reference areas became similar over time (with the exception of areas mantled with coarse sand or pebbles). The disposal site is subject to relatively strong tidal currents, but the landmasses surrounding NLDS shelter the seafloor from wave disturbance

(Waddell et al. 2001). When tidal currents are sufficient to transport fine sand as bedload, some fine materials may be winnowed leaving a lag deposit of sands and shells too large for transport. Semi-diurnal tidal currents at the NLDS appear to be strong enough to rework unconsolidated surface sediments through this process until surface sediments have a lag deposit of sand or shells. However, fine surface sediments are also bound by biological activity and may be remarkably resistant to erosion while the organisms are alive.

The result of the surface sediment winnowing process includes six characteristics in REMOTS® images: shell lag, winnowed surfaces, disturbed amphipod tube mats, physical boundary roughness, and sand-over-mud stratigraphy. There are three potential causes for surface disturbance of tube mats: 1) predator foraging; 2) microbial decomposition following the abandonment of the tubes; and 3) disturbance from either trawling or a temporary increase in near-bottom turbulence or current velocity. When tubes are abandoned they are much more susceptible to physical transport by currents.

Surface sediment reworking at NLDS appears to be limited to winnowing of fines accumulated during the summer in areas where shell lag armors the surface. The shell lag may form in the fall and winter during periodic storms, then again be covered with tube mats that bind finer sediments in the spring and summer. This seasonal response is observed to be consistent between reference areas and disposal areas, and results in a cyclic fluctuation between seafloor surfaces covered with muddy tubes to surfaces with clean shell and fine sand. This seasonal cycle may open opportunities for settlement of recolonizing benthic organisms and explain their patchy distribution at reference areas. Any deposition of fresh dredged material will begin to be exposed to this cycle and will eventually acquire tubes or attached organisms depending on grain size. In general, there is evidence of fall-winter winnowing in many areas of NLDS and spring-summer deposition of finer materials. As shown by the long-term stability of mounds at the site (see above), this cycle does not appear to result in any significant net loss or gain of sediment.

4.2 Seawolf Disposal Mound

The Seawolf Mound was developed during the 1995-1996 dredging season (September-May). Disposal of maintenance work (material dredged within an authorized depth) and new work (material dredged to a newly authorized depth) resulted in a total estimated disposal volume of 877,512 m^3 of sediments.

The first portion of the project included an approximate barge volume of 306,000 m^3 of UDM originating primarily from the New London Naval Submarine Base and the Thames River navigational channel and 800 m^3 of UDM from the Mystic River. These materials were placed at the "Navy" buoy prior to capping operations (Figure 1-3). Following the placement of UDM, an estimated barge volume of 556,000 m^3 of CDM dredged from the

Thames River channel, yielding a 1.82:1.0 CDM to UDM ratio, was placed over the Seawolf Mound area. These materials consisted of new work material (largely glacial clay) and maintenance material from the outer channel (largely fine sand). In addition, a total of 15,490 m^3 of CDM from Mystic River and Venetian Harbor were deposited at the NDA 95 buoy, which also contributed to the Seawolf Mound. The resulting Seawolf Mound is a flat area east of the NL-RELIC Mound with a small oval apex.

4.2.1 Topographic Changes of the Seawolf Mound

The topographic profile of the Seawolf Mound at the completion of the project showed a large, flat plateau (600 m diameter) with a small central apex with minimum depths of 16 m (Figure 3-5). Postcapping surveys showed that consolidation of the deposit followed the typical pattern for dredged material disposal mounds, with rapid consolidation in areas of the thickest material (e.g., Poindexter-Rollings 1990; Silva et al. 1994). Consolidation continued in the period between the first postcap survey (February 1996) and the follow-up September 1997 survey (Figure 3-9). A small area of CDM on the western side of the mound may have remolded, resulting in a slight increase in mound height adjacent to an area of apparent consolidation. Consolidation analysis also revealed isolated areas of apparent consolidation and accumulation. These small isolated fluctuations are a product of slight variations in survey conditions (survey artifacts) and do not represent changes in seafloor conditions (see Section 2.1.3).

Sediment core and REMOTS® sediment profile data were evaluated to verify that CDM covered the entire UDM deposit and provide more detail than possible with bathymetric techniques (Section 4.2.4). REMOTS® images at Stations 150W and 300W (the areas with apparent remolding) indicated the presence of glacial gray clay and brown sand typical of the Seawolf CDM. The gray clay (Gardiners clay) is the product of improvement dredging that removed glacial lake clays deposited beneath the estuarine deposits in the Thames River. It is a stiff olive-gray to blue-gray clay that is very distinctive in cores and REMOTS® images.

Results from the July 1998 survey indicated that topographic changes after September 1997 were greatly reduced, consistent with the equilibrium phase of dredged material consolidation (Figure 3-12). The pattern of consolidation measured at other open-water disposal mounds in Long Island Sound predicts that the Seawolf Mound will remain in its current configuration with minor resuspension of the surface sediments (Section 4.2.3). In the event of a large storm event in the Sound, follow-up confirmatory bathymetric data should be collected.

4.2.2 Benthic Community Recolonization

4.2.2.1 Evaluation of Recovery

One of the principle objectives in the tiered monitoring approach to dredged material disposal used in the DAMOS program is to determine the benthic recolonization status at intervals following the completion of disposal mounds or capping projects (Germano et al. 1994). For the Seawolf Mound, an infaunal assessment was conducted with grab samples in 1997 to evaluate the benthic community and to compare with sediment profile results. Grab samples were collected at six stations to examine the benthic infaunal species diversity and relative abundance over the surface of the Seawolf Mound. Sediment profile images were collected at these stations and over a wider grid in 1997 and 1998 to evaluate the response of benthic succession to the presence of fresh dredged material and confirm the location of cap material.

The grab sampling stations were selected to represent distinct areas of the mound. A comparison of the bathymetric contours of the mound and sample locations (Figure 2-5) indicated that the stations could be grouped as follows: mound apex (CTR, 75E); mound plateau (150N, 150W, 300WSW); mound apron (300SE). While the initial intention was to sample mound slope deposits (adjacent to the apex), these were very spatially limited at the Seawolf Mound. Most of the mound formed a broad, flat plateau that gently thinned into apron deposits. Within the plateau, the stations can be ordered (from apex to plateau edge 150N, 150W, 300WSW). The apron areas are likely to have experienced the least physical disturbance from dredged material disposal whereas the apex should reflect the most frequent disturbance due to elevation and exposure to bottom currents (or may be an area most recently disturbed by disposal).

Predicted results, based on ecological theory, include the following: moderate diversity at apron stations (reflecting minimal disturbance) with lowered diversity at the mound apex (reflecting greater disturbance), and higher OSI and successional stages at apron stations compared to the apex. Stations located on the mound plateau area should be intermediate between the values with no distinct gradient. The one potential exception would be a transitional increase in diversity within the plateau due to stimulation of the benthic community from input of organic-rich dredged sediments. This increase in diversity may be difficult to separate from other temporal and spatial variations.

4.2.2.2 Comparison of Species Composition, Abundance, Successional Stage

Six stations were sampled by a single 0.04 m^2 grab sample for the purpose of evaluating benthic community composition, abundance, diversity, and the faunal successional status as inferred from REMOTS® image data from the same stations (Stations

CTR, 75E, 150N, 150W, 300WSW, and 300SE). Organisms retained on a 500-micrometer sieve were identified and enumerated (Appendix C). Based on knowledge of their life histories and feeding habitats, particularly the polychaetes (Fauchald and Jumars, 1979), a significant number of the collected infauna were assigned to a successional stage as defined in the REMOTS® successional paradigm (Table 4-1). The following comparisons between the grab sample and REMOTS® results therefore are based mainly on the taxa and their associated successional stage classifications listed in Table 4-1 and in Tables 2 through 4 of Appendix C. In the following comparisons, the generic and species names and abundances come from traditional benthic grab analyses. The successional designation(s) come from REMOTS® image interpretation based on between one and three replicate images per station. Not all replicates provided useful data.

The numerically dominant species at Station CTR (mound apex) was the protobranch bivalve *Nucula annulata* followed by the tube-dwelling amphipod crustacean *Ampelisca vadorum*. *Nucula* spp. are known to appear on other disposal sites in Long Island Sound (an infrequently used sandy Guilford, CT site [Rhoads pers. comm.]) and in the vicinity of the former New York Mud Dump on relict dredged material (Valente 1998, Chang et al. 1992). The same bivalve is an important component of the *Nephtys incisa* / *Yoldia limatula* assemblage (*sensu* Sanders 1960) in both Long Island Sound and Buzzards Bay. The appearance of *N. annulata* at Station CTR is unusual because of its co-occurrence with a well-known Stage II species, *A. vadorum*. *Nucula annulata* is considered a late Stage II species due to its relatively conservative reproduction, relatively slow growth rate, and long life span (several years). All of the *Nucula* were small, i.e., within the range of 0.75 to 1.5 mm. None of these protobranchs showed annular growth bands suggesting that they were a single age-class (cohort) that settled as larvae during the spring to early summer of 1997. Alternatively, these small juvenile bivalves may have been passively transported to the station from the ambient bottom by means of turbulence and resuspension. Small *N. annulata* have been recovered from sediment traps located decimeters above the bottom in Buzzards Bay (Rhoads pers. comm.).

Based on the dominance of *Nucula annulata* and *Ampelisca vadorum*, as well as the presence of the Stage II amphipod *Leptocheirus pingus* and the Stage II/III polychaete *Spiochaetopterus costarum* among the dominants (Appendix C, Table 2), the species found in the grabs would identify Station CTR as being a late Stage II or early Stage III assemblage. However, REMOTS® images did not show any evidence of macrofaunal organisms and so the successional status was not assigned. The presence of the highly plastic, relic gray Gardiner's clay had the apparent effect of retarding infaunal succession relative to dredged material of more recent age. The apparent absence of macrofauna from the profile camera images is explained by the low density of macrofauna recovered from the grab samples (50 individuals per 0.04 m^2). At this density of organisms, a random vertical cut of the bottom by the camera presents a low probability of imaging an organism.

Table 4-1
Infaunal successional stage classifications for selected taxa collected across the Seawolf Mound (descriptions for polychaete families are based on Fauchald and Jumars, 1979)

TAXA	DESCRIPTION	CLASSIFICATION
POLYCHAETES:		
Ampharetidae	tube-dwelling, surface deposit feeders	Stage I
Capitellidae	mostly tubicolous, motile opportunisitc deposit feeders	Stage I
Chaetopteridae	deep tube-dwelling, suspension/surface deposit feeders	Stage II/III
Cirratulidae	surface deposit feeders	Stage I
Cossuridae	surface deposit feeders	Stage I
Dorvilleidae	free-living facultative carnivores	Stage II/III
Eunicidae	free-living/tubicolous carnivores or omnivores	Stage II/III
Flabelligeridae	surface deposit feeders	Stage I
Glyceridae	free-living carnivores or detritivores	Stage II/III
Lumbrineridae	surface/sub-surface deposit feeders	Stage III
Maldanidae	head-down, sub-surface deposit feeders	Stage III
Nephtyidea	motile carnivores or omnivores	Stage II/III
Oweniidae	surface deposit feeders	Stage I
Paraonidae	form vertical, spiraling burrows, deposit feeders	Stage III
Pectinaridae	sub-surface deposit feeders	Stage III
Phyllodocidae	motile predatory carnivores	Stage II/III
Polynoidae	motile carnivores	Stage II/III
Sabellidae	tubicolous suspension- or surface- deposit-feeders	Stage I/II
Sabellariidae	tubicolous, epifaunal suspension feeders	N/A
Sigalionidae	carnivores	Stage II/III
Spionidae	tubicolous, surface deposit-feeders or suspension feeders	Stage I
Syllidae	mostly free-living, carnivores or surface deposit-feeders	Stage I
Terrebellidae	surface deposit feeders	Stage I
Trichobranchidae	tubicolous, surface deposit-feeders	Stage I
CRUSTACEA:		
Ampelisca abdita/vadorum	tubicolous, surface filter feeders	Stage II
Leptocheirus pinguis	surface filter feeders	Stage II
Corophiidae	nest or tube builder, probably filter feeders	Stage II/III
BIVALVE MOLLUSCS:		
Carditidae	attached filter feeder	
Nuculidae	shallow burrower	Stage II/III
Tellinidae	shallow burrowers, feed through siphon	Stage II
Pitar morrhuanus	larger-bodied burrowers	Stage III

The small body size of the numerical dominant (*N. annulata*) also precluded detection of these bivalves in the images.

At Station 75E (mound apex), faunal dominants were *Nucula annulata* (Stage II), *Prionospio steenstrupi* (Stage I), and the capitellid *Mediomastus ambiseta* (Stage I). Stage II also was represented by *Ampelisca vadorum* and *Ampelisca abdita*, while Stage III included one maldanid polychaete and four individuals of the polychaete *Spiochaetopterus costarum*. Two REMOTS® replicates provided information; one was designated a I–II status and the second a II-III. Although there is a general agreement with the taxonomic data, the

REMOTS® results suggest that there was high spatial patchiness at this station. The population of *N. annulata* showed a diverse range of size (0.75 to 3.75 mm) suggesting that more than one age class (cohort) may have been present. The larger specimens showed growth annuli in the shells indicating that they were >1 year old. At least two cohorts appeared to be present in the larger specimens.

At Station 150N (mound plateau nearest apex), *Nucula annulata* (Stage II) represented over one half of the individuals sampled. Small specimens (0.75 mm) appeared to be the 1997 cohort, while individuals approaching 3.75 mm were probably over one year old based on the presence of growth annuli within the shell. Another bivalve, *Tellina agilis*, represented by four juvenile individuals is known to be a Stage II species. Their small size suggested that they comprised a 1997 cohort. *Mediomastus ambiseta* and *Prionospio steenstrupi* are Stage I polychaetes that were moderately abundant, and there were also a few individuals collected representing Stage III polychaete taxa (e.g., *Nephtys incisa* and *Levinsenta gracilis*). Two sediment profile images provided useful successional information. Both replicates indicated a Stage II successional designation, mainly reflecting the presence of *Nucula annulata*. This inference is supported by the ground-truth sampling. The presence of low densities of both Stage I and Stage III polychaetes was apparently missed in the sediment profile images.

Faunal dominants at Station 150W (mound plateau) included two Stage I polychaetes (*P. steenstrupi* and *M. ambiseta*) and the Stage II bivalve *N. annulata*. Juvenile *Tellina agilis* (Stage II) were also present (n=1), along with two Stage III polychaetes (*Maldanidae sp.* and *Nephtys incisa*). The overall designation of this station as being in a Stage I-II sere was based on one sediment profile replicate showing Stage I; a second replicate, Stage II; and a third replicate, Stage I-III. This inference is supported by the benthic grab sample data. A low density of Stage III polychaetes apparently was present along with the surface-dwelling Stage I and II taxa. A range of sizes (0.75 to 4.0 mm) was present in the *N. annulata* population. The largest specimens appeared to have at least two shell growth annuli, suggesting that several age classes may have been present.

Several species were present at Station 300WSW (mound plateau) that represented a mixture of successional stages. Stage I taxa included the polychaetes *P. steenstrupi* and *M. ambiseta*. Stage II taxa were represented by *N. annulata* and *A. vadorum*. Stage III taxa also were present (maldanid polychaetes). Sediment profile images showed the following successional development: I-II, I-III, and I-III. This station therefore was assigned a mixed successional status, suggesting that it was in an advanced state of recolonization. Individuals ranging from 0.75 to 3.0 mm were present in the *N. annulata* population. The size distribution was skewed toward small specimens suggesting a successful 1997 recruitment.

The dominant organism at Station 300SE (mound apron), *Monticellina baptisteae*, is a Stage I cirratulid polychaete. A relatively low density of *M. ambiseta* (Stage I) also was present, along with Stage II amphipods (*A. vadorum*) and a small range in shell length sizes of Stage II *N. annulata* (0.75 to 2.0 mm). Two REMOTS® replicates provided useful information; both showed this station to be a Stage II assemblage. This conclusion is supported by the ground-truth samples. The presence of six relatively large specimens of the bivalves *Pitar morrhuana*, *Astarte undata*, and *Anadara transversa*, along with Stage III Lumbrinerid polychaete *Scoletema hebes*, further suggested that this station had not experienced a great deal of disturbance in the recent past. The relatively large body size of the bivalves (biomass) indicates that they have occupied this station for more than one year; from a functional perspective they are considered Stage III organisms. However, the REMOTS® successional designation failed to acknowledge the presence of these larger-bodied Stage III organisms.

Overall, comparison of the grab sample faunal data with successional stage interpretation from REMOTS® images shows that the Seawolf Disposal Mound was predominantly in a Stage II assemblage based on the numerical dominance of *Nucula annulata* and tubicolous amphipods. Stage I taxa were also present (spionid and capitellid polychaetes), but in lower abundance than is typically found in the earliest pioneering assemblage. Undisturbed Stage III species (e.g., large bivalves) were encountered at one station (300SE) on the thin apron of the Seawolf Mound. Small numbers of Stage III polychaetes were found at all of the stations, but because of their low densities, they were largely undetected in the sediment profile images.

The importance of *N. annulata* in intermediate stage colonization at this site is a relatively new observation. While *N. annulata* are commonly found as members of Stage III deposit-feeding communities in soft mud, this is only the third time that this species has been noted as playing an important role in colonization of sandy to muddy dredged material. Sediment-profile imagery is unlikely to allow identification of very small *N. annulata*, but REMOTS® data from the N.Y. Mud Dump Site did allow identification of abundant populations of large mature specimens of *Nucula spp*. (Valente 1998).

4.2.2.3 Spatial Trends in Faunal Diversity and Abundance

As previously indicated, the benthic sampling stations were located in three distinct topographic areas of the capped mound: mound apex (CTR, 75E); mound plateau (150W, 150N, 300WSW); and mound apron (300SE) (Figure 2-5). The Seawolf Mound lacked a large area with steep mound slopes and could be best characterized as a broad flat mound with a small apex. The apron areas consisted of thin deposits of dredged material (usually less than 10 cm) that typically cause minimal disturbance to the benthic community.

A theoretical relationship between disturbance (and/or organic enrichment) and Species numbers, Abundance, and Biomass (SAB) is shown in Figure 4-1 as modified from Pearson and Rosenberg (1978). These relationships can form some basis for comparison of mound successional dynamics compared to systems evaluated on their response to organic loading. It should be noted that some systems show variations in their SAB response, and the concept is best-developed in relatively enclosed estuarine systems (Maurer et al. 1993).

The distribution of species abundance (richness, in units of number of species per 0.04 m^2) and numbers of individuals (number of individuals per 0.04 m^3) show that the thin apron deposits had the highest faunal densities and number of species (Figure 4-2). The mound apex had the lowest species richness and abundance, and the mound plateau stations were intermediate with respect to these parameters (Figure 4-2). The shape of these curves suggests that the overall disposal mound was close to the Pearson and Rosenberg transition (or ecotonal) part of the disturbance gradient (Figure 4-1). Because biomass was not quantified in the traditional benthic sample work-up, this variable cannot be mapped. However, qualitative inspection of the faunal collection indicates that biomass was greatest at Station 300SE because of the presence of three genera of relatively large bivalves. In Figure 4-1, note that biomass peaks in the Transition area (TR), and a subordinate biomass peak exists under the Peak of Opportunists (PO).

Although the species abundance and numbers of individuals increased away from the center of the mound, calculations of diversity did not show such a clear trend. Diversity indices are weighted to consider the impact of dominance by one or more species. The most widely used diversity index is the Shannon-Wiener information statistic H' which is often calculated with the statistic for Evenness, J'. The trends of these two statistics against station type showed a complex relationship (Figure 4-3) until the effect of dominant species was evaluated. Relatively low abundance; few species and high evenness (i.e., a small number of species with similar abundance) characterized the CTR station. The resultant diversity was low but in the same range as many other stations on the mound plateau and apron. Stations 75E and 150N both contained several dominant species that depressed the evenness and diversity. Plotting the abundance to species ratio (Maurer et al. 1993) and examining the effects of removing the top three dominant species (Figure 4-4), one can see this relationship more clearly. The increasing abundance of individuals away from the center stayed ahead of the increase in species, but peaked at Stations 75E and 150N, due to the influence of the top three numerical dominant species (Figure 4-4). When the top three numerical dominants were removed, the relative abundance to species decreased with distance from the center. The relatively small sample size and influence of a few species on diversity indices limits the conclusions that can be made about mound disturbance and community structure from these data alone. However, it is clear that there were only marginal differences in diversity and evenness apart from the station dominated by *Nucula annulata* (150N).

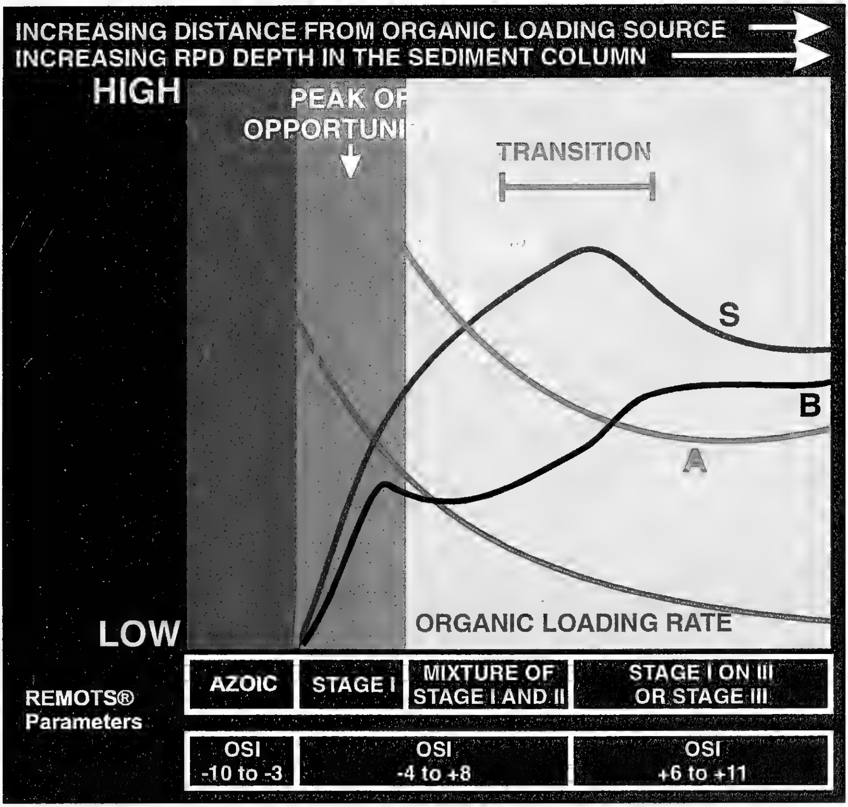


Figure 4-1. SAB curves along a gradient of organic enrichments. S = number of species; A = abundance; B = biomass. The relationships between the SAB curves and REMOTS® successional stage and OSI also are depicted. (Modified from Pearson and Rosenberg 1978.)

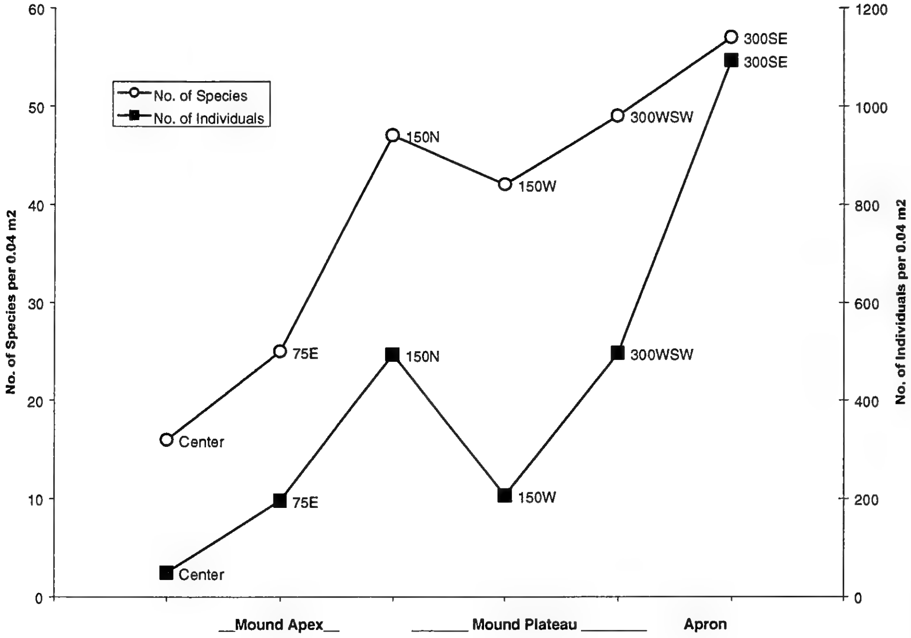


Figure 4-2. Distribution of species abundance and number of individuals over the Seawolf Mound.

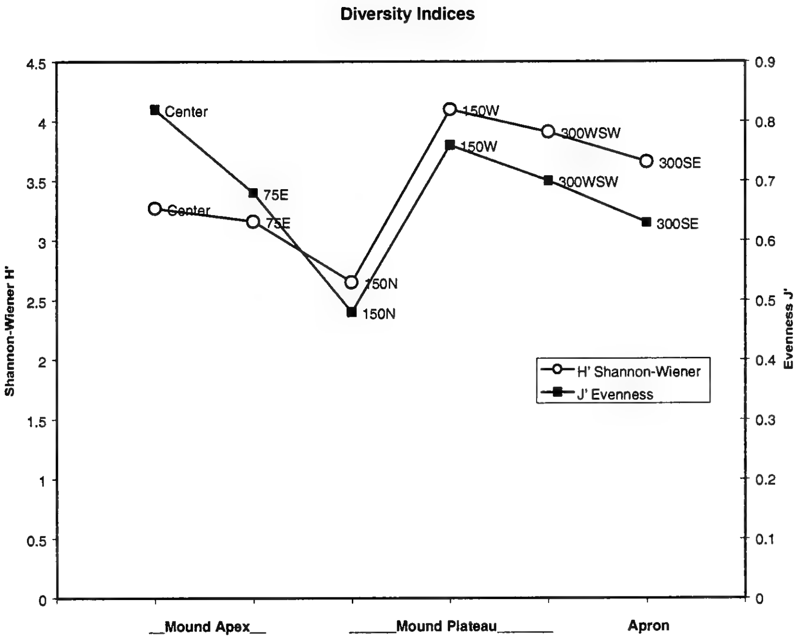


Figure 4-3. Diversity indices (Shannon-Wiener H′ and Evenness J′) distributed over the Seawolf Mound.

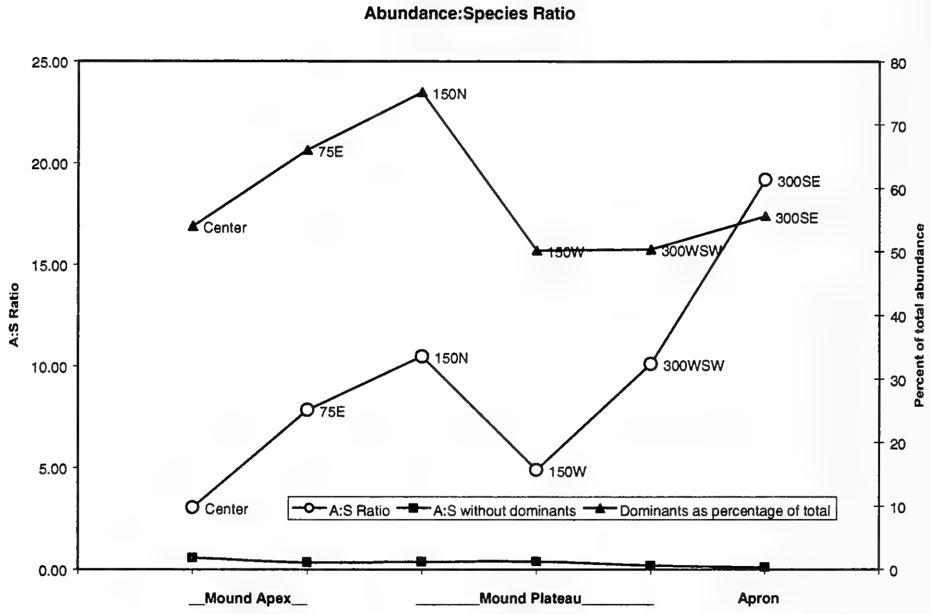


Figure 4-4. Abundance species ratios (with and without dominants) and dominants as a percentage of total abundance distributed over the Seawolf Mound.

A more effective method for evaluating diversity, especially for comparison between different sample sizes, is the rarefaction curve approach (Sanders 1968). Rarefaction curves plot the expected species for different population sample sizes. While these curves cannot extrapolate beyond existing abundance data, they can interpolate species numbers for smaller sample sizes and facilitate comparison of samples. These curves can also be used to rank the relative ecological impact of dredged material deposition (Figure 3-22). If disturbance is scaled to diversity, calculated by the rarefaction method, we would rank the stations from high to low disturbance as follows: Center > 75E >150N >150W > 300WSW >300SE.

Similarly, the REMOTS® Organism-Sediment Index (OSI) can also be used to rank stations. Unfortunately, the REMOTS® data from the stations sampled with the grabs was limited by a variety of confounding factors. Many of the stations had indeterminate OSI values, or the value was based on one replicate. Successional stage could not be determined adequately at the center station (CTR) due to the presence of plastic glacial clay. The OSI evaluation, however, does provide some insight into the relationship of disturbance to benthic community structure across the mound. The lower OSI values (particularly <+6) indicate greater impacts. Based on the OSI, the stations are ranked in the order of highest to lowest impact: (No data on Station Center or 150 N) 150W > 300WSW > 300SE > 75E.

The major difference in these three rankings is the relative position of Station 75E. Based on the Shannon-Wiener H' statistic, and rarefaction curves, Station 75E was comparable in disturbance to the CTR station. The OSI plot indicates that, while showing an impact, Station 75E had a relatively high OSI (5.5). This result is attributed to one of the station replicates showing the presence of Stage III feeding voids at depth. Other than this discrepancy, the overall station ranking was comparable between the rarefaction curves and the OSI.

Spatial trends in faunal composition (numbers of species, individual abundances, and biomass) are related to organic enrichment gradients (in both space and time). These qualitative relationships are shown in Figure 4-1. Similarly, organism-sediment relationships, as measured by the REMOTS® OSI, also tend to change across zones of organic/physical impacts (Figure 4-1). Based on faunal trends in declining species richness (S), declining abundance (A) (Figure 4-2), OSI values between +4 and +5.5, and relatively high H' values, the Seawolf Mound at the time of the 1997 survey appeared to fit into the ecotonal transition in the SAB/OSI diagram (Figure 4-1).

Station abundance ranged from a minimum of 1250 individuals per square meter at Station CTR to a peak of ca. 28,000 per square meter at Station 300SE (Figure 4-2). These abundances are far less (by one to two orders-of-magnitude) than is typically observed at the peak of opportunists (PO, in Figure 4-1). This is another reason for fitting Seawolf Mound data into the ecotonal part of the disturbance gradient.

Biomass data were not available from the traditional grab sampling data taken to document S and A. However, Station 300SE had a significantly higher biomass than the other stations related to the presence of several large bivalve specimens. This observation suggests that Station 300SE was farther to the right of the ecotonal point than other Seawolf stations and therefore had experienced less intensive and/or less frequent impact than other stations.

The results are consistent with the predictions based on the topographic location of the stations and sediment type. The CTR station experienced the greatest disturbance due to massive physical disturbance, and/or ecological impacts of the presence of a layer of gray plastic glacial clay from new work dredging that has low food value and is resistant to penetration by infaunal organisms. The broad area of the mound plateau was variable in levels of disturbance and successional response, but generally represents an expected pattern of recovery 1–2 years after a mound is capped. The station located on the apron (300SE) showed the lowest level of disturbance to the extent that large, long-lived bivalves were still in place and the successional stage was transitional (Stage II).

4.2.2.4 Evaluation of Recolonization in 1998

Because the 1998 survey was conducted nearly two-and-a-half years after completion of disposal, the recolonization paradigm predicts that the successional stage in 1998 will be dominated by Stage III organisms (Germano et al. 1994). The monitoring results confirmed this prediction, but there was some evidence of a continuing effect of the gray clay. The results of the 1998 survey indicated that the successional status of the Seawolf Mound was advanced, showing healthy Stage II, Stage II to III, or Stage II on III communities inhabiting the sediments (Table 3-1). The large chaetopterus tubes on the sediment surface also provided evidence of stable, recolonized dredged material. Overall, the average OSI values were less than those observed in 1997, primarily due to shallower mean RPDs measured in 1998. At the reference areas, the mean RPDs were slightly greater in 1998 at the NLON REF and WEST REF reference areas, and lower at NE REF than observed in 1997.

At the Seawolf Mound, the lowest mean RPDs in 1998 were observed at two stations on the southwestern side of the central mound area (Figure 3-18). Although in general, the lower RPDs tended to be over the central area, the RPDs were variable spatially. The calculated average RPD suggested that the depth of the oxidized layer had become shallower since the 1997 survey. However, this apparent reduction was due primarily to five stations sampled in 1997 that had RPDs of >4 cm (Figure 4-5). In both 1997 and 1998, the modal RPD was 1–2 cm, which was slightly less than the modal reference RPD (2–3 cm). This result indicates that the majority of measured RPDs were similar from one year to the next.

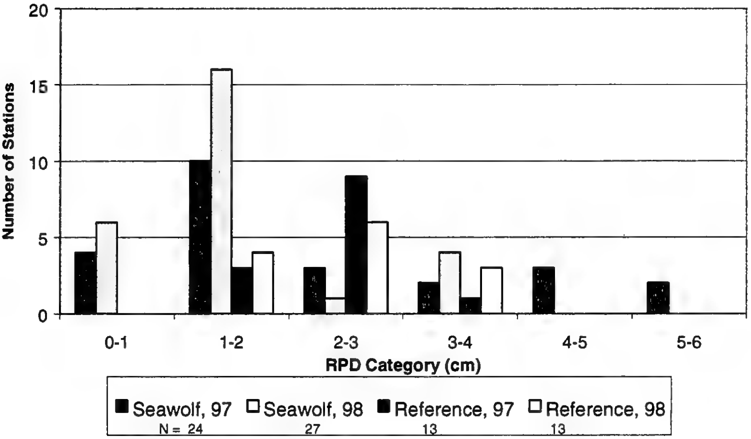


Figure 4-5. Frequency distribution of mean apparent RPDs at the NLDS reference areas and the Seawolf Mound in 1997 and 1998.

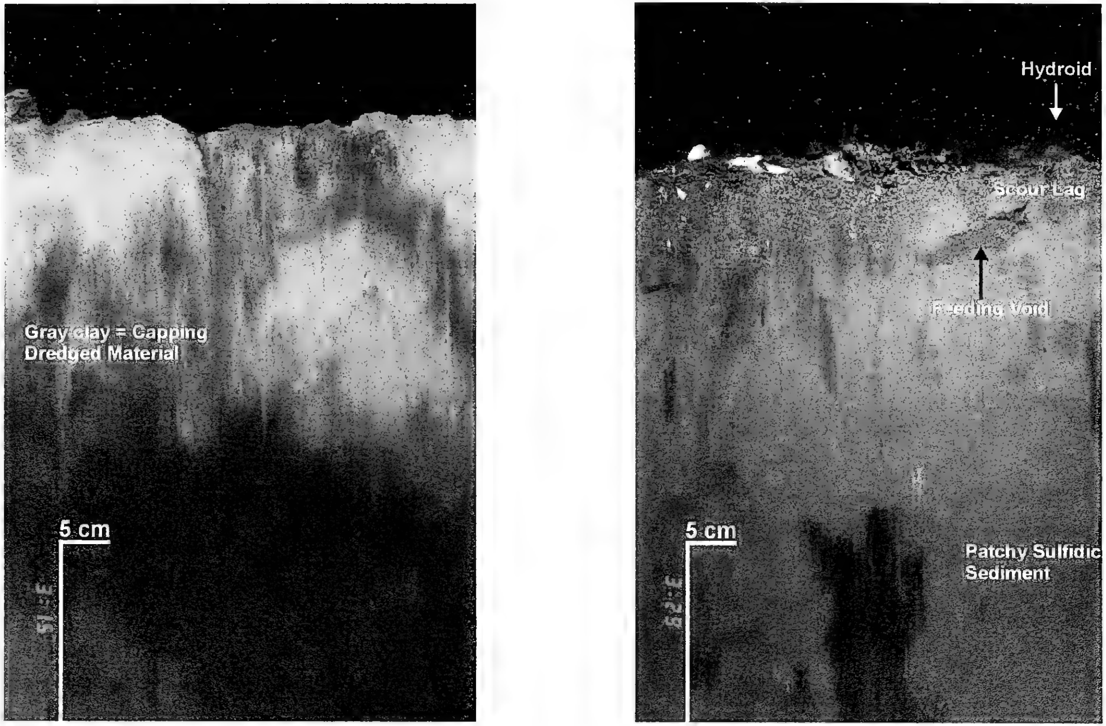
The presence of deeper RPDs at several stations in 1997 was probably due to spatial variability, although also may have been a function of remnant oxidation of new, fine-grained dredged material. As the dredged material (and especially the gray clay) continues to be recolonized, the modal RPD should become similar to or greater than that measured at the reference areas.

In 1998, the presence of gray clay was widespread on the apex and plateau areas of the mound (Figure 3-20). While most photos showed evidence that the gray clay was breaking down and becoming bioturbated (Figure 4-6), some replicates on the apex (150N replicates B and C) had limited colonization or development of RPDs. In 1997, a much higher number of replicates appeared to be affected by fresh gray clay with restricted recolonization due to the apparent low food value of ancient clays and the resistance to penetration by burrowing organisms. The 1998 photographs also showed increased evidence of scour lag and physical reworking of the surface sediments (Section 4.2.3). Sulfidic sediments within the gray clay were also more common in 1998, as the surface sediments began to reach equilibrium in the new environment (Figure 4-7).

The combination of initial biological reworking, physical scour and development of sulfidic profiles appear to be early stages in the incorporation of non-ambient ancient clays into the sediment fabric of the near-surface sediments at NLDS. It is not surprising that these processes have left a patchy response with areas of Stage III succession interspersed with patches of shallow RPDs. As individual clumps and blocks of clay are broken down, the areas between them will collect ambient sediments and support rapid recolonization. The integrated picture of benthic assemblages collected in 1997 and REMOTS® data from 1997 and 1998 suggests that biological recolonization is progressing on the surface of the Seawolf Mound, but is still moving toward equilibrium with the surrounding ambient sediments. There is no biological evidence of toxic conditions in the surface sediments of the Seawolf Mound as a range of sensitive Stage II and III species are continuing to colonize.

4.2.3 Potential Resuspension from the Seawolf Mound

In a parallel study, oceanographic conditions at NLDS were evaluated in 1997 and 1998 with specific reference to the Seawolf Mound (Waddell et al. 2001). The results of this study were consistent with numerical modeling results for Long Island Sound (Signell et al. 1998) as well as the physiographic description of bottom sediments (Knebel et al. 1999). Semi-diurnal (twice-daily) tidal currents dominate the physical oceanographic environment at NLDS. These currents appear sufficiently strong to winnow unconsolidated fine sediments, however the site is well protected from most storm-generated wave disturbances (Signell et al. 1998, Waddell et al. 2001). The result is that the surface sediments at NLDS (and the Seawolf Mound) should reflect the response of deposited dredged material (whether it be clay, silt or sand) to twice daily tidal current stress. The prediction (and pattern of



A. 1997 CTR

B. 1998 CTR

Figure 4-6. Evidence of sediment recolonization at NLDS; A) September 1997 CTR Station compared to B) July 1998.

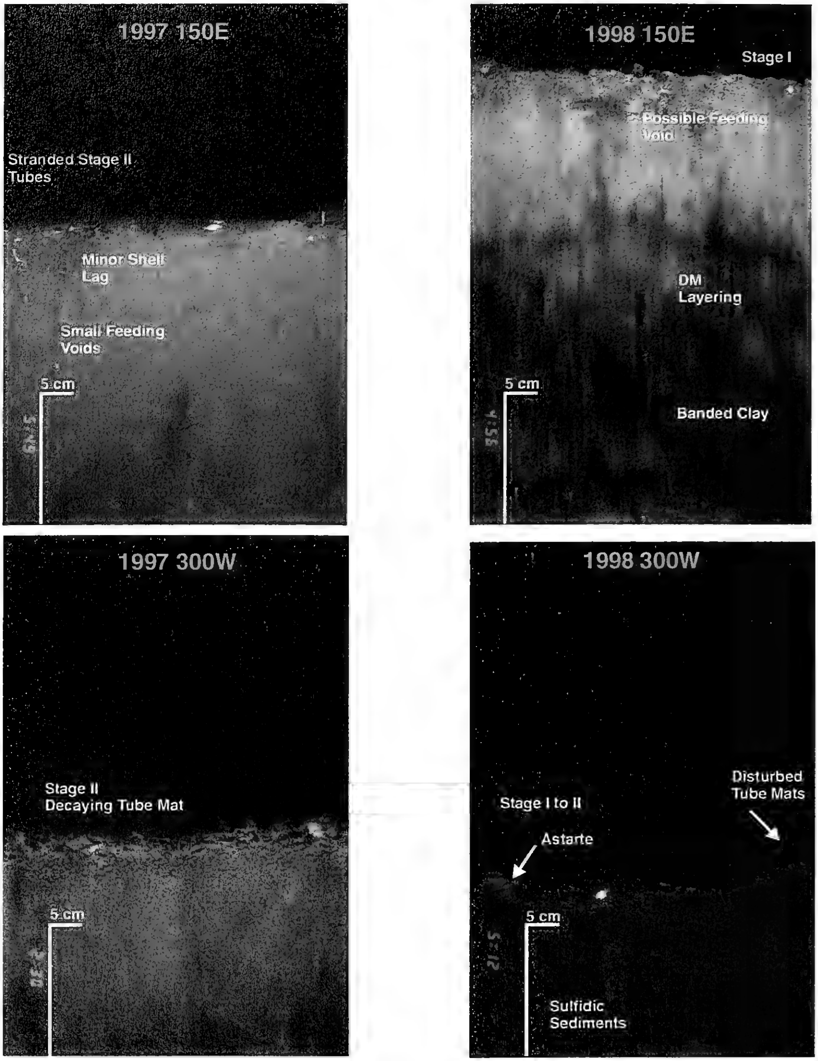


Figure 4-7. Comparison of September 1997 and July 1998 Seawolf REMOTS® stations

observation in previous studies) was that the surface sediments of the Seawolf Mound would eventually be winnowed of some of the silt-clay fraction resulting in a surficial residuum of fine sand mixed with shell and coarse sand (Johnson and Baldwin 1986).

In many areas the sand may be transported in bedload over silty sediments without erosion of the cohesive silts, resulting in a "sand-over-mud stratigraphy" detectable in REMOTS® images. It is expected that the sand and shell "lag" deposits (large sediment particles that "lag" behind as the finer materials are washed away) would be resistant to further erosion of the scale experienced on a regular basis. This process is called "textural armoring." These sediment transport features have been widely observed in studies of ancient and modern coastal sediment transport patterns (Johnson and Baldwin 1986). The techniques used to investigate sediment transport history in sedimentary geology are analogous to interpretation of REMOTS® sediment profile images.

The surface sediments of the Seawolf Mound were evaluated relative to these predictions. Characteristics of surface sediment winnowing identified in REMOTS® images include shell lag, disturbed amphipod tube mats, physical boundary roughness, and sand over mud stratigraphy. Shell lag can be seen as exposed bivalve and gastropod shells (Figure 4-8a) or shells mixed with sand. Winnowed surfaces are observed when the surface shows evidence of recently lost material (mud bands on polychaete tubes, lack of bioturbated "fluff" layer, irregular surface topography; Figure 4-8b). Amphipod tube mats go through a cyclic process where tubes are abandoned and begin to decompose, in this state they are easily transported. The decomposition and loss of a few amphipod tubes will trigger instability in the mat and cause the mats to roll-up and be transported in pieces. Stages in this process can be seen in REMOTS® images including new mats, adult mats, decaying mats, and persistent fragments of mats with adjacent exposed sediment (Figure 4-9). Physical boundary roughness is evaluated by the difference between the highest and lowest elevation of the sediment surface in an image and subjectively assigned to biological (tubes, mounds, burrow pits) or physical (shell lag, dredged material clumps, mud clasts) causes.

Three of the characteristics of winnowing were widely distributed at the Seawolf Mound (Figure 4-10). Only two of the REMOTS® stations showed no evidence of small-scale winnowing (CTR and 300W). Station CTR showed persistent clumps of gray clay and 300W showed no evidence of dredged material, but some decaying amphipod tubes (Figure 4-11). The presence of cohesive gray Gardiners glacial clay (from improvement dredging below the estuarine sediments) across the mound had an influence on the surface sediment distribution. The grain size at the inner stations was finer than at the reference areas, which was characterized as very fine sand. A mix of silt-clay and very fine sand characterized most of the sediments of the Seawolf Mound, and surface sand overlying fine-grained sediment (sand over mud stratigraphy) was noted for most images.

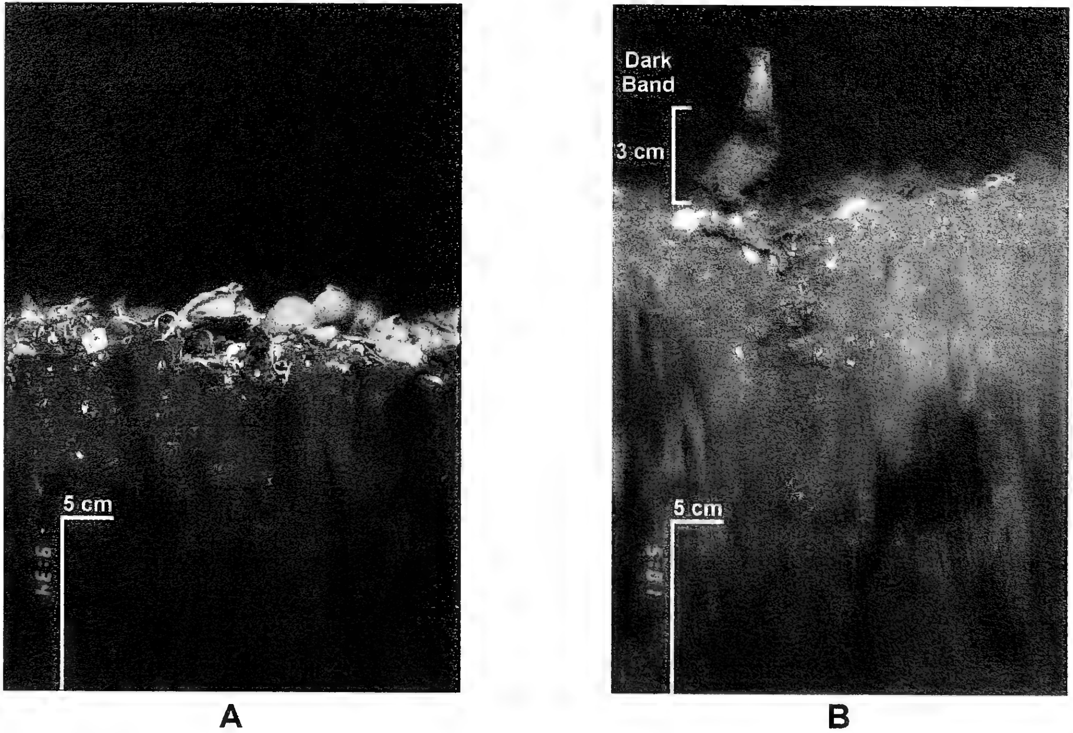


Figure 4-8. Evidence of sediment disturbance at NLDS. A) An example of shell lag deposits obtained from the NL 94 Mound. B) Winnowed surface at the Seawolf Mound, note ca. 3 cm dark band on *Chaetopterus* tube (polychaete) indication winnowing of fines over this depth interval.

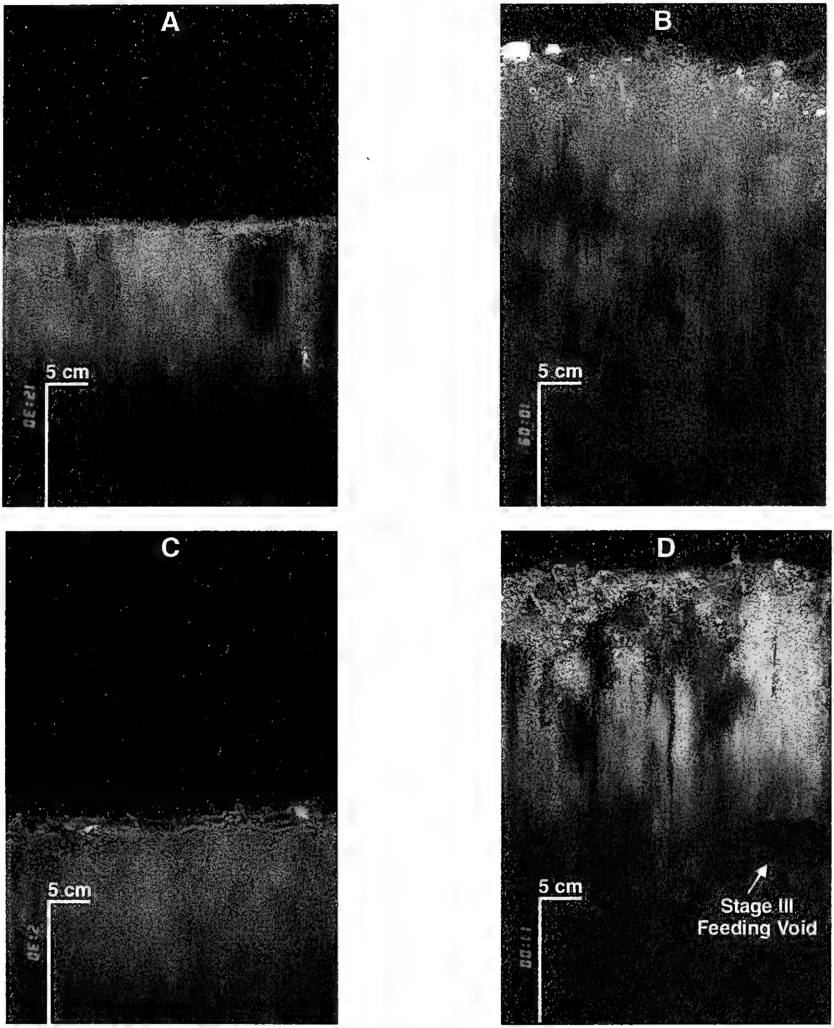


Figure 4-9. Cycle of Ampeliscid tube mat development, decay, and disturbance. A) Juvenile tube mat. B) Adult tube mat on shell lag over dredged material. C) Decaying tube mat on ambient sediment. D) Disturbed tube mat with sand-over-mud layering, Stage III feeding void.

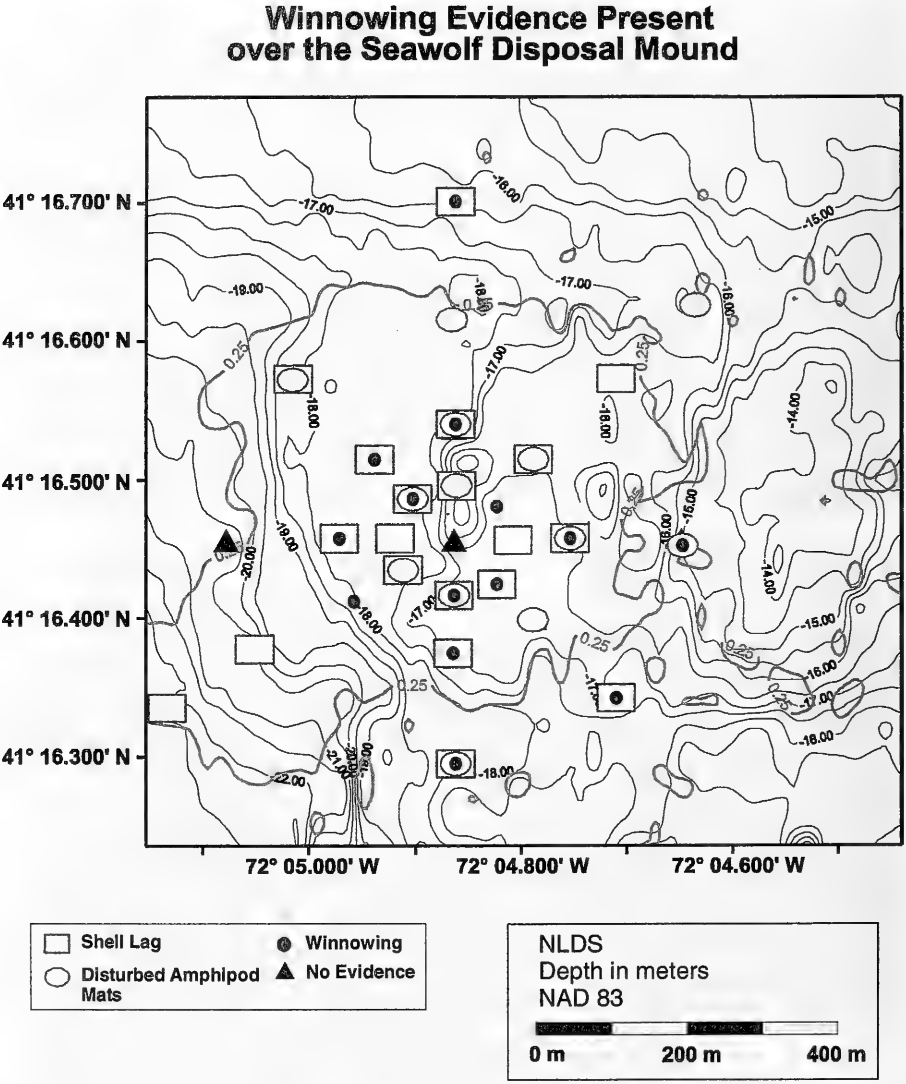


Figure 4-10. Three characteristics of small-scale winnowing over the Seawolf Disposal Mound documented during the September 1997 survey.

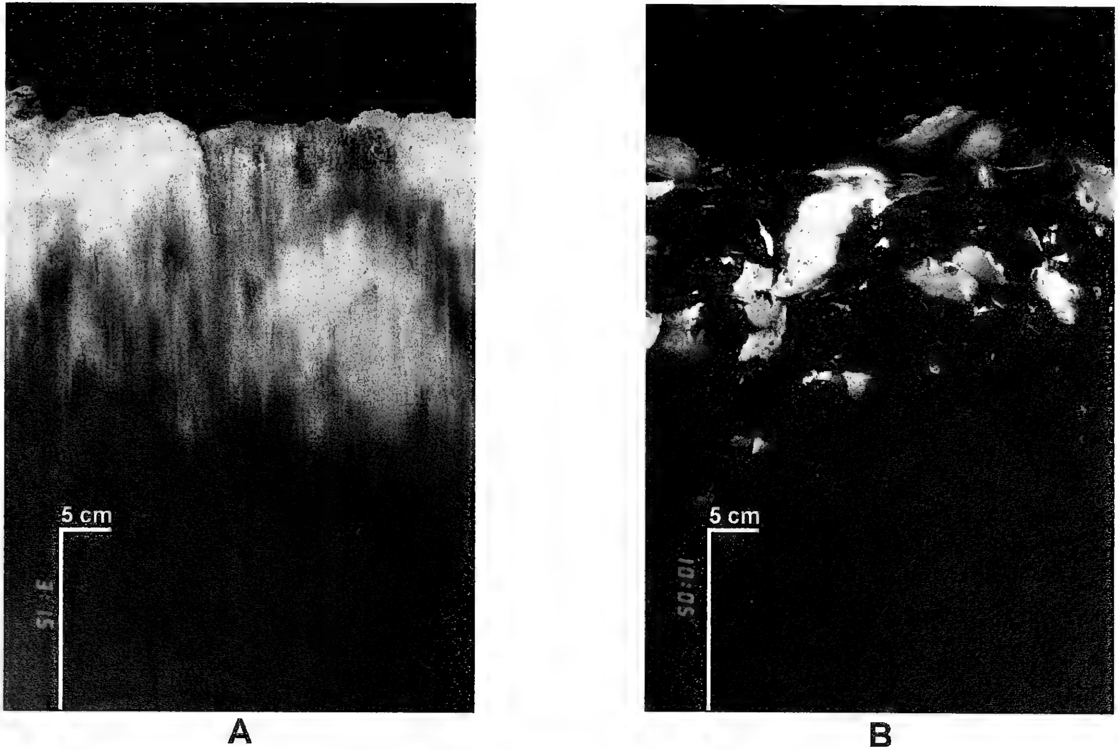


Figure 4-11. A) Clumps of glacial gray Gardiners clay at center of Seawolf Mound. B) Shell lag with disturbed tube mats at Seawolf Station 300N.

The direct observations of the surface sediments of the Seawolf Mound in the REMOTS® images were consistent with the predictions from modeling, direct physical oceanographic measurements and past observations (Waddell et al. 2001). There was evidence of winnowing of no more than 3 cm of fine-grained cap material and no evidence of storm-induced winnowing (characterized by dense layers of pebbles and shells with no bioturbated layer). Armored shell lag surfaces were mixed with decaying tube mats, indicating sufficient stability to induce settlement and growth of dense amphipod tube mats with eventual senescence (Figure 4-11b). The available sand fractions show some evidence of transport over silt layers without winnowed interfaces (this process can be difficult to distinguish from sand layers directly deposited by disposal barges onto previously deposited silt layers). This visual evidence strongly supports the conclusion that depth difference results are due to consolidation not erosion of sediments from the surface of the Seawolf Mound.

In 1998, surface sand overlying fine-grained sediment (sand-over-mud stratigraphy) was noted for most REMOTS® photographs collected from the Seawolf Mound. The depth of the sand layer was usually less than 5 cm. Both the core samples and REMOTS® photographs indicated fine-grained sediments over the apex and plateau of the mound. Very fine sand was observed on the apron of the mound similar to observations of sediments at the reference areas. Many replicate photographs also showed evidence of shell lag. Although there was no obvious spatial pattern of boundary roughness values, several stations were identified as winnowed (Figure 4-12). If at least one replicate contained evidence of winnowing, shell lag, or disturbed amphipod mats the station was identified as winnowed. All of the surface types were common across the mound. The presence of shell lag tends to limit the process of further erosion through armoring of the surface sediment. Similar to the Seawolf Mound, the reference area sediments were affected by tidal processes. Sand-over-mud stratigraphy and shell fragments at the surface were common, as well as disturbed tube mats. These results, combined with bathymetric results, demonstrate that while minor surface transport of sediments is characteristic of the area surrounding NLDS, the cohesive sediments that comprise the bulk of the material in the Seawolf Mound have remained in place throughout the period of this study. This finding is consistent with the observations of stable disposal mounds at NLDS over a period of at least twenty years (SAIC 2001).

4.2.4 Sediment Chemistry of the Seawolf Mound

To provide a basis for comparison with cores collected from the Seawolf Mound, the results of chemical testing of sediments in the Thames River prior to dredging were reviewed. Data from pre-dredged sediments indicated an overlap in chemical concentrations between the material classified as UDM and CDM (Maguire Group 1997). In general, the

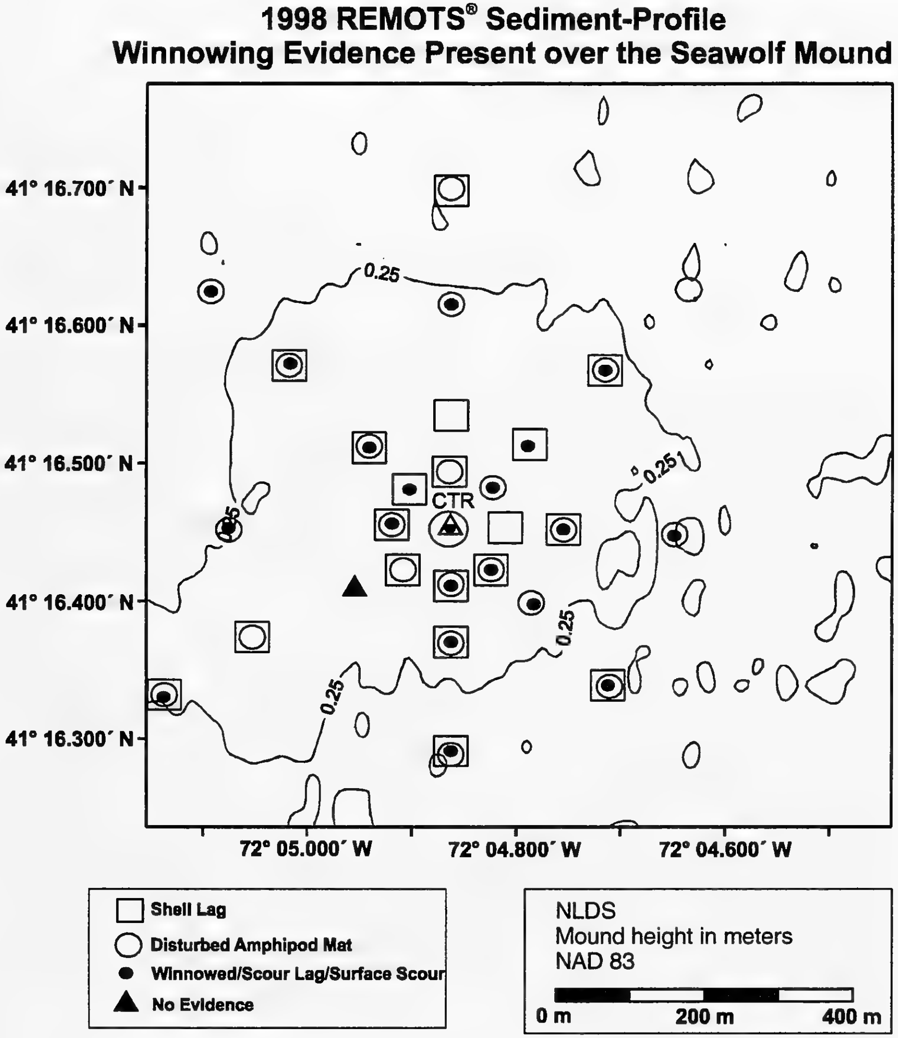


Figure 4-12. Spatial distribution of observed winnowing evidence over the Seawolf Mound during the 1998 survey.

UDM was classified as unsuitable based on biological testing results, but some of the chemical analyses, notably those conducted in 1992, did indicate that the sediments were elevated in contaminants, especially in PAHs, relative to reference data.

Samples collected in the material from the dredging areas ranged from pure silt-clay in the channel (1994 samples) to dominantly sand (>50%) in the outer channel reaches (Maguire Group 1997). The sand content in the cores suggested that the upper 50 cm of the Seawolf Mound was representative of CDM from the outer Thames River (sand averages 20% [inner, outer zones] to 31% [middle zone]). The visible presence of clay in the top layers of the cores (and REMOTS® photographs) was representative of the last CDM placed at the Seawolf Mound, which was predominantly material resulting from improvement dredging (gray Gardiners clay).

In addition to the core descriptions and grain size results, the overall lack of elevated contaminant concentrations typical of the surface sediments of the most contaminated pier areas suggested that at least the upper 50 cm of the disposal mound consisted of CDM. Specifically, the PAH concentrations were low overall, with little variability in the samples collected either spatially across the mound (inner, middle, and outer zones), or with depth in the long cores. These results confirmed the placement of CDM across the mound, as well as indicating that the thickness of CDM exceeded 50 cm in the inner, middle, and outer zones. The chemistry data were evaluated in context of the different zones of the deposit in parallel to the apex, plateau, and apron areas discussed above.

Figure 4-13 depicts the core locations from 1997 and 1998 with respect to the UDM deposit and final capped mound footprint. With the placement of capping material and passage of time, the UDM deposit consolidated since the December 1995 precap survey. Therefore, even though the figure suggests that the peaks of the capped mound and the UDM deposit have a similar height, the CDM layer actually compressed the UDM (Figure 3-6), which further consolidated between the 1995-96 CDM placement activity and the 1997 and 1998 surveys. As mentioned previously, the small area of UDM on the eastern edge of the mound that did not appear to be sufficiently covered by capping material in the bathymetric depth difference plots, did appear to be covered adequately by CDM in REMOTS® images from Station 300E over this location. Figure 4-13 shows that the UDM deposit was located primarily within the inner zone, with the apron of the deposit extending into the middle zone beneath the CDM layer.

4.2.4.1 Outer Zone 1997

In 1997, five cores were collected in the outer zone, four short cores (2A, 2B, 3A, 3B), and one long core (4A). All of the short cores, collected near the boundary of the limit of detectable dredged material (Figure 4-13), indicated that ambient material was collected

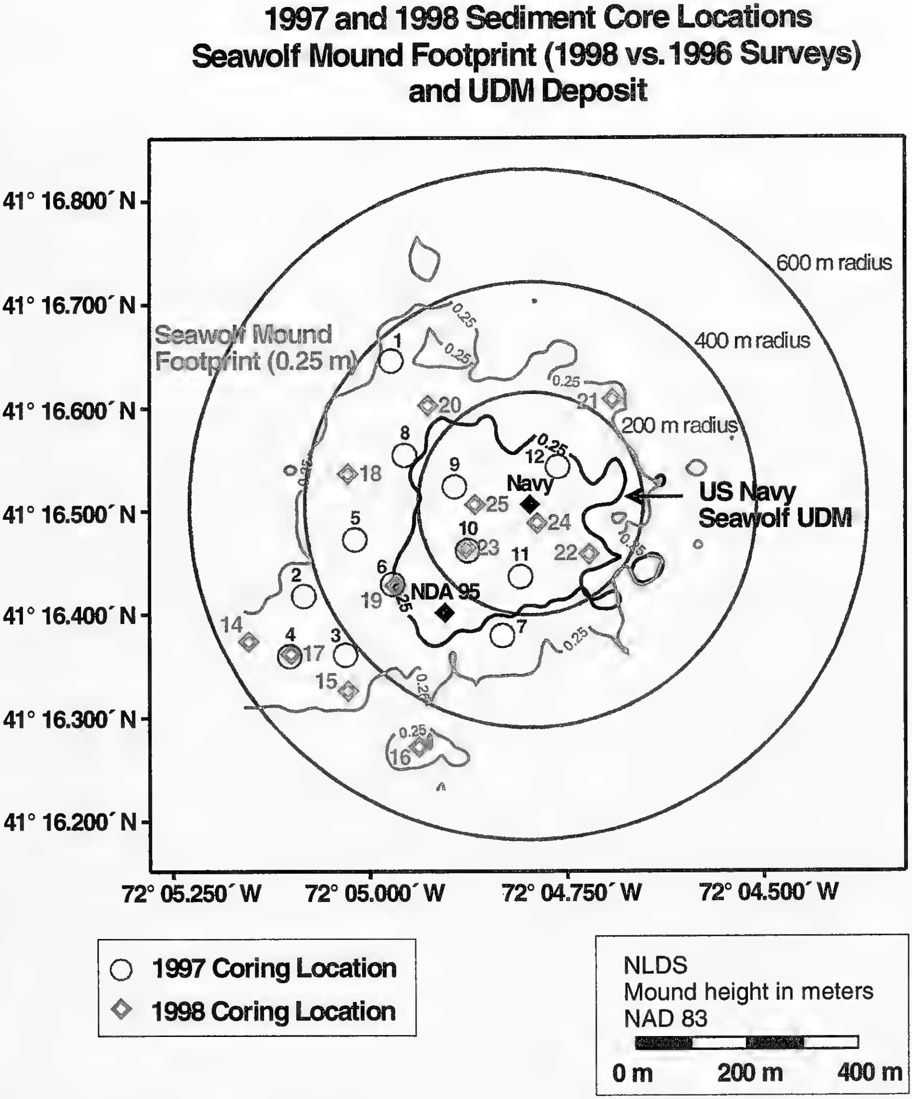


Figure 4-13. 1997 and 1998 sediment core locations with respect to the UDM deposit and the capped Seawolf Mound footprint.

below the CDM material, which was consistent with the bathymetric data (e.g., Core 2A; Appendix D). Overall, the grain size of cores 3A and 3B was slightly sandier than the other cores.

The long core, Core 4A, was situated in the outer zone but in an area of recent dredged material accumulation (Figure 2-6). The core consisted uniformly of dark olive-gray silty clay that was similar in appearance and texture to the material collected in the upper portion of cores from many of the other stations. This suggests that the material in Core 4A was predominantly CDM. The three samples collected down-core were very similar in both physical and chemical characteristics (Tables 3-5 and 3-6). Both metals and PAH data were consistent with the samples collected from the cores representing CDM (Appendix E).

4.2.4.2 Middle Zone 1997

Five cores were collected in 1997 in the middle zone, four short cores (1A, 5A, 7A, and 8A), and one long core, 6A. At the base of Core 1A, located near the boundary of the mound, there was an olive-gray gravelly sand and shell hash, similar to the ambient sediments collected in Core 13A (Appendix D). This core also had relatively low metal concentrations. In general, the middle zone cores consisted of sandy fine-grained sediment (11–37% sand; 63-89% fine-sediment). The metals and PAH concentrations of the cores collected in the middle zone were consistent with the CDM values measured at the dredging area. The long core collected in the middle zone, Core 6A, again showed overall fine-grained sediments relative to other middle zone cores, as with long Core 4A in the outer zone.

4.2.4.3 Inner Zone 1997

Three short cores (9A, 11A, and 12A) and one long core (10A) were collected in the inner zone as part of the 1997 survey. Core 9A was located relatively close to middle zone Core 8A and was similar in lithology and chemical concentrations to the cores in the middle zone. The other two short cores collected in the inner zone showed overall higher fines content (67-88%) and less sand. The PAH values were consistent with CDM, and metals concentrations generally were within the range of those measured in the middle and outer zones. The concentrations of Zn were on the higher side of the range measured in the CDM material (101 mg/kg at Station 11A and 215 mg/kg at Station 12A), but evidence from the PAH data support the determination that these were cap sediments.

The long core collected in the inner zone (Core 10A) was the longest of the 1997 survey, and recovered the widest variety of lithologies. The upper two meters was similar to CDM recovered in the other cores. Below this interval, patches of black oily sediment, gravel, and silty clay were recovered, indicating potential recovery of UDM. No chemical or grain size samples were collected, however, in that part of the core, in accordance with the sampling design (Table 2-6, but see results for 23A below). The grain size and chemistry data of the three samples collected in Core 10A were consistent with the other inner zone cores, including the lowest sand percentages (5–8%), and high total fines (92–95%). Because no chemistry data were available for the improvement material (gray clay), however the metals concentration in the areas of higher clay may be related to the clay content.

Trace metal and PAH concentrations of the upper 50 cm (short cores) in 1997 and 1998 confirmed the presence of CDM over the Seawolf Mound. The trace metal concentrations stayed relatively constant from 1997 to 1998 and in most cases the 1998 samples were lower than values detected in the previous year, which was probably due to both spatial and analytical variability. Normalized to the fine-grained fraction (silt and clay), trace metal concentrations were similar or less than measured in the CDM prior to dredging (Figure 3-28). The exception was the average value of Zn, because of one sample with a relatively high value in one surface (0–50 cm) core (14B). This core was located in the southwestern region of the mound, where ambient material was detected below the layer of CDM. A similar small elevation in PAH concentrations, relative to the other short core samples (see below), supports a conclusion that this sediment was not Seawolf UDM, but probably reflects either an existing elevation in the ambient sediments at this location or dredged material associated with other projects. In addition, the zinc value in Core 14B was well below the maximum values measured at the dredging site prior to dredging.

4.2.4.4 Core Results 1998

Both the long and short core samples from the Seawolf Mound in 1998 contained average PAH values that were less than either the UDM or the CDM PAH data collected prior to dredging. For example, the average LMW PAH phenanthrene concentration measured in the short cores was 25 μg/kg, compared to 44 and 565 μg/kg measured in the UDM in 90/94 and 92, respectively. The maximum concentrations of PAHs were measured in the samples from the deepest sections of long Cores 17A and 23A and the 0.5–0.75 m sample from middle Core 19A (Table 3-7). These concentrations were similar to PAHs measured in CDM/UDM in 1990/94 and significantly less than that measured in 1992. Some of the differences in PAH concentrations were due to the variability of organic carbon (Figure 4-14).

All of the short cores in all three zones in 1998 had TOC-normalized PAH levels that were consistently less than the concentrations at the reference area (Figure 4-14; Appendix D, Tables 1 and 2). PAH levels (LMW and HMW) generally increased with depth and were greater than the reference area values in downcore samples from the middle and outer zones.

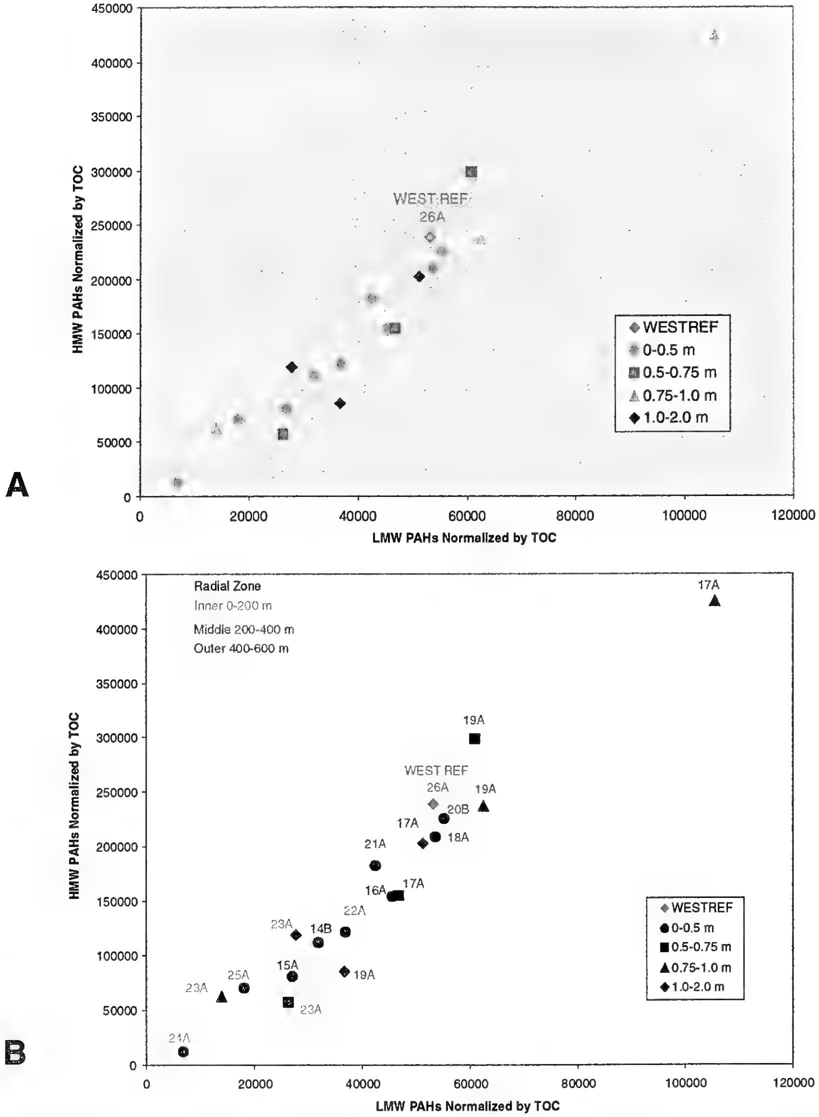


Figure 4-14. Concentrations of HMW versus LMW PAHs normalized by TOC in Seawolf Mound and WEST REF sediment samples shown in relation to (A) sample depth and to (B) radial zone.

The greatest total PAH concentration, 1060 µg/kg, occurred in the Outer Zone in the 1–1.7 m sample of Core 17A, indicating an elevation in the ambient eastern Long Island Sound sediments (possibly related to historic dredged material disposal) occurring below a CDM layer of at least 1.0 m. The Middle Zone long Core 19A, located on the edge of the UDM deposit, may have contained small amounts of UDM in the 0.5–1.0 m section as indicated by the slightly higher normalized PAH levels than present at the reference station (Figure 4-14). Although the long core from the Inner Zone (Core 23A) had visually apparent UDM, the normalized PAH concentrations were consistent with other measured values (Figure 4-14). In long Core 23A, the section below 110 cm was described as black, oily fine sand, and both samples below 75 cm had high TOC concentrations (>5.5%). The 1–2 m depth interval contained 20% gravel content, 37% sand, and only a 43% silt and clay fraction. Core 23A was the longest (3 m) and yet did not appear to contain ambient sediments. The PAH concentrations were rather low in the 0.5–0.75 m interval of Core 23A and increased with depth. The cumulative evidence of increasing PAH concentrations, high TOC, and an atypical grain size distribution suggested that long Core 23A did penetrate into UDM.

To summarize the chemistry and physical characteristics of the cores taken from the Seawolf Mound, in all samples between the surface and 50 cm depth intervals in the cores, metal and PAH concentrations were comparable to CDM material and in two cases marginally higher than Reference area values for metals normalized to grain size (Cores 3A and 14B). The long cores did not sample any material with strongly elevated chemistry values, but changes in grain size, TOC, appearance and chemistry indicated two cores that may have sampled UDM (Cores 19A and 23A) and a third core (Core 17A) may have been influenced by historic contamination in the existing, pre-Seawolf sediments. In each of these cores, the elevated chemical concentrations were found at depths below 50 cm.

The data from 1997 and 1998 were very consistent and indicate that the sediments on the surface of the Seawolf Mound were not elevated in contaminants relative to the original, pre-dredged testing of the channel sediments. Where higher concentrations were found at depth in the cores (all 50 cm or deeper), there was no evidence of elevation in the top core intervals relative to other samples. The weight of the chemical evidence combined with biological and REMOTS® sediment profile images indicates that the cap was effective in isolating the underlying UDM deposits, with no evidence of mixing or release of contaminants into the surface sediments. Furthermore, the chemistry data clearly showed a minimum of 50 cm of suitable material covering the mound at all sites cored. In the case of the long cores, the capping material was shown to be much thicker (1.6 to 2.0 m thick in 1997, 0.5-2.0 m thick in 1998). The results of the core analyses support a conclusion that the Seawolf Mound was capped with at least 50 cm of material, and this cap material was effective in consolidating and isolating the underlying UDM material.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The New London Disposal Site (NLDS) monitoring results from 1992-1998 provide a time-series of observations of individual mounds and the site as a whole, including reference areas. This time-series provides insights into physical and biological processes and any potential environmental impacts from the disposal of dredged material at the site. We include general conclusions for the site as a whole in this report for convenience; the results for some of these conclusions were presented and discussed in Volume I (SAIC 2001). The current report (Volume II) presented and discussed results from surveys conducted at the U.S. Navy Seawolf Mound from 1995-1998. This section provides conclusions both for the site and the Seawolf Mound (and recommendations for site management).

5.1 Overview of NLDS Monitoring

- A dredged material management strategy has been successfully developed for NLDS that takes into account regional influences over the site as well as site-specific constraints on dredged material disposal. This strategy has incorporated the use of off-site reference areas to determine regional effects on the site. It also uses preexisting disposal mounds, and a planned placement of mounds to form a "ring of mounds," that will both contain the spread of dredged material on the seafloor and allow unacceptably contaminated dredged material (UDM) to be capped.

- The stability of historic disposal mounds at the NLDS has remained the same over at least the last twenty years, indicating a stabilization of the mass of material at the disposal site, despite sorting and winnowing of surficial fine-grained material. There is strong evidence of stability of deposits placed at NLDS as much as twenty to thirty years ago (NL-RELIC, NL-I, -II, -III and -TR).

- All areas surveyed during this period showed evidence of healthy, stable benthic communities and rapid recolonization of dredged material following disposal activities.

- Biological activity had a strong seasonal impact on surface sediments. Widespread settlement and growth of tube-building organisms during spring and summer promoted deposition of fine-grained sediment on the surface of NLDS. Senescence or migration of these organisms during the fall and winter caused decomposition of tubes and removal of fines and tubes leaving coarser sediment on the surface.

- Physical and biological monitoring data from the NLDS were consistent with a model of seasonal winnowing of surficial fine-grained material. This process serves to armor the disposal mounds with a surficial scour lag deposit providing a mechanism for long-term stabilization of the mounds.

- Reference areas reflected conditions throughout eastern Long Island Sound including: seasonal responses to biological and physical processes and apparent impacts of low dissolved oxygen or organic enrichment. All reference areas supported stable, healthy benthic communities.

5.2 U.S. Navy Seawolf Mound

- The U.S. Navy Seawolf Mound was found to be a flat, circular deposit with a diameter of approximately 600 m. Peak heights of a small central apex extended 1-2 m above a large flat plateau and a relatively narrow apron. The Seawolf Mound (minimum elevation 16 m) is a few meters lower than the NL-RELIC Mound (minimum elevation 13.5 m) that lies immediately to the east.

- The Seawolf Mound was formed from five distinct disposal events resulting in a thick sediment cap (CDM) over a discrete mound of unsuitable dredged material (UDM). The CDM to UDM ratio was 1.82:1.0, providing a substantial volume of capping material composed of improvement dredging material from the Thames River channel (Gardiner's Clay) and sandy sediments from the outer channel.

1997

The survey conducted in 1997 achieved the following five objectives:

- **Assess the benthic recolonization status of the Seawolf Mound relative to the three reference areas surrounding NLDS.**

Sediment profile images showed the widespread presence of improvement material (gray Gardiner's clay) that was serving to cover and stabilize the mound surface. The presence of this non-marine, glacially-derived plastic clay may have slowed somewhat the normal rate of recolonization. The successional stage of the Seawolf Mound during the 1997 survey was predominantly Stage II, based on both REMOTS® and benthic taxonomic data showing the numerical dominance of *Nucula annulata* and tubicolous polychaetes. Although the OSI values were more variable than those at the reference areas (range +5.0 to +10.0), the average OSI value for the Seawolf Mound (+6.1) was similar to the reference area average (+6.7). The presence of non-marine, glacially-derived plastic clay at NLDS and other disposal sites monitored under the DAMOS program (e.g., Massachusetts Bay Disposal Site) requires minor adjustment of the normal recolonization paradigm because of the lack of organic matter in such clays. As ambient sediments accumulate and are worked into the clay, normal recolonization will proceed.

- **Collect cores along the cross-sections of the Seawolf Mound to assess the physical and chemical composition of the sediments to verify the presence of at least 50 cm of cap material.**

The thickness and lateral coverage of the capping material was confirmed with sediment cores and sediment profile image surveys. Cores revealed that the cap was at least 50 cm thick throughout the area sampled and may have reached 2-3 meters near the center of the mound. Core data indicated that the top 50-cm of material had no elevated levels of chemical contaminants that would indicate the presence of contaminated UDM. None of the analytical samples recovered from the cores collected in 1997 had contaminant levels consistent with UDM. One core did recover material below 2 m that appeared oily, and consistent with UDM.

- **Examine the benthic infaunal species diversity and relative abundance over the surface of the Seawolf Mound through analysis of six sediment grab samples.**

Benthic analysis of samples collected in September 1997 indicated that the Seawolf Mound was in the intermediate stages of recolonization, with abundances of organisms increasing with distance from the center of the mound. Species diversity, as calculated by the Shannon-Wiener index H', ranged from 2.65 to 4.10. Evenness, as calculated by the Shannon-Wiener index J', ranged from 0.48 to 0.82. The low diversity value was attributed to the dominant presence of the bivalve, *Nucula annulata*. The diversity at Station CTR was relatively high considering the low abundance of individuals. The high diversity relative to low species abundance is indicative of an early stage of succession (Pearson and Rosenberg 1978).

The use of standard benthic parameters (species richness, abundance, OSI, diversity) provided a useful comparison with reference areas and seasonal patterns. REMOTS® results were consistent with benthic data, except for a difference at the Seawolf Mound center station that was due to slower than expected recolonization of the Gardiner's clay. Community analysis is a suitable second tier evaluation to provide additional interpretation of REMOTS® results

- **Perform a detailed master bathymetric survey of the region surrounding NLDS as defined by the 1982 FPEIS**

The master bathymetric survey demonstrated that the configuration of disposal mounds at the NLDS has remained stable over at least the last twenty years (see above and Volume I). The 1997 master bathymetric survey provides a detailed benchmark for future studies of dredged material disposal and consolidation processes.

- **Document and delineate the changes in bottom topography (accumulation and consolidation) in the areas of concentrated disposal since August 1995.**

The large volume of capping material at the Seawolf Mound produced consolidation of the underlying UDM through a process observed in other mounds (Poindexter-Rollings 1990; Silva et al. 1994). This combination of self-weight consolidation and overburden from the cap sediments typically proceeds rapidly for the first nine months to a year after capping is completed and then decreases to a very slow rate over subsequent years until equilibrium is reached. In the case of the Seawolf Mound, consolidation of the entire mound was as much as 2 m (about 50% by volume), equivalent to the initial thickness of the cap. These volumetric changes were confirmed by long cores recovered from the center of the mound.

1998

The follow-up monitoring in 1998 required by the Navy's Seawolf Program Monitoring Plan achieved the following three main objectives:

- **Assess Further Consolidation of the Seawolf Mound Dredged Material**

The lack of significant topographic change between the 1997 and 1998 surveys indicated that the Seawolf Mound completed the rapid phase of consolidation, and was in the phase of limited, slow (secondary) consolidation. Tiered monitoring protocols, as well as historical evidence from open-water disposal mounds, predict that the mound will remain stable. Should a large storm occur in the eastern Sound, a follow-up, confirmatory bathymetric survey should be conducted. Almost 2.5 years after capping was concluded, the bathymetric configuration of the Seawolf Mound continued to depict a broad, flat topography with a small central apex, large plateau, and surrounding apron.

- **Verify the Presence of at Least 50 cm of Capping Dredged Material (CDM)**

Core data again indicated that the top 50-cm of material had no elevated levels of chemical contaminants that would indicate the presence of contaminated UDM. The long core collected in the inner zone (Core 23A) indicated approximately 1.1 m of CDM overlying UDM, which was similar to the depth in the previous year near the same location on the apex (Core 10A, 1.8 m of CDM). The PAH levels in the deepest samples of core 23A, and the 0.5–0.75 m sample in 19A, also suggested the possible presence of recovered UDM, although PAH concentrations alone were not diagnostic of CDM/UDM materials. Two cores clearly recovered ambient material: Core 17A in the outer zone below 2.2 m, and short Core 21A. Core 21A was located near the outer edge of the cap and had physical properties consistent with the reference area. There was no consistent difference in sediment physical characteristics or contaminant concentrations on the plateau away from the center apex of the mound, most likely due to the widely distributed CDM disposal locations. Total organic carbon concentrations of >5% were all located in the inner zone cores, but there was no similar pattern to the measured organic contaminants.

- **Evaluate Benthic Conditions and Recolonization**

Sediment profile images continued to show the widespread presence of improvement material (gray Gardiner's clay) that was serving to cover and stabilize the mound surface. The presence of this non-marine, glacially-derived plastic clay continued to slow somewhat the normal rate of recolonization.

The successional stage of the Seawolf Mound during the 1998 survey did show signs of advancement since 1997, with a combination of Stage II, Stage III, and Stage II on III seres. Stage III feeding voids were visible in areas of gray clay, suggesting some biological breakdown near the sediment surface. Patchy sulfidic sediments were observed in sediment-profile photographs collected over the apex and plateau of the mound. Some sulfidic sediment was also seen on the apron of the mound and was similar to sediments seen in some of the replicates from the NEREF reference area. The sulfidic sediments may have acted to decrease sediment dissolved oxygen levels and hinder recolonization rates at some stations of the Seawolf Mound in 1998.

The surface sediments of the Seawolf Mound showed evidence of current winnowing within the top 3 cm, manifested by the presence of disturbed amphipod mats, armoring by shell hash, and sand-over-mud topography, consistent with 1997 results, results from surveys over the past two decades, and predictions from physical oceanographic measurements conducted in a separate study (Waddell et al. 2001).

5.3 Recommendations

- Continue to monitor the benthic recolonization on the surface of the mound to provide long-term response to glacial clays in the estuarine environment.
- Future surveys at NLDS could optimally be scheduled after benthic recruitment has begun (early June) but before mid-August when tube mats appear to senesce.

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Appendix A
Disposal Logs

BUOY	PERMITTEE	PROJECT	DISPAREA	DISPDATE	LATDEG	LATMIN	LONGDEG	LONGMIN	FRBUOY	DIR	CYVOL
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	25-Nov-95	41	16.338	72	4.943	5'		300
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	27-Nov-95	41	16.338	72	4.943	20'		300
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	30-Nov-95	41	16.338	72	4.943	10'		250
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	3-Dec-95	41	16.355	72	4.927	15'	S	300
					Volume of Brewers Yacht Yard material deposited at the NDA 95 Buoy					yd^3	1150
					Volume of Brewers Yacht Yard material deposited at the NDA 95 Buoy					m^3	879.29

Precap Bathymetric Survey over the Seawolf Project Area 07-Dec-95

BUOY	PERMITTEE	PROJECT	DISPAREA	DISPDATE	LATDEG	LATMIN	LONGDEG	LONGMIN	FRBUOY	DIR	CYVOL
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	28-Dec-95	41	16.366	72	4.935	10'		400
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	30-Dec-95	41	16.38	72	4.931	15'		400
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	4-Jan-96	41	19.206	72	4.126	5'		350
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	6-Jan-96	41	16.366	72	4.935	5'		300
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	9-Jan-96	41	16.366	72	4.935	5'		350
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	10-Jan-96	41	16.383	72	4.919	50'	S	350
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	11-Jan-96	41	16.383	72	4.919	10'		300
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	12-Jan-96	41	16.352	72	4.939	10'		250
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	14-Jan-96	41	16.369	72	4.923	10'		300
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	15-Jan-96	41	16.366	72	4.935	10'		250
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	16-Jan-96	41	16.366	72	4.935	10'		300
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	19-Jan-96	41	16.38	72	4.931	20'		300
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	22-Jan-96	41	16.38	72	4.931	10'		250
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	23-Jan-96	41	16.366	72	4.935	5'		300
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	26-Jan-96	41	16.38	72	4.931	5'		350
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	29-Jan-96	41	16.338	72	4.943	100'		300
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	30-Jan-96	41	16.38	72	4.931	15'		300
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	31-Jan-96	41	16.338	72	4.943	50'		350
					Volume of Brewers Yacht Yard material deposited at the NDA 95 Buoy					yd^3	5700
					Volume of Brewers Yacht Yard material deposited at the NDA 95 Buoy					m^3	4358.22

Postcap Bathymetric Survey over the Seawolf Project Area 01-Feb-96

BUOY	PERMITTEE	PROJECT	DISPAREA	DISPDATE	LATDEG	LATMIN	LONGDEG	LONGMIN	FRBUOY	DIR	CYVOL
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	1-Feb-96	41	16.38	72	4.931	20'		300
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	2-Feb-96	41	16.366	72	4.935	50'		250
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	6-Feb-96	41	16.38	72	4.931	10'		250
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	7-Feb-96	41	16.394	72	4.927	15'		250
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	8-Feb-96	41	16.394	72	4.927	10'		300
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	9-Feb-96	41	16.355	72	4.927	100'		250
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	13-Feb-96	41	16.366	72	4.935	25'		350
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	14-Feb-96	41	16.366	72	4.935	25'		300
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	15-Feb-96	41	16.38	72	4.931	15'		300
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	19-Feb-96	41	16.38	72	4.931	5'		300
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	20-Feb-96	41	16.394	72	4.927	20'		300
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	21-Feb-96	41	16.352	72	4.939	25'		300
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	22-Feb-96	41	16.338	72	4.943	20'		350

NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	23-Feb-96	41	16.366	72	4.935	20'	200
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	24-Feb-96	41	16.394	72	4.927	8'	150
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	26-Feb-96	41	16.338	72	4.943	75'	200
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	27-Feb-96	41	16.338	72	4.943	100'	200
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	28-Feb-96	41	16.352	72	4.939	100'	200
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	28-Feb-96	41	16.338	72	4.943	125'	200
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	29-Feb-96	41	16.352	72	4.939	100'	200
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	1-Mar-96	41	16.352	72	4.939	125'	150
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	4-Mar-96	41	16.38	72	4.931	75'	150
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	4-Mar-96	41	16.366	72	4.935	75'	175
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	5-Mar-96	41	16.338	72	4.943	250'	150
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	6-Mar-96	41	16.352	72	4.939	200'	150
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	6-Mar-96	41	16.338	72	4.943	225'	150
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	7-Mar-96	41	16.366	72	4.935	150'	175
NDA-95	BREWER'S YACHT YARD AT MYSTIC	MYSTIC RIVER, MYSTIC CT	NLDS	11-Mar-96	41	16.366	72	4.935	150'	200

Volume of Brewers Yacht Yard material deposited at the NDA 95 Buoy	yd^3	6450
Volume of Brewers Yacht Yard material deposited at the NDA 95 Buoy	m^3	4931.67

Total Volume of Brewers Yacht Yard material deposited at the NDA 95 Buoy	yd^3	**13,300**
Total Volume of Brewers Yacht Yard material deposited at the NDA 95 Buoy	m^3	**10,169.18**

BUOY	PERMITTEE	PROJECT	DISPAREA	DISPDATE	LATDEG	LATMIN	LONGDEG	LONGMIN	FRBUOY	DIR	CYVOL
NDA-95	GROTON LONG POINT ASSOC	VENETIAN HARBOR	NLDS	04-Dec-95	41	16.352	72	4.939	50'	SW	300
NDA-95	GROTON LONG POINT ASSOC	VENETIAN HARBOR	NLDS	05-Dec-95	41	16.355	72	4.927	40'	S	275
NDA-95	GROTON LONG POINT ASSOC	VENETIAN HARBOR	NLDS	05-Dec-95	41	16.352	72	4.939	50'	S	350
NDA-95	GROTON LONG POINT ASSOC	VENETIAN HARBOR	NLDS	06-Dec-95	41	16.355	72	4.927	75'	S	325
NDA-95	GROTON LONG POINT ASSOC	VENETIAN HARBOR	NLDS	06-Dec-95	41	16.352	72	4.939	50'	S	300
NDA-95	GROTON LONG POINT ASSOC	VENETIAN HARBOR	NLDS	07-Dec-95	41	16.366	72	4.935	50'	S	325
					Volume of Venetian Harbor material deposited at the NDA 95 Buoy					yd^3	1875
					Volume of Venetian Harbor material deposited at the NDA 95 Buoy					m^3	1433.63

Precap Bathymetric Survey over the Seawolf Project Area **07-Dec-95**

BUOY	PERMITTEE	PROJECT	DISPAREA	DISPDATE	LATDEG	LATMIN	LONGDEG	LONGMIN	FRBUOY	DIR	CYVOL
NDA-95	GROTON LONG POINT ASSOC	VENETIAN HARBOR	NLDS	07-Dec-95	41	16.369	72	4.923	50'	S	350
NDA-95	GROTON LONG POINT ASSOC	VENETIAN HARBOR	NLDS	08-Dec-95	41	16.369	72	4.923	50'	SW	325
NDA-95	GROTON LONG POINT ASSOC	VENETIAN HARBOR	NLDS	08-Dec-95	41	16.366	72	4.935	30'	S	300
NDA-95	GROTON LONG POINT ASSOC	VENETIAN HARBOR	NLDS	13-Dec-95	41	16.366	72	4.935	15'	NE	325
NDA-95	GROTON LONG POINT ASSOC	VENETIAN HARBOR	NLDS	13-Dec-95	41	16.338	72	4.943	10'	NE	300
NDA-95	GROTON LONG POINT ASSOC	VENETIAN HARBOR	NLDS	14-Dec-95	41	16.369	72	4.923	50'	S	300
NDA-95	GROTON LONG POINT ASSOC	VENETIAN HARBOR	NLDS	14-Dec-95	41	16.352	72	4.939	15'		150
NDA-95	GROTON LONG POINT ASSOC	VENETIAN HARBOR	NLDS	15-Dec-95	41	16.366	72	4.935	50'	S	275
NDA-95	GROTON LONG POINT ASSOC	VENETIAN HARBOR	NLDS	16-Dec-95	41	16.383	72	4.919	50'	NE	300
NDA-95	GROTON LONG POINT ASSOC	VENETIAN HARBOR	NLDS	16-Dec-95	41	16.383	72	4.919	50'	NE	275
NDA-95	GROTON LONG POINT ASSOC	VENETIAN HARBOR	NLDS	17-Dec-95	41	16.383	72	4.919	50'	NE	300
NDA-95	GROTON LONG POINT ASSOC	VENETIAN HARBOR	NLDS	17-Dec-95	41	16.383	72	4.919	50'	NE	275
NDA-95	GROTON LONG POINT ASSOC	VENETIAN HARBOR	NLDS	18-Dec-95	41	16.38	72	4.931	50'	NE	250
NDA-95	GROTON LONG POINT ASSOC	VENETIAN HARBOR	NLDS	18-Dec-95	41	16.366	72	4.935	10'		300
NDA-95	GROTON LONG POINT ASSOC	VENETIAN HARBOR	NLDS	19-Dec-95	41	16.338	72	4.943	1'		350
NDA-95	GROTON LONG POINT ASSOC	VENETIAN HARBOR	NLDS	22-Dec-95	41	16.352	72	4.939	10'		350
NDA-95	GROTON LONG POINT ASSOC	VENETIAN HARBOR	NLDS	23-Dec-95	41	16.352	72	4.939	5'		350
					Volume of Venetian Harbor material deposited at the NDA 95 Buoy					yd^3	5075
					Volume of Venetian Harbor material deposited at the NDA 95 Buoy					m^3	3880.35

Postcap Bathymetric Survey over the Seawolf Project Area **01-Feb-96**

Total Volume of Venetian Harbor material deposited at the NDA 95 Buoy	yd^3	**6,950**
Total Volume of Venetian Harbor material deposited at the NDA 95 Buoy	m^3	**5,313.97**

BUOY	PERMITTEE	PROJECT	DISPAREA	DISPDATE	LATDEG	LATMIN	LONGDEG	LONGMIN	FRBUOY	DIR	CYVOL
U.S. NAVY	MYSTIC SEAPORT MUSEUM	MYSTIC RIVER	NLDS	31-Oct-95	41	16.497	72	4.82	20'		300
U.S. NAVY	MYSTIC SEAPORT MUSEUM	MYSTIC RIVER	NLDS	01-Nov-95	41	16.497	72	4.82	5'		250
U.S. NAVY	MYSTIC SEAPORT MUSEUM	MYSTIC RIVER	NLDS	02-Nov-95	41	16.497	72	4.82	15'		250
U.S. NAVY	MYSTIC SEAPORT MUSEUM	MYSTIC RIVER	NLDS	06-Nov-95	41	16.497	72	4.82	25'		250
					Volume of Mystic Seaport material deposited at the Navy Buoy					yd^3	1050
					Volume of Mystic Seaport material deposited at the Navy Buoy					m^3	802.83

Precap Bathymetric Survey over the Seawolf Project Area **07-Dec-95**

Total Volume of Mystic Seaport material deposited at the Navy Buoy	yd^3	**1,050**
Total Volume of Mystic Seaport material deposited at the Navy Buoy	m^3	**802.83**

BUOY	PERMITTEE	PROJECT	DISPAREA	DISPDATE	LATDEG	LATMIN	LONGDEG	LONGMIN	FRBUOY	DIR	CYVOL
U.S. NAVY	DEPT/NAVY - PIER 17	THAMES RIVER, GROTON, CT	NLDS	24-Oct-95	41	16.494	72	4.832	100	N	800
U.S. NAVY	DEPT/NAVY - PIER 17	THAMES RIVER, GROTON, CT	NLDS	25-Oct-95	41	16.483	72	4.824	100	N	900
U.S. NAVY	DEPT/NAVY - PIER 17	THAMES RIVER, GROTON, CT	NLDS	26-Oct-95	41	16.494	72	4.832	100	N	800
U.S. NAVY	DEPT/NAVY - PIER 17	THAMES RIVER, GROTON, CT	NLDS	27-Oct-95	41	16.494	72	4.832	100	N	800
U.S. NAVY	DEPT/NAVY - PIER 17	THAMES RIVER, GROTON, CT	NLDS	30-Oct-95	41	16.494	72	4.832	100	N	800
U.S. NAVY	DEPT/NAVY - PIER 17	THAMES RIVER, GROTON, CT	NLDS	06-Nov-95	41	16.494	72	4.832	90	N	800
U.S. NAVY	DEPT/NAVY - PIER 17	THAMES RIVER, GROTON, CT	NLDS	06-Nov-95	41	16.497	72	4.82	50'	N	800
U.S. NAVY	DEPT/NAVY - PIER 17	THAMES RIVER, GROTON, CT	NLDS	07-Nov-95	41	16.497	72	4.82	50'	N	800
U.S. NAVY	DEPT/NAVY - PIER 17	THAMES RIVER, GROTON, CT	NLDS	08-Nov-95	41	16.497	72	4.82	50'	N	800
U.S. NAVY	DEPT/NAVY - PIER 17	THAMES RIVER, GROTON, CT	NLDS	08-Nov-95	41	16.511	72	4.816	75'	N	800
U.S. NAVY	DEPT/NAVY - PIER 17	THAMES RIVER, GROTON, CT	NLDS	09-Nov-95	41	16.494	72	4.832	85'	N	800
U.S. NAVY	DEPT/NAVY - PIER 17	THAMES RIVER, GROTON, CT	NLDS	09-Nov-95	41	16.494	72	4.832	80'	N	800
U.S. NAVY	DEPT/NAVY - PIER 17	THAMES RIVER, GROTON, CT	NLDS	09-Nov-95	41	16.497	72	4.82	40'	N	800
U.S. NAVY	DEPT/NAVY - PIER 17	THAMES RIVER, GROTON, CT	NLDS	10-Nov-95	41	16.483	72	4.824	50'	E	800
U.S. NAVY	DEPT/NAVY - PIER 17	THAMES RIVER, GROTON, CT	NLDS	10-Nov-95	41	16.488	72	4.861	60'	N	800
U.S. NAVY	DEPT/NAVY - PIER 17	THAMES RIVER, GROTON, CT	NLDS	11-Nov-95	41	16.483	72	4.824	50'	E	800
U.S. NAVY	DEPT/NAVY - PIER 17	THAMES RIVER, GROTON, CT	NLDS	13-Nov-95	41	16.494	72	4.832	80'	N	800
U.S. NAVY	DEPT/NAVY - PIER 17	THAMES RIVER, GROTON, CT	NLDS	16-Nov-95	41	16.47	72	4.884	75'	W	800
U.S. NAVY	DEPT/NAVY - PIER 17	THAMES RIVER, GROTON, CT	NLDS	16-Nov-95	41	16.47	72	4.884	75'	W	800
U.S. NAVY	DEPT/NAVY - PIER 17	THAMES RIVER, GROTON, CT	NLDS	17-Nov-95	41	16.377	72	4.887	75'	SW	800
U.S. NAVY	DEPT/NAVY - PIER 17	THAMES RIVER, GROTON, CT	NLDS	18-Nov-95	41	16.456	72	4.888	90'	W	800
U.S. NAVY	DEPT/NAVY - PIER 17	THAMES RIVER, GROTON, CT	NLDS	18-Nov-95	41	16.47	72	4.884	75'	W	800
U.S. NAVY	DEPT/NAVY - PIER 17	THAMES RIVER, GROTON, CT	NLDS	19-Nov-95	41	16.47	72	4.884	75'	W	800
U.S. NAVY	DEPT/NAVY - PIER 17	THAMES RIVER, GROTON, CT	NLDS	19-Nov-95	41	16.472	72	4.872	90'	SW	800
U.S. NAVY	DEPT/NAVY - PIER 17	THAMES RIVER, GROTON, CT	NLDS	20-Nov-95	41	16.461	72	4.864	90'	SW	800
U.S. NAVY	DEPT/NAVY - PIER 17	THAMES RIVER, GROTON, CT	NLDS	20-Nov-95	41	16.47	72	4.884	80'	W	800
U.S. NAVY	DEPT/NAVY - PIER 17	THAMES RIVER, GROTON, CT	NLDS	21-Nov-95	41	16.458	72	4.876	100'	SW	800
U.S. NAVY	DEPT/NAVY - PIER 17	THAMES RIVER, GROTON, CT	NLDS	22-Nov-95	41	16.458	72	4.876	90'	SW	800
U.S. NAVY	DEPT/NAVY - PIER 17	THAMES RIVER, GROTON, CT	NLDS	22-Nov-95	41	16.47	72	4.884	80'	W	800
U.S. NAVY	DEPT/NAVY - PIER 17	THAMES RIVER, GROTON, CT	NLDS	24-Nov-95	41	16.458	72	4.876	90'	SW	800
U.S. NAVY	DEPT/NAVY - PIER 17	THAMES RIVER, GROTON, CT	NLDS	25-Nov-95	41	16.458	72	4.876	95'	SW	800
U.S. NAVY	DEPT/NAVY - PIER 17	THAMES RIVER, GROTON, CT	NLDS	25-Nov-95	41	16.47	72	4.884	85'	W	800
U.S. NAVY	DEPT/NAVY - PIER 17	THAMES RIVER, GROTON, CT	NLDS	26-Nov-95	41	16.456	72	4.888	90'	W	800
U.S. NAVY	DEPT/NAVY - PIER 17	THAMES RIVER, GROTON, CT	NLDS	26-Nov-95	41	16.47	72	4.884	80'	W	800
U.S. NAVY	DEPT/NAVY - PIER 17	THAMES RIVER, GROTON, CT	NLDS	27-Nov-95	41	16.458	72	4.876	90'	SW	800
U.S. NAVY	DEPT/NAVY - PIER 17	THAMES RIVER, GROTON, CT	NLDS	27-Nov-95	41	16.458	72	4.876	90'	SW	800
U.S. NAVY	DEPT/NAVY - PIER 17	THAMES RIVER, GROTON, CT	NLDS	28-Nov-95	41	16.458	72	4.876	95'	SW	800
U.S. NAVY	DEPT/NAVY - PIER 17	THAMES RIVER, GROTON, CT	NLDS	28-Nov-95	41	16.47	72	4.884	80'	W	800
U.S. NAVY	DEPT/NAVY - PIER 17	THAMES RIVER, GROTON, CT	NLDS	29-Nov-95	41	16.456	72	4.888	95'	W	800
U.S. NAVY	DEPT/NAVY - PIER 17	THAMES RIVER, GROTON, CT	NLDS	30-Nov-95	41	16.456	72	4.888	100'	W	800
					Volume of US Navy Pier 17 material deposited at the Navy Buoy yd^3						32100
					Volume of US Navy Pier 17 material deposited at the Navy Buoy m^3						24543.66

Precap Bathymetric Survey over the Seawolf Project Area **07-Dec-95**

Total Volume of US Navy Pier 17 material deposited at the Navy Buoy	yd^3	**32,100**
Total Volume of US Navy Pier 17 material deposited at the Navy Buoy	m^3	**24,543.66**

BUOY	PERMITTEE	PROJECT	DISPAREA	DISPDATE	LATDEG	LATMIN	LONGDEG	LONGMIN	FRBUOY	DIR	CYVOL
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	21-Oct-95	41	16.485	72	4.824	75'	W	1950
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	21-Oct-95	41	16.501	72	4.824	50'	W	1950
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	21-Oct-95	41	16.502	72	4.82	100'	W	1900
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	21-Oct-95	41	16.503	72	4.827	80'	W	1900
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	22-Oct-95	41	16.48	72	4.825	75'	E	1950
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	22-Oct-95	41	16.485	72	4.827	30	N	1950
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	22-Oct-95	41	16.485	72	4.82	90'	E	1875
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	22-Oct-95	41	16.5	72	4.827	10	N	1950
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	22-Oct-95	41	16.5	72	4.82	5'	W	1850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	23-Oct-95	41	16.5	72	4.824	0'		1550
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	23-Oct-95	41	16.501	72	4.827	10'	W	1400
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	23-Oct-95	41	16.501	72	4.826	0'		1700
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	23-Oct-95	41	16.501	72	4.825	0'		1750
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	23-Oct-95	41	16.501	72	4.824	0'		1750
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	23-Oct-95	41	16.502	72	4.825	20'	E	1700
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	23-Oct-95	41	16.502	72	4.822	20'	E	1500
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	24-Oct-95	41	16.503	72	4.827	0'		1700
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	24-Oct-95	41	16.503	72	4.827	0'		1800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	24-Oct-95	41	16.504	72	4.82	0'		1800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	24-Oct-95	41	16.505	72	4.818	0'		1700
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	25-Oct-95	41	16.48	72	4.85	0'		1750
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	25-Oct-95	41	16.5	72	4.824	0'		1750
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	25-Oct-95	41	16.508	72	4.827	50'	N	1600
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	26-Oct-95	41	16.48	72	4.821	35'	S	1650
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	26-Oct-95	41	16.493	72	4.831	25'	N	1850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	26-Oct-95	41	16.501	72	4.825	5'	S	1100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	26-Oct-95	41	16.501	72	4.824	5'	S	1700
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	26-Oct-95	41	16.502	72	4.824	5'	S	1850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	26-Oct-95	41	16.503	72	4.823	0'		1850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	27-Oct-95	41	16.49	72	4.821	10'	E	1800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	27-Oct-95	41	16.501	72	4.854	30'	N	1400
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	27-Oct-95	41	16.501	72	4.82	20'	E	1850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	27-Oct-95	41	16.503	72	4.827	20'	W	1600
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	28-Oct-95	41	16.493	72	4.826	10'	S	1700
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	28-Oct-95	41	16.5	72	4.82	10'	E	1850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	29-Oct-95	41	16.495	72	4.827	25'	S	1750
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	29-Oct-95	41	16.496	72	4.827	20'	S	1800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	29-Oct-95	41	16.5	72	4.821	30'	N	1500
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	29-Oct-95	41	16.503	72	4.827	40'	N	1900
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	30-Oct-95	41	16.496	72	4.825	75'	S	1850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	30-Oct-95	41	16.498	72	4.826	30'	S	1700
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	30-Oct-95	41	16.5	72	4.827	0'		1800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	30-Oct-95	41	16.501	72	4.828	20'	N	1800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	30-Oct-95	41	16.502	72	4.827	20'	W	1850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	30-Oct-95	41	16.504	72	4.827	40'	N	1850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	30-Oct-95	41	16.504	72	4.827	50'	N	1850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	31-Oct-95	41	16.5	72	4.827	0'		1900
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	31-Oct-95	41	16.5	72	4.825	0'		1850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	31-Oct-95	41	16.501	72	4.827	10'	N	1850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	31-Oct-95	41	16.501	72	4.825	10'	W	1850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	31-Oct-95	41	16.501	72	4.825			1700

U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	31-Oct-95	41	16.501	72	4.821	10'	E	1850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	31-Oct-95	41	16.503	72	4.823			1750
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	01-Nov-95	41	16.463	72	4.801	15'	S	1700
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	01-Nov-95	41	16.47	72	4.802	10'	SSE	1800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	01-Nov-95	41	16.491	72	4.802	12'	NNE	1950
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	01-Nov-95	41	16.499	72	4.805	8'	NNE	1800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	01-Nov-95	41	16.502	72	4.827	10'	S	1750
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	01-Nov-95	41	16.503	72	4.828	20'	N	1850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	02-Nov-95	41	16.472	72	4.832	30'	SW	1850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	02-Nov-95	41	16.494	72	4.818	20'	N	1900
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	02-Nov-95	41	16.495	72	4.852	25'	W	1050
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	03-Nov-95	41	16.477	72	4.818	5'	SSW	1750
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	03-Nov-95	41	16.48	72	4.832	10'	SW	1650
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	03-Nov-95	41	16.494	72	4.805	12'	N	1850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	04-Nov-95	41	16.466	72	4.843	50'	WSW	1900
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	04-Nov-95	41	16.471	72	4.834	30'	S	1950
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	04-Nov-95	41	16.475	72	4.839	40'	S	1900
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	04-Nov-95	41	16.477	72	4.823	20'	S	1950
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	04-Nov-95	41	16.495	72	4.812	50'	N	1700
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	04-Nov-95	41	16.504	72	4.809	15'	N	1900
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	05-Nov-95	41	16.464	72	4.829	35'	S	1900
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	05-Nov-95	41	16.472	72	4.843	45'	SW	1850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	05-Nov-95	41	16.492	72	4.8	40'	NE	2100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	05-Nov-95	41	16.493	72	4.812	70'	N	2000
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	05-Nov-95	41	16.505	72	4.815	60'	N	1750
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	06-Nov-95	41	16.465	72	4.819	40'	S	1800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	06-Nov-95	41	16.479	72	4.834	30'	WSW	1900
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	06-Nov-95	41	16.482	72	4.85	0'		1450
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	06-Nov-95	41	16.5	72	4.805	50'	N	1200
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	07-Nov-95	41	16.461	72	4.807	75'	S	1750
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	07-Nov-95	41	16.476	72	4.848	45'	WSW	1650
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	07-Nov-95	41	16.5	72	4.814	30'	N	1400
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	07-Nov-95	41	16.506	72	4.812	60'	N	1750
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	07-Nov-95	41	16.507	72	4.815	75'	N	1700
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	08-Nov-95	41	16.45	72	4.83	100'	S	1600
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	08-Nov-95	41	16.456	72	4.811	90'	S	1950
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	08-Nov-95	41	16.458	72	4.833	100'	SW	1650
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	08-Nov-95	41	16.459	72	4.816	100'	S	1700
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	09-Nov-95	41	16.447	72	4.89	90'	SSW	1800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	09-Nov-95	41	16.449	72	4.814	60'	N	1600
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	09-Nov-95	41	16.475	72	4.834	100'	SW	1850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	09-Nov-95	41	16.5	72	4.826			1900
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	10-Nov-95	41	16.464	72	4.805	70'	SSE	1850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	10-Nov-95	41	16.469	72	4.757	70'	E	1900
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	10-Nov-95	41	16.479	72	4.796	60'	SE	1850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	10-Nov-95	41	16.494	72	4.856	100'	NW	1800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	10-Nov-95	41	16.496	72	4.842	60'	NW	2000
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	10-Nov-95	41	16.505	72	4.853	100'	NNW	1700
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	11-Nov-95	41	16.49	72	4.844	50'	WNW	1950
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	11-Nov-95	41	16.5	72	4.87	75'	N	2100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	11-Nov-95	41	16.509	72	4.835	120'	WNW	1950
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	11-Nov-95	41	16.511	72	4.833	130'	NNW	1800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	13-Nov-95	41	16.435	72	4.86	60'	ESE	2200
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	13-Nov-95	41	16.465	72	4.951	75'	S	2150

U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	13-Nov-95	41	16.48	72	4.843	50'	W	2200
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	13-Nov-95	41	16.486	72	4.779	10'	NE	2100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	13-Nov-95	41	16.51	72	4.76	50'	N	2100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	13-Nov-95	41	16.522	72	4.804	50'	N	2200
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	13-Nov-95	41	16.522	72	4.804	50'	N	1950
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	14-Nov-95	41	16.434	72	4.833	80'	W	2100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	14-Nov-95	41	16.445	72	4.861	60'	N	2100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	14-Nov-95	41	16.449	72	4.818	100'	NW	2000
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	14-Nov-95	41	16.46	72	4.859	75'	W	2100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	14-Nov-95	41	16.469	72	4.906	50'	NW	2050
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	15-Nov-95	41	16.48	72	4.861	75'	W	2100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	16-Nov-95	41	16.431	72	4.859	90'	SW	2100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	16-Nov-95	41	16.442	72	4.884	80'	SW	2000
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	16-Nov-95	41	16.449	72	4.859	80'	SW	2050
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	16-Nov-95	41	16.478	72	4.882	75'	SW	2050
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	16-Nov-95	41	16.479	72	4.884	75'	S	2050
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	16-Nov-95	41	16.51	72	4.859	75'	SSW	2100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	17-Nov-95	41	16.428	72	4.81	75'	W	1950
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	17-Nov-95	41	16.44	72	4.884	80'	SW	2200
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	17-Nov-95	41	16.446	72	4.88	90'	SW	2200
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	17-Nov-95	41	16.454	72	4.904	90'	SW	2100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	17-Nov-95	41	16.474	72	4.893	75'	W	2100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	17-Nov-95	41	16.49	72	4.89	20'	E	2000
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	18-Nov-95	41	16.444	72	4.868	75'	SW	2100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	18-Nov-95	41	16.475	72	4.842	75'	WSW	2100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	18-Nov-95	41	16.49	72	4.875	80'	WSW	2000
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	18-Nov-95	41	16.495	72	4.893	8'	W	2000
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	18-Nov-95	41	16.5	72	4.835	75'	SW	2200
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	19-Nov-95	41	16.445	72	4.841	90'	SSW	1750
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	19-Nov-95	41	16.453	72	4.852	100'	SW	1950
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	19-Nov-95	41	16.465	72	4.872	75'	SW	1900
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	19-Nov-95	41	16.467	72	4.905	100'	W	2100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	19-Nov-95	41	16.482	72	4.85	100'	WSW	1750
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	19-Nov-95	41	16.49	72	4.895	80'	W	2400
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	20-Nov-95	41	16.461	72	4.863	125'	SW	2050
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	20-Nov-95	41	16.466	72	4.907	135'	WSW	1900
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	20-Nov-95	41	16.466	72	4.831	60'	SSW	1850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	20-Nov-95	41	16.471	72	4.829	75'	SSW	1950
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	20-Nov-95	41	16.49	72	4.899	110'	WSW	1850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	21-Nov-95	41	16.457	72	4.855	80'	SW	1950
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	21-Nov-95	41	16.462	72	4.897	70'	SW	1800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	21-Nov-95	41	16.485	72	4.86	90'	SW	1900
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	21-Nov-95	41	16.499	72	4.867	100'	WSW	1725
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	21-Nov-95	41	16.499	72	4.865	100'	WSW	1850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	22-Nov-95	41	16.445	72	4.857	90'	SW	1775
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	22-Nov-95	41	16.452	72	4.867	100'	SW	1900
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	22-Nov-95	41	16.468	72	4.83	70'	SSW	1900
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	22-Nov-95	41	16.475	72	4.872	110'	SW	1825
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	22-Nov-95	41	16.491	72	4.796	125'	NE	1975
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	22-Nov-95	41	16.511	72	4.837	110'	N	1950
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	23-Nov-95	41	16.455	72	4.787	140'	SE	1775
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	23-Nov-95	41	16.503	72	4.825	100'	N	1800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	23-Nov-95	41	16.515	72	4.865	125'	N	1900
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	23-Nov-95	41	16.515	72	4.837	125'	N	1850

U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT		NLDS	24-Nov-95	41	16.443	72	4.736	150'	SSE	1875
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT		NLDS	24-Nov-95	41	16.49	72	4.791	90'	E	1950
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT		NLDS	24-Nov-95	41	16.499	72	4.878	100'	NW	1825
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT		NLDS	24-Nov-95	41	16.499	72	4.815	75'	NE	1825
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT		NLDS	24-Nov-95	41	16.508	72	4.796	100'	NNE	1850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT		NLDS	24-Nov-95	41	16.511	72	4.76	150'	NE	1850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT		NLDS	25-Nov-95	41	16.418	72	4.778	160'	SSE	1925
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT		NLDS	25-Nov-95	41	16.46	72	4.783	110'	SE	1850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT		NLDS	25-Nov-95	41	16.485	72	4.783	110'	E	1825
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT		NLDS	25-Nov-95	41	16.497	72	4.817	65'	ENE	1900
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT		NLDS	25-Nov-95	41	16.499	72	4.838	90'	NNE	1975
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT		NLDS	25-Nov-95	41	16.509	72	4.804	120'	ENE	1775
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT		NLDS	26-Nov-95	41	16.44	72	4.808	100'	ESE	2050
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT		NLDS	26-Nov-95	41	16.45	72	4.788	100'	ESE	2100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT		NLDS	26-Nov-95	41	16.47	72	4.875	110'	ESE	2000
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT		NLDS	26-Nov-95	41	16.506	72	4.837	110'	N	1850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT		NLDS	27-Nov-95	41	16.45	72	4.77	100'	ESE	2100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT		NLDS	27-Nov-95	41	16.488	72	4.784	150'	E	2100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT		NLDS	27-Nov-95	41	16.492	72	4.762	110'	ENE	2100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT		NLDS	28-Nov-95	41	16.435	72	4.795	120'	ESE	2100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT		NLDS	29-Nov-95	41	16.443	72	4.808	125'	S	2100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	1	NLDS	02-Dec-95	41	16.414	72	4.86	100'	S	2200
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	1	NLDS	02-Dec-95	41	16.42	72	4.875	100'	NE	2150
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	1	NLDS	02-Dec-95	41	16.477	72	4.773	150'	E	2100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	1	NLDS	02-Dec-95	41	16.479	72	4.77	150'	E	2150
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	1	NLDS	03-Dec-95	41	16.459	72	4.792	110'	SE	2100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	1	NLDS	03-Dec-95	41	16.49	72	4.835	150'	N	2150
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	1	NLDS	03-Dec-95	41	16.504	72	4.824	110'	N	1975
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	1	NLDS	03-Dec-95	41	16.517	72	4.862	125'	NNW	2100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	1	NLDS	04-Dec-95	41	16.501	72	4.828	125'	N	2050
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT		NLDS	05-Dec-95	41	16.466	72	4.758	80'	SSE	1850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT		NLDS	05-Dec-95	41	16.484	72	4.821	60'	NNW	1950
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT		NLDS	05-Dec-95	41	16.525	72	4.852	140'	NNW	1825
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT		NLDS	06-Dec-95	41	16.511	72	4.894	80'	NNW	1800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT		NLDS	06-Dec-95	41	16.514	72	4.868	90'	NNW	1850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT		NLDS	07-Dec-95	41	16.507	72	4.842	100'	NW	1975
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT		NLDS	07-Dec-95	41	16.524	72	4.811	120'	NNW	1300
						Volume of US Navy Seawolf UDM deposited at the Navy Buoy					yd^3	367100
						Volume of US Navy Seawolf UDM deposited at the Navy Buoy					m^3	280684.66

Precap Bathymetric Survey over the Seawolf Project Area

07-Dec-95

Total Volume of US Navy Seawolf UDM deposited at the Navy Buoy	yd^3	**367,100**
Total Volume of US Navy Seawolf UDM deposited at the Navy Buoy	m^3	**280,684.66**

BUOY	PERMITTEE	PROJECT	DISPAREA	DISPDATE	LATDEG	LATMIN	LONGDEG	LONGMIN	FRBUOY	DIR	CYVOL
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	08-Dec-95	41	16.489	72	4.834	60'	WSW	1900
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	08-Dec-95	41	16.53	72	4.802	120'	NNW	1850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	09-Dec-95	41	16.467	72	4.77	200'	ESE	1850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	09-Dec-95	41	16.489	72	4.777	180'	ENE	1825
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	09-Dec-95	41	16.503	72	4.815	80'	N	1850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	09-Dec-95	41	16.516	72	4.863	60'	NW	1925
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	09-Dec-95	41	16.517	72	4.786	150'	NNE	1825
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	09-Dec-95	41	16.518	72	4.843	100'	N	1800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	10-Dec-95	41	16.437	72	4.828	200'	S	1700
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	10-Dec-95	41	16.444	72	4.789	200'	SSE	1750
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	10-Dec-95	41	16.466	72	4.841	50'	SW	1650
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	10-Dec-95	41	16.493	72	4.873	200'	W	1700
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	10-Dec-95	41	16.496	72	4.862	240'	WNW	1750
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	10-Dec-95	41	16.508	72	4.848	190'	NNW	1825
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	11-Dec-95	41	16.456	72	4.765	0		2100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	11-Dec-95	41	16.475	72	4.87	0		2100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	11-Dec-95	41	16.51	72	4.778	0		2000
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	11-Dec-95	41	16.549	72	4.817	230'	N	1775
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	12-Dec-95	41	16.447	72	4.828	0		2100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	12-Dec-95	41	16.479	72	4.868	0		2050
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	12-Dec-95	41	16.5	72	4.824	0		2100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	12-Dec-95	41	16.53	72	4.794	0		2100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	13-Dec-95	41	16.435	72	4.834	0		2200
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	13-Dec-95	41	16.473	72	4.79	0		2150
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	13-Dec-95	41	16.511	72	4.847	0		2000
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	13-Dec-95	41	16.514	72	4.824	0		2050
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	13-Dec-95	41	16.52	72	4.777	0		2000
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	13-Dec-95	41	16.541	72	4.824	0		2050
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	14-Dec-95	41	16.446	72	4.788	0		2150
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	14-Dec-95	41	16.46	72	4.845	0		2100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	14-Dec-95	41	16.476	72	4.776	0		2150
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	14-Dec-95	41	16.517	72	4.828	0		2100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	15-Dec-95	41	16.467	72	4.822	0		2150
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	15-Dec-95	41	16.467	72	4.81	0		2150
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	15-Dec-95	41	16.506	72	4.88	0		2000
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	15-Dec-95	41	16.522	72	4.78	0		2200
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	15-Dec-95	41	16.526	72	4.76	0		2000
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	15-Dec-95	41	16.528	72	4.85	0		2150
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	15-Dec-95	41	16.534	72	4.844	0		2200
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	16-Dec-95	41	16.455	72	4.805	0		2150
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	16-Dec-95	41	16.508	72	4.862	0		2050
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	16-Dec-95	41	16.508	72	4.862	0		2050
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	16-Dec-95	41	16.51	72	4.865	0		2100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	16-Dec-95	41	16.512	72	4.861	0		1800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	16-Dec-95	41	16.518	72	4.78	0		2150
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	16-Dec-95	41	16.52	72	4.808	0		2200
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	16-Dec-95	41	16.543	72	4.803	0		2200
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	17-Dec-95	41	16.442	72	4.817	250'	S	1825
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	17-Dec-95	41	16.45	72	4.777	0		2150
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	17-Dec-95	41	16.46	72	4.777	0		2200
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	17-Dec-95	41	16.469	72	4.841	50'	SSW	1775
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	17-Dec-95	41	16.484	72	4.875	200'	W	1875
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	17-Dec-95	41	16.497	72	4.865	190'	WNW	1800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	17-Dec-95	41	16.527	72	4.842	250'	NNW	1950
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	17-Dec-95	41	16.528	72	4.808	225'	N	1750

U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	18-Dec-95	41	16.443	72	4.823	240'	S	1925
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	18-Dec-95	41	16.457	72	4.781	225'	SSE	1875
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	18-Dec-95	41	16.463	72	4.771	250'	ESE	1750
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	18-Dec-95	41	16.487	72	4.882	250'	W	1825
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	18-Dec-95	41	16.505	72	4.8	100'	NW	1850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	18-Dec-95	41	16.518	72	4.792	250'	NNE	1825
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	18-Dec-95	41	16.521	72	4.775	225'	ENE	1875
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	19-Dec-95	41	16.46	72	4.775	250'	ESE	1700
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	19-Dec-95	41	16.514	72	4.774	250'	ENE	1850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	19-Dec-95	41	16.517	72	4.868	250'	WNW	2000
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	19-Dec-95	41	16.518	72	4.812	60'	NNW	1775
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	19-Dec-95	41	16.521	72	4.789	250'	NNE	1925
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	19-Dec-95	41	16.526	72	4.841	250'	NNW	1875
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	19-Dec-95	41	16.533	72	4.816	250'	N	1900
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	20-Dec-95	41	16.444	72	4.816	250'	S	1950
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	20-Dec-95	41	16.453	72	4.79	250'	SSE	1300
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	20-Dec-95	41	16.494	72	4.88	250'	W	1625
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	21-Dec-95	41	16.508	72	4.876	270'	WNW	1500
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	21-Dec-95	41	16.521	72	4.836	250'	NNW	1300
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	23-Dec-95	41	16.462	72	4.859	100'	W	1950
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	24-Dec-95	41	16.508	72	4.889	150'	W	1825
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	24-Dec-95	41	16.513	72	4.748	0		2000
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	24-Dec-95	41	16.52	72	4.905	175'	W	1750
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	24-Dec-95	41	16.533	72	4.888	0		2050
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	24-Dec-95	41	16.536	72	4.776	0		2150
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	24-Dec-95	41	16.544	72	4.841	0		1950
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	24-Dec-95	41	16.546	72	4.857	0		2000
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	25-Dec-95	41	16.421	72	4.859	0		1950
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	25-Dec-95	41	16.424	72	4.907	0		2050
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	25-Dec-95	41	16.429	72	4.894	0		2000
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	25-Dec-95	41	16.429	72	4.8	0		2000
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	25-Dec-95	41	16.448	72	4.756	0		2000
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	25-Dec-95	41	16.472	72	4.741	0		2050
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	26-Dec-95	41	16.447	72	4.899	0		1950
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, NEW LONDON & GROTON CT	NLDS	26-Dec-95	41	16.436	72	4.863			2000
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, NEW LONDON & GROTON CT	NLDS	26-Dec-95	41	16.5	72	4.905	145'		1950
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, NEW LONDON & GROTON CT	NLDS	26-Dec-95	41	16.5	72	4.903	145'		2200
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, NEW LONDON & GROTON CT	NLDS	26-Dec-95	41	16.508	72	4.902	145'		1300
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, NEW LONDON & GROTON CT	NLDS	26-Dec-95	41	16.518	72	4.856	145'		1250
U.S. NAVY**	DEPT/NAVY - SEAWOLF	THAMES RIVER, GROTON & NEW LONDON, CT	NLDS	26-Dec-95	41	16	72	4	0		2050
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, NEW LONDON & GROTON CT	NLDS	27-Dec-95	41	16.488	72	4.733			2000
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, NEW LONDON & GROTON CT	NLDS	27-Dec-95	41	16.501	72	4.759	145'		2000
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, NEW LONDON & GROTON CT	NLDS	27-Dec-95	41	16.507	72	4.823	145'		1200
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, NEW LONDON & GROTON CT	NLDS	27-Dec-95	41	16.528	72	4.741	145'		1800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, NEW LONDON & GROTON CT	NLDS	28-Dec-95	41	16.387	72	4.903			2200
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, NEW LONDON & GROTON CT	NLDS	28-Dec-95	41	16.428	72	4.788			1800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, NEW LONDON & GROTON CT	NLDS	28-Dec-95	41	16.43	72	4.877			1950
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, NEW LONDON & GROTON CT	NLDS	28-Dec-95	41	16.43	72	4.793			1800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, NEW LONDON & GROTON CT	NLDS	28-Dec-95	41	16.45	72	4.896			2200
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, NEW LONDON & GROTON CT	NLDS	28-Dec-95	41	16.476	72	4.896			1800
U.S. NAVY**	DEPT/NAVY - SEAWOLF	THAMES RIVER, NEW LONDON & GROTON CT	NLDS	28-Dec-95	41	16	72	4			1850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, NEW LONDON & GROTON CT	NLDS	29-Dec-95	41	16.303	72	4.899			2100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, NEW LONDON & GROTON CT	NLDS	29-Dec-95	41	16.454	72	4.854	145'		1950
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, NEW LONDON & GROTON CT	NLDS	29-Dec-95	41	16.513	72	4.913			2200
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, NEW LONDON & GROTON CT	NLDS	29-Dec-95	41	16.529	72	4.861	145'		2000
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, NEW LONDON & GROTON CT	NLDS	29-Dec-95	41	16.537	72	4.898			2200
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, NEW LONDON & GROTON CT	NLDS	29-Dec-95	41	16.548	72	4.831			2000
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, NEW LONDON & GROTON CT	NLDS	30-Dec-95	41	16.462	72	4.753			2050

U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, NEW LONDON & GROTON CT	NLDS	30-Dec-95	41	16.498	72	4.739		1700
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, NEW LONDON & GROTON CT	NLDS	31-Dec-95	41	16.419	72	4.808		2000
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, NEW LONDON & GROTON CT	NLDS	31-Dec-95	41	16.424	72	4.854		2200
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, NEW LONDON & GROTON CT	NLDS	31-Dec-95	41	16.438	72	4.89		2200
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, NEW LONDON & GROTON CT	NLDS	31-Dec-95	41	16.46	72	4.899		1825
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, NEW LONDON & GROTON CT	NLDS	31-Dec-95	41	16.476	72	4.908		1700
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, NEW LONDON & GROTON CT	NLDS	31-Dec-95	41	16.514	72	4.76		1800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, NEW LONDON & GROTON CT	NLDS	31-Dec-95	41	16.534	72	4.778		2200
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, NEW LONDON & GROTON, CT	NLDS	01-Jan-96	41	16.408	72	4.879		1800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, NEW LONDON & GROTON, CT	NLDS	01-Jan-96	41	16.454	72	4.848		1850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, NEW LONDON & GROTON, CT	NLDS	01-Jan-96	41	16.504	72	4.92		1900
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, NEW LONDON & GROTON, CT	NLDS	01-Jan-96	41	16.518	72	4.91		1750
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, NEW LONDON & GROTON, CT	NLDS	01-Jan-96	41	16.541	72	4.884		1950
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, NEW LONDON & GROTON, CT	NLDS	01-Jan-96	41	16.55	72	4.862		1875
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER AT GROTON & NEW LONDON CT	NLDS	02-Jan-96	41	16.451	72	4.762		1950
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER AT GROTON & NEW LONDON CT	NLDS	02-Jan-96	41	16.479	72	4.738		1825
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER AT GROTON & NEW LONDON CT	NLDS	02-Jan-96	41	16.517	72	4.744		1550
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, NEW LONDON & GROTON, CT	NLDS	02-Jan-96	41	16.54	72	4.782		1800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER, NEW LONDON & GROTON, CT	NLDS	02-Jan-96	41	16.548	72	4.819		1825
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER AT GROTON & NEW LONDON CT	NLDS	03-Jan-96	41	16.408	72	4.902		1700
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER AT GROTON & NEW LONDON CT	NLDS	03-Jan-96	41	16.42	72	4.849		1900
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER AT GROTON & NEW LONDON CT	NLDS	03-Jan-96	41	16.428	72	4.802		1825
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER AT GROTON & NEW LONDON CT	NLDS	03-Jan-96	41	16.431	72	4.889		1825
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER AT GROTON & NEW LONDON CT	NLDS	03-Jan-96	41	16.449	72	4.898		1800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER AT GROTON & NEW LONDON CT	NLDS	03-Jan-96	41	16.461	72	4.862		1800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER AT GROTON & NEW LONDON CT	NLDS	03-Jan-96	41	16.476	72	4.898		1775
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER AT GROTON & NEW LONDON CT	NLDS	03-Jan-96	41	16.504	72	4.908		1800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER AT GROTON & NEW LONDON CT	NLDS	04-Jan-96	41	16.521	72	4.898		1550
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER AT GROTON & NEW LONDON CT	NLDS	04-Jan-96	41	16.54	72	4.895		1850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER AT GROTON & NEW LONDON CT	NLDS	04-Jan-96	41	16.543	72	4.814		2050
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER AT GROTON & NEW LONDON CT	NLDS	04-Jan-96	41	16.546	72	4.863		1650
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	05-Jan-96	41	16.447	72	4.76		1800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	05-Jan-96	41	16.481	72	4.735		1750
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	05-Jan-96	41	16.512	72	4.75		1900
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER AT GROTON & NEW LONDON CT	NLDS	05-Jan-96	41	16.542	72	4.774		1850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	06-Jan-96	41	16.42	72	4.856		1800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	06-Jan-96	41	16.427	72	4.802		1825
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	06-Jan-96	41	16.432	72	4.891		1900
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	06-Jan-96	41	16.452	72	4.904		1700
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	06-Jan-96	41	16.477	72	4.899		1850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	07-Jan-96	41	16.403	72	4.9		1750
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	07-Jan-96	41	16.513	72	4.892	145'	1850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	07-Jan-96	41	16.519	72	4.886	145'	1950
U.S. NAVY**	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	07-Jan-96	41	16	72	4		1700
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	08-Jan-96	41	16.525	72	4.861	145'	1850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	09-Jan-96	41	16.405	72	4.859	145'	1950
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	09-Jan-96	41	16.41	72	4.805	145'	2050
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	09-Jan-96	41	16.43	72	4.757	145'	1900
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	09-Jan-96	41	16.497	72	4.748	145'	1650
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	09-Jan-96	41	16.529	72	4.82	145'	2000
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	09-Jan-96	41	16.546	72	4.777	145'	1800
U.S. NAVY*	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	09-Jan-96	41	16.27	72	4.51		800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	10-Jan-96	41	16.432	72	4.895		2000
U.S. NAVY*	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	10-Jan-96	41	16.3	72	4.54		800
U.S. NAVY*	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	10-Jan-96	41	16.31	72	4.54		800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	11-Jan-96	41	16.401	72	4.896		1500
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	11-Jan-96	41	16.496	72	4.894		2150
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	11-Jan-96	41	16.52	72	4.902		1600

U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	12-Jan-96	41	16.504	72	4.778	145'	1500
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	12-Jan-96	41	16.518	72	4.906		1900
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	12-Jan-96	41	16.532	72	4.889		1900
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	12-Jan-96	41	16.543	72	4.82		1950
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	12-Jan-96	41	16.547	72	4.857		1200
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	13-Jan-96	41	16.419	72	4.905	145'	2000
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	13-Jan-96	41	16.42	72	4.857		2000
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	13-Jan-96	41	16.423	72	4.8		1900
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	13-Jan-96	41	16.43	72	4.757		1750
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	13-Jan-96	41	16.435	72	4.907	145'	1900
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	13-Jan-96	41	16.456	72	4.903	145'	2100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	13-Jan-96	41	16.498	72	4.753	145'	1700
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	13-Jan-96	41	16.502	72	4.909		1900
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	13-Jan-96	41	16.513	72	4.75		2100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	13-Jan-96	41	16.538	72	4.881		1700
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	13-Jan-96	41	16.543	72	4.775		1750
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	13-Jan-96	41	16.547	72	4.828		1800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	13-Jan-96	41	16.549	72	4.86		1400
U.S. NAVY*	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	13-Jan-96	41	16.32	72	4.53		800
U.S. NAVY*	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	13-Jan-96	41	16.33	72	4.51		800
U.S. NAVY*	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	13-Jan-96	41	16.32	72	4.49		800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	14-Jan-96	41	16.369	72	4.899	145'	1600
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	14-Jan-96	41	16.424	72	4.859		1650
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	14-Jan-96	41	16.429	72	4.812		2050
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	14-Jan-96	41	16.434	72	4.897		1950
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	14-Jan-96	41	16.444	72	4.76		1850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	14-Jan-96	41	16.488	72	4.906	145'	1950
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	14-Jan-96	41	16.498	72	6.902		2000
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	14-Jan-96	41	16.521	72	4.774		1500
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	14-Jan-96	41	16.533	72	4.899		1500
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	14-Jan-96	41	16.534	72	4.858	145'	1900
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	14-Jan-96	41	16.537	72	4.827		1950
U.S. NAVY*	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	14-Jan-96	41	16.32	72	4.46		800
U.S. NAVY*	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	14-Jan-96	41	16.3	72	4.44		800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	15-Jan-96	41	16.398	72	4.898		1400
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	15-Jan-96	41	16.411	72	4.803	145'	1950
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	15-Jan-96	41	16.423	72	4.855		1200
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	15-Jan-96	41	16.456	72	4.905		1675
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	15-Jan-96	41	16.457	72	4.896	80'	2000
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	15-Jan-96	41	16.473	72	4.908		1825
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	15-Jan-96	41	16.498	72	4.746	145'	2100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	15-Jan-96	41	16.506	72	4.908		1600
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	15-Jan-96	41	16.516	72	4.909		1900
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	15-Jan-96	41	16.534	72	4.898		1850
U.S. NAVY*	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	15-Jan-96	41	16.27	72	4.45		900
U.S. NAVY*	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	15-Jan-96	41	16.29	72	4.43		800
U.S. NAVY**	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	15-Jan-96	41	16	72	4		1500
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	16-Jan-96	41	16.39	72	4.89		2100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	16-Jan-96	41	16.4	72	4.89		1200
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	16-Jan-96	41	16.43	72	4.808		1800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	16-Jan-96	41	16.439	72	4.91		1900
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	16-Jan-96	41	16.447	72	4.763		1825
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	16-Jan-96	41	16.45	72	4.902		900
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	16-Jan-96	41	16.503	72	4.752		1700
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	16-Jan-96	41	16.52	72	4.89		2000
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	16-Jan-96	41	16.539	72	4.764		1800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	16-Jan-96	41	16.543	72	4.814		1800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	16-Jan-96	41	16.548	72	4.862		1800

U.S. NAVY*	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	16-Jan-96	41	16.26	72	4.53		800
U.S. NAVY*	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	16-Jan-96	41	16.25	72	4.51		900
U.S. NAVY*	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	16-Jan-96	41	16.26	72	4.48		900
U.S. NAVY**	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	16-Jan-96	41	16	72	4		2100
U.S. NAVY**	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	16-Jan-96	41	16	72	4		1850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	17-Jan-96	41	16.414	72	4.845		1875
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	17-Jan-96	41	16.42	72	4.85		2200
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	17-Jan-96	41	16.42	72	4.8		2150
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	17-Jan-96	41	16.43	72	4.89		1000
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	17-Jan-96	41	16.435	72	4.9		1250
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	17-Jan-96	41	16.44	72	4.74		800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	17-Jan-96	41	16.457	72	4.904		1700
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	17-Jan-96	41	16.5	72	4.75		1900
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	17-Jan-96	41	16.506	72	4.934		1550
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	17-Jan-96	41	16.53	72	4.81		2100
U.S. NAVY*	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	17-Jan-96	41	16.27	72	4.54		900
U.S. NAVY*	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	17-Jan-96	41	16.24	72	4.52		900
U.S. NAVY**	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	17-Jan-96	41	16	72	4		1400
U.S. NAVY**	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	17-Jan-96	41	16	72	4		1400
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	18-Jan-96	41	16.4	72	4.89		1400
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	18-Jan-96	41	16.47	72	4.9		1200
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	18-Jan-96	41	16.52	72	4.93		1400
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	18-Jan-96	41	16.53	72	4.93		1600
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	18-Jan-96	41	16.534	72	4.94		1925
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	18-Jan-96	41	16.54	72	4.91		2100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	18-Jan-96	41	16.549	72	4.918		1800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	18-Jan-96	41	16.56	72	4.88		2200
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	18-Jan-96	41	16.56	72	4.84		2100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	18-Jan-96	41	16.565	72	4.888		1525
U.S. NAVY*	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	18-Jan-96	41	16.3	72	4.56		700
U.S. NAVY*	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	18-Jan-96	41	16.32	72	4.55		900
U.S. NAVY**	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	18-Jan-96	41	16	72	4		2100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	19-Jan-96	41	16.43	72	4.74		2100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	19-Jan-96	41	16.439	72	4.745		1500
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	19-Jan-96	41	16.457	72	4.717		1750
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	19-Jan-96	41	16.46	72	4.86	300'	1200
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	19-Jan-96	41	16.47	72	4.8	300'	2050
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	19-Jan-96	41	16.47	72	4.79	300'	2050
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	19-Jan-96	41	16.47	72	4.72		2100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	19-Jan-96	41	16.569	72	4.832		1725
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	19-Jan-96	41	16.569	72	4.818		2100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	19-Jan-96	41	16.57	72	4.81		2000
U.S. NAVY*	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	19-Jan-96	41	16.33	72	4.55		850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	20-Jan-96	41	16.35	72	4.92	300'	2000
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	20-Jan-96	41	16.392	72	4.814		1850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	20-Jan-96	41	16.408	72	4.788		1825
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	20-Jan-96	41	16.411	72	4.896		1550
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	20-Jan-96	41	16.46	72	4.95		1500
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	20-Jan-96	41	16.46	72	4.89	300'	2000
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	20-Jan-96	41	16.521	72	4.903		1450
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	20-Jan-96	41	16.542	72	4.892		1500
U.S. NAVY*	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	20-Jan-96	41	16.26	72	4.95	200'	1000
U.S. NAVY*	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	20-Jan-96	41	16.33	72	4.53		850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	21-Jan-96	41	16.384	72	4.928		1525
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	21-Jan-96	41	16.386	72	4.869		1350
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	21-Jan-96	41	16.393	72	4.884		1400
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	21-Jan-96	41	16.442	72	4.947		1200
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	21-Jan-96	41	16.46	72	4.95		1700

U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	21-Jan-96	41	16.49	72	4.95		1800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	21-Jan-96	41	16.5	72	4.94		1800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	21-Jan-96	41	16.5	72	4.91	300'	2100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	21-Jan-96	41	16.515	72	4.904		1500
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	21-Jan-96	41	16.52	72	4.93		2100
U.S. NAVY*	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	21-Jan-96	41	16.25	72	4.95		1400
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	22-Jan-96	41	16.4	72	4.81		2100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	22-Jan-96	41	16.41	72	4.78		1500
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	22-Jan-96	41	16.43	72	4.74		2000
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	22-Jan-96	41	16.462	72	4.944		1450
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	22-Jan-96	41	16.503	72	4.948		1850
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	22-Jan-96	41	16.537	72	4.933		1950
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	22-Jan-96	41	16.548	72	4.916		1575
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	22-Jan-96	41	16.57	72	4.81		1200
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	23-Jan-96	41	16.39	72	4.86		2200
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	23-Jan-96	41	16.393	72	4.874		1600
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	23-Jan-96	41	16.409	72	4.818		1650
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	23-Jan-96	41	16.44	72	4.94		2050
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	23-Jan-96	41	16.44	72	4.745		1700
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	23-Jan-96	41	16.45	72	4.79		2150
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	23-Jan-96	41	16.454	72	4.731		1600
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	23-Jan-96	41	16.46	72	4.95		2150
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	23-Jan-96	41	16.505	72	4.887		1475
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	23-Jan-96	41	16.584	72	4.799		1425
U.S. NAVY*	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	23-Jan-96	41	16.26	72	4.95		2000
U.S. NAVY*	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	23-Jan-96	41	16.569	72	4.488		1600
U.S. NAVY**	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	23-Jan-96	41	16	72	4		2050
U.S. NAVY**	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	23-Jan-96	41	16	72	4		2000
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	24-Jan-96	41	16.3	72	4.91	300'	2200
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	24-Jan-96	41	16.384	72	4.911		1725
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	24-Jan-96	41	16.414	72	4.79		1550
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	24-Jan-96	41	16.44	72	4.94	300'	2200
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	24-Jan-96	41	16.44	72	4.82		2200
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	24-Jan-96	41	16.49	72	4.93	300'	1500
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	24-Jan-96	41	16.49	72	4.91	300'	2100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	24-Jan-96	41	16.52	72	4.9		2200
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	24-Jan-96	41	16.54	72	4.89		2200
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	25-Jan-96	41	16.38	72	4.86		2200
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	25-Jan-96	41	16.38	72	4.74	300'	1300
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	25-Jan-96	41	16.41	72	4.81		2150
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	25-Jan-96	41	16.41	72	4.78	300'	2050
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	25-Jan-96	41	16.433	72	4.948		1525
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	25-Jan-96	41	16.453	72	4.939		1350
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	25-Jan-96	41	16.477	72	4.961		1600
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	25-Jan-96	41	16.484	72	4.957		1725
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	25-Jan-96	41	16.5	72	4.88	300'	2000
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	25-Jan-96	41	16.5	72	4.84	300'	2100
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	25-Jan-96	41	16.5	72	4.81	300'	2150
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	25-Jan-96	41	16.5	72	4.8	300'	2000
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	25-Jan-96	41	16.57	72	4.84		1000
U.S. NAVY*	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	25-Jan-96	41	16.232	72	4.941		1850
U.S. NAVY*	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	25-Jan-96	41	16.34	72	4.5		925
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	26-Jan-96	41	16.44	72	4.94		2200
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	26-Jan-96	41	16.45	72	4.79		1800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	26-Jan-96	41	16.46	72	4.95		2200
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	26-Jan-96	41	16.49	72	4.95		2150
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	26-Jan-96	41	16.498	72	4.936		1750
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	26-Jan-96	41	16.53	72	4.929		1675

U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	26-Jan-96	41	16.55	72	4.899			1725
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	26-Jan-96	41	16.57	72	4.834			1750
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	26-Jan-96	41	16.575	72	4.884			1650
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	26-Jan-96	41	16.581	72	4.799			1500
U.S. NAVY*	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	26-Jan-96	41	16.39	72	4.92			2000
U.S. NAVY*	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	26-Jan-96	41	16.24	72	4.95			2150
U.S. NAVY*	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	26-Jan-96	41	16.34	72	4.48			900
U.S. NAVY*	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	26-Jan-96	41	16.27	72	4.43			925
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	27-Jan-96	41	16.392	72	4.824			1875
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	27-Jan-96	41	16.406	72	4.782			1750
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	27-Jan-96	41	16.418	72	4.733			1475
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	27-Jan-96	41	16.44	72	4.82			2150
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	27-Jan-96	41	16.45	72	4.94	300'		2200
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	27-Jan-96	41	16.453	72	4.731			1450
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	27-Jan-96	41	16.49	72	4.93	300'		2000
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	27-Jan-96	41	16.49	72	4.84	300'		2150
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	27-Jan-96	41	16.5	72	4.91	300'		2150
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	27-Jan-96	41	16.52	72	4.88	300'		2000
U.S. NAVY*	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	27-Jan-96	41	16.25	72	4.44			900
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	28-Jan-96	41	16.4	72	4.95	300'		2000
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	28-Jan-96	41	16.44	72	4.92	300'		1200
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	28-Jan-96	41	16.473	72	4.94			1775
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	28-Jan-96	41	16.476	72	4.962			1350
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	28-Jan-96	41	16.49	72	4.95			1400
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	28-Jan-96	41	16.49	72	4.74	300'		1700
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	28-Jan-96	41	16.52	72	4.81	300'		2200
U.S. NAVY*	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	28-Jan-96	41	16.33	72	4.86	300'		2100
U.S. NAVY*	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	28-Jan-96	41	16.36	72	4.81	300'		1600
U.S. NAVY*	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	28-Jan-96	41	16.379	72	4.928			1575
U.S. NAVY*	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	28-Jan-96	41	16.38	72	4.78	300'		2000
U.S. NAVY*	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	28-Jan-96	41	16.382	72	4.874			1500
U.S. NAVY*	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	28-Jan-96	41	16.24	72	4.46			800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	29-Jan-96	41	16.392	72	4.857	100'	SE	750
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	29-Jan-96	41	16.405	72	4.813	120'	SE	925
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	29-Jan-96	41	16.42	72	4.81	300'		2150
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	29-Jan-96	41	16.44	72	4.82			1700
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	29-Jan-96	41	16.45	72	4.79			2150
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	29-Jan-96	41	16.48	72	4.81			1600
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	29-Jan-96	41	16.48	72	4.81			1600
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	29-Jan-96	41	16.48	72	4.81			1800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	29-Jan-96	41	16.48	72	4.81			2200
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	29-Jan-96	41	16.497	72	4.944			1600
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	29-Jan-96	41	16.5	72	4.94			2200
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	29-Jan-96	41	16.529	72	4.932			1750
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	29-Jan-96	41	16.554	72	4.915			1800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	30-Jan-96	41	16.386	72	4.919	100'	SSW	800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	30-Jan-96	41	16.43	72	4.74			2000
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	30-Jan-96	41	16.435	72	4.946	50'	NW	800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	30-Jan-96	41	16.44	72	4.81	300'		2150
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	30-Jan-96	41	16.49	72	4.93			1300
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	30-Jan 96	41	16.5	72	4.84			2200
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	30-Jan-96	41	16.55	72	4.91			1600
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	30-Jan-96	41	16.56	72	4.88			1700
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	30-Jan-96	41	16.562	72	4.89			1900
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	30-Jan-96	41	16.566	72	4.814			1750
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	30-Jan-96	41	16.569	72	4.849			1800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	30-Jan-96	41	16.57	72	4.81			1600
U.S. NAVY*	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	30-Jan-96	41	16.237	72	4.949		SSW	800

U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	31-Jan-96	41	16.39	72	4.92		2000
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	31-Jan-96	41	16.39	72	4.86		1800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	31-Jan-96	41	16.4	72	4.81		1800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	31-Jan-96	41	16.41	72	4.78		1800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	31-Jan-96	41	16.435	72	4.728		1800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	31-Jan-96	41	16.449	72	4.731		1975
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	31-Jan-96	41	16.46	72	4.95		1800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	31-Jan-96	41	16.46	72	4.95		600
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	31-Jan-96	41	16.46	72	4.948	N	800
U.S. NAVY	DEPT/NAVY - SEAWOLF	THAMES RIVER	NLDS	31-Jan-96	41	16.49	72	4.95		2100
					Volume of US Navy Seawolf CDM deposited at the Navy Buoy				yd³	727175
					Volume of US Navy Seawolf CDM deposited at the Navy Buoy				m	555998.01

NB- No Bouy, disposal directed to specified mound area.

U.S. NAVY* Latitude and Longitude positions may not be correct due to syntax errors.

U.S. NAVY** Decimal minutes of navigation positions were not recorded by disposal inspector.

Postcap Bathymetric Survey over the Seawolf Project Area **01-Feb-96**

Total Volume of US Navy Seawolf CDM deposited at the Navy Buoy	yd³	**727,175**
Total Volume of US Navy Seawolf CDM deposited at the Navy Buoy	m³	**555,998.01**

Appendix B
REMOTS® Results

B1a
1997 Seawolf Disposal Mound
Results

Mound/ Ref. Area	Station	Rep.	Date	TIME	ANALYST	LATITUDE	LONGITUDE	Successional Stage	Grain Size (phi)		Major	Mudclasts		Camera Penetration				Dredged Material Thickness			
									Minimum	Maximum	Mode	Count	Diameter	Minimum	Maximum	Range	Mean	Area	Minimum	Maximum	Mean
Seawolf	ctr	a	09/08/97	3:15	HLS	41 16.460N	072 04.865W	INDET	>4	4	>4	0	0.00	16.70	18.16	1.46	17.43	239.32	16.80	18.25	17.12
Seawolf	ctr	b	09/08/97	3:16	HLS	41 16.455N	072 04.863W	INDET	>4	4	4 to 3	0	0.00	16.07	16.89	0.83	16.48	228.83	15.92	16.80	16.30
Seawolf	ctr	c	09/08/97	3:17	HLS	41 16.451N	072 04.863W	INDET	>4	4	>4	0	0.00	16.21	18.06	1.84	17.14	238.31	16.21	18.01	17.12
Seawolf	75n	a	09/08/97	4:53	HLS	41 16.497N	072 04.860W	ST_III	>4	3	>4	0	0.00	11.85	12.90	1.05	12.38	174.07	12.05	12.95	12.43
Seawolf	75n	b	09/08/97	4:54	HLS	41 16.497N	072 04.860W	ST_III	>4	3	4 to 3	0	0.00	10.80	12.65	1.85	11.73	163.44	10.65	12.55	11.71
Seawolf	75n	c	09/08/97	4:54	HLS	41 16.496N	072 04.856W	ST_II_TO_III	>4	3	4 to 3	0	0.00	15.75	17.00	1.25	16.38	227.67	15.60	16.85	16.08
Seawolf	75ne	a	09/08/97	4:14	HLS	41 16.451N	072 04.863W	ST_II	>4	4	>4	0	0.00	14.37	15.73	1.36	15.05	210.00	14.32	15.83	15.12
Seawolf	75ne	b	09/08/97	4:15	HLS	41 16.479N	072 04.906W	ST_II	>4	3	4 to 3	0	0.00	12.67	13.40	0.73	13.03	181.83	12.82	13.40	13.05
Seawolf	75ne	c	09/08/97	4:15	HLS	41 16.451N	072 04.897W	ST_I	>4	3	>4	0	0.00	12.74	13.43	0.70	13.08	179.78	12.59	13.48	12.81
Seawolf	75e	a	09/10/97	5:44	HLS	41 16.461N	072 04.812W	ST_II_TO_III	>4	3	>4	0	0.00	14.20	15.05	0.85	14.63	205.42	14.30	15.35	14.72
Seawolf	75e	b	09/10/97	5:45	HLS	41 16.470N	072 04.815W	INDET	>4	3	>4	0	0.00	13.90	14.35	0.45	14.13	198.52	13.85	14.40	14.15
Seawolf	75e	c	09/10/97	5:46	HLS	41 16.463N	072 04.819W	ST_I_TO_II	>4	3	>4	0	0.00	15.25	16.30	1.05	15.78	223.58	15.35	16.35	15.94
Seawolf	75se	a	09/08/97	3:11	HLS	41 16.417N	072 04.843W	ST_III	>4	4	>4	0	0.00	12.40	13.00	0.60	12.70	178.05	12.50	12.95	12.69
Seawolf	75se	b	09/08/97	3:11	HLS	41 16.418N	072 04.847W	ST_I_TO_II	>4	3	4 to 3	0	0.00	12.43	13.20	0.78	12.82	174.90	12.28	13.01	12.55
Seawolf	75se	c	09/08/97	3:12	HLS	41 16.430N	072 04.846W	ST_II	>4	3	4 to 3	0	0.00	14.76	16.46	1.70	15.61	215.15	14.85	16.36	15.38
Seawolf	75s	a	09/08/97	4:47	HLS	41 16.410N	072 04.843W	ST_II	>4	3	>4	0	0.00	10.00	12.30	2.30	11.15	152.20	10.05	12.25	10.89
Seawolf	75s	b	09/08/97	4:49	HLS	41 16.403N	072 04.871W	ST_II_ON_III	4	3	4 to 3	0	0.00	13.90	14.40	0.50	14.15	198.20	13.90	14.55	14.25
Seawolf	75s	c	09/08/97	4:50	HLS	41 16.405N	072 04.873W	ST_II_TO_III	>4	4	4 to 3	0	0.00	12.40	13.15	0.75	12.78	180.67	12.45	13.30	12.96
Seawolf	75wsw	a	09/08/97	4:28	HLS	41 16.415N	072 04.919W	ST_II_TO_III	>4	3	>4	0	0.00	15.39	16.41	1.02	15.90	221.51	15.34	16.36	15.84
Seawolf	75wsw	b	09/08/97	4:30	HLS	41 16.439N	072 04.913W	ST_II_TO_III	>4	4	>4	0	0.00	15.00	15.92	0.92	15.46	214.79	15.10	15.97	15.43
Seawolf	75wsw	c	09/08/97	4:31	HLS	41 16.433N	072 04.905W	INDET	>4	3	>4	0	0.00	14.10	14.55	0.45	14.33	197.72	13.95	14.45	14.21
Seawolf	75w	a	09/08/97	4:19	HLS	41 16.460N	072 04.900W	ST_II_TO_III	>4	4	>4	0	0.00	14.85	16.26	1.41	15.56	216.19	14.81	16.50	15.46
Seawolf	75w	b	09/08/97	4:19	HLS	41 16.454N	072 04.899W	ST_I_ON_III	>4	3	>4	0	0.00	17.57	18.88	1.31	18.23	250.88	17.48	18.98	18.11
Seawolf	75w	c	09/08/97	4:20	HLS	41 16.451N	072 04.897W	ST_I	>4	4	>4	0	0.00	15.44	16.75	1.31	16.09	225.46	15.44	16.84	16.13
Seawolf	75nw	a	09/10/97	5:39	HLS	41 16.490N	072 04.896W	INDET	>4	3	>4	0	0.00	9.45	10.65	1.20	10.05	142.13	9.10	10.75	10.12
Seawolf	75nw	b	09/10/97	5:39	HLS	41 16.488N	072 04.906W	ST_II	>4	3	4 to 3	0	0.00	16.00	16.70	0.70	16.35	230.43	16.10	16.65	16.36
Seawolf	75nw	c	09/10/97	5:40	HLS	41 16.488N	072 04.906W	ST_II_TO_III	>4	3	>4	0	0.00	15.95	16.70	0.75	16.33	229.81	15.90	16.75	16.46
Seawolf	150n	a	09/08/97	4:57	HLS	41 16.535N	072 04.863W	ST_II	>4	4	>4	0	0.00	13.80	14.55	0.75	14.18	202.54	13.90	14.75	14.43
Seawolf	150n	b	09/08/97	4:57	HLS	41 16.532N	072 04.860W	INDET	>4	4	>4	0	0.00	13.20	14.10	0.90	13.65	191.92	13.35	14.00	13.61
Seawolf	150n	c	09/08/97	4:58	HLS	41 16.528N	072 04.860W	ST_II	>4	4	>4	1	1.87	5.10	5.95	0.85	5.53	77.74	5.10	5.90	5.54
Seawolf	150ne	a	09/08/97	6:16	HLS	41 16.508N	072 04.797W	INDET	>4	3	>4	2	0.75	14.15	15.00	0.85	14.58	200.84	14.05	15.00	14.38
Seawolf	150ne	b	09/10/97	6:17	HLS	41 16.512N	072 04.772W	ST_III	>4	3	>4	0	0.00	12.85	14.30	1.45	13.58	192.68	13.20	14.45	13.73
Seawolf	150ne	c	09/10/97	6:18	HLS	41 16.508N	072 04.783W	ST_I_TO_II	>4	3	>4	0	0.00	14.95	16.65	1.70	15.80	229.13	15.25	16.90	16.18
Seawolf	150e	a	09/10/97	5:49	HLS	41 16.454N	072 04.756W	ST_II	>4	3	4 to 3	0	0.00	14.35	15.70	1.35	15.03	210.44	14.60	15.70	14.94
Seawolf	150e	b	09/10/97	5:49	HLS	41 16.460N	072 04.758W	ST_II_TO_III	>4	3	>4	0	0.00	11.30	12.10	0.80	11.70	161.28	11.25	12.05	11.53
Seawolf	150e	c	09/10/97	5:50	HLS	41 16.464N	072 04.758W	INDET	>4	3	>4	0	0.00	15.75	16.60	0.85	16.18	224.72	15.70	16.60	16.02
Seawolf	150se	a	09/08/97	3:07	HLS	41 16.398N	072 04.792W	ST_II	>4	3	4 to 3	0	0.00	13.79	14.27	0.49	14.03	NA	13.79	14.27	14.03
Seawolf	150se	b	09/08/97	3:08	HLS	41 16.391N	072 04.796W	ST_II	>4	3	4 to 3	0	0.00	10.73	11.60	0.87	11.17	154.21	10.53	11.84	11.19
Seawolf	150se	c	09/08/97	3:08	HLS	41 16.392N	072 04.797W	ST_I_ON_III	>4	4	>4	0	0.00	17.52	19.22	1.70	18.37	251.53	17.48	19.13	18.00
Seawolf	150s	a	09/08/97	4:42	HLS	41 16.382N	072 04.880W	ST_I	>4	2	3 to 2	0	0.00	11.95	12.15	0.20	12.05	169.46	11.75	12.20	12.02
Seawolf	150s	b	09/08/97	4:42	HLS	41 16.378N	072 04.876W	ST_II_ON_III	>4	3	4 to 3	0	0.00	14.70	15.40	0.70	15.05	212.39	15.00	15.45	15.19
Seawolf	150s	c	09/08/97	4:43	HLS	41 16.369N	072 04.875W	ST_II_ON_III	>4	2	4 to 3	0	0.00	14.90	16.30	1.40	15.60	220.80	14.65	17.05	15.82
Seawolf	150wsw	a	09/08/97	4:34	HLS	41 16.420N	072 04.939W	ST_I_TO_II	>4	3	4 to 3	0	0.00	13.40	14.60	1.20	14.00	197.88	13.30	14.60	14.04
Seawolf	150wsw	b	09/08/97	4:35	HLS	41 16.413N	072 04.938W	ST_III	>4	3	4 to 3	0	0.00	16.05	17.55	1.50	16.80	238.95	16.10	17.45	16.89
Seawolf	150wsw	c	09/08/97	4:36	HLS	41 16.414N	072 04.965W	ST_I	>4	4	>4	0	0.00	15.10	15.70	0.60	15.40	214.49	15.10	15.70	15.43
Seawolf	150w	a	09/08/97	4:23	HLS	41 16.463N	072 04.955W	ST_II	>4	4	>4	0	0.00	13.54	13.79	0.24	13.67	187.68	13.25	13.88	13.59
Seawolf	150w	b	09/08/97	4:24	HLS	41 16.459N	072 04.951W	ST_I	>4	3	4 to 3	0	0.00	14.03	15.34	1.31	14.68	204.48	14.13	15.49	14.78
Seawolf	150w	c	09/08/97	4:24	HLS	41 16.451N	072 04.897W	ST_I_TO_II	>4	4	>4	0	0.00	13.78	14.33	0.55	14.06	196.32	13.83	14.38	14.00
Seawolf	150nw	a	09/08/97	2:09	HLS	41 16.513N	072 04.945W	ST_I_TO_II	>4	4	>4	0	0.00	13.88	15.78	1.89	14.83	196.59	13.74	15.63	14.30
Seawolf	150nw	b	09/08/97	2:10	HLS	41 16.514N	072 04.952W	ST_I_ON_III	>4	4	>4	1	1.50	13.11	13.50	0.39	13.30	186.17	13.16	14.08	13.46
Seawolf	150nw	c	09/08/97	2:11	HLS	41 16.515N	072 04.957W	INDET	>4	4	>4	0	0.00	15.53	17.09	1.55	16.31	228.27	15.44	17.14	16.33

Mound/ Ref. Area	Station	Rep.	Date	TIME	ANALYST	LATITUDE	LONGITUDE	Successional Stage	Grain Size (phi)		Major	Mudclasts		Camera Penetration				Dredged Material Thickness			
									Minimum	Maximum	Mode	Count	Diameter	Minimum	Maximum	Range	Mean	Area	Minimum	Maximum	Mean
Seawolf	300n	a	09/08/97	5:01	HLS	41 16.620N	072 04.862W	ST_II	>4	3	4 to 3	0	0.00	13.65	15.55	1.90	14.60	204.83	13.55	15.35	14.47
Seawolf	300n	b	09/08/97	5:02	HLS	41 16.618N	072 04.852W	INDET	>4	3	4 to 3	0	0.00	15.15	16.65	1.50	15.90	221.45	15.20	16.35	15.79
Seawolf	300n	c	09/08/97	5:02	HLS	41 16.619N	072 04.851W	ST_I	>4	3	>4	0	0.00	16.35	17.40	1.05	16.88	236.88	16.35	17.45	16.89
Seawolf	300ne	a	09/10/97	6:12	HLS	41 16.582N	072 04.710W	ST_II_TO_III	>4	3	4 to 3	0	0.00	14.15	15.65	1.50	14.90	210.27	14.20	15.75	14.92
Seawolf	300ne	b	09/10/97	6:13	HLS	41 16.578N	072 04.710W	ST_II_ON_III	>4	3	4 to 3	0	0.00	11.15	12.30	1.15	11.73	160.15	10.65	12.50	11.50
Seawolf	300ne	c	09/10/97	6:14	HLS	41 16.576N	072 04.711W	ST_II	>4	4	>4	0	0.00	13.55	14.45	0.90	14.00	194.91	13.45	14.30	14.01
Seawolf	300e	a	09/10/97	5:53	HLS	41 16.463N	072 04.665W	ST_II_ON_III	>4	2	4 to 3	0	0.00	14.40	16.20	1.80	15.30	213.10	14.55	16.25	15.26
Seawolf	300e	b	09/10/97	6:03	HLS	41 16.449N	072 04.659W	ST_II	>4	3	>4	0	0.00	15.30	17.60	2.30	16.45	230.89	15.30	17.55	16.46
Seawolf	300e	c	09/10/97	6:04	HLS	41 16.458N	072 04.660W	ST_II	>4	3	4 to 3	0	0.00	16.30	17.45	1.15	16.88	239.33	16.50	17.70	17.07
Seawolf	300se	a	09/08/97	3:02	HLS	41 16.349N	072 04.718W	INDET	>4	3	4 to 3	0	0.00	7.86	9.81	1.94	8.84	121.19	8.06	9.66	8.73
Seawolf	300se	b	09/08/97	3:03	HLS	41 16.349N	072 04.718W	ST_II_ON_III	>4	3	4 to 3	0	0.00	14.37	15.97	1.60	15.17	209.89	14.32	16.26	15.00
Seawolf	300se	c	09/08/97	3:03	HLS	41 16.346N	072 04.720W	ST_II	>4	3	4 to 3	0	0.00	8.79	9.61	0.83	9.20	131.20	8.59	10.05	9.42
Seawolf	300s	b	09/08/97	2:53	HLS	41 16.456N	072 05.087W	ST_II	>4	3	4 to 3	0	0.00	10.45	11.15	0.70	10.80	150.44	10.20	11.20	10.81
Seawolf	300s	c	09/08/97	2:54	HLS	41 16.281N	072 04.877W	ST_I_ON_III	>4	3	4 to 3	0	0.00	12.38	13.54	1.17	12.96	NA	12.38	13.54	12.96
Seawolf	300s	d	09/10/97	5:33	HLS	41 16.281N	072 04.877W	ST_II	>4	3	4 to 3	0	0.00	13.67	14.57	0.90	14.12	195.88	13.72	14.67	14.07
Seawolf	300wsw	a	09/08/97	2:35	HLS	41 16.373N	072 05.054W	ST_I_TO_II	>4	4	>4	0	0.00	14.27	15.00	0.73	14.64	200.12	14.22	14.90	14.43
Seawolf	300wsw	b	09/08/97	2:36	HLS	41 16.370N	072 05.058W	ST_II_ON_III	>4	4	>4	0	0.00	15.19	16.31	1.12	15.75	217.12	15.00	16.31	15.46
Seawolf	300wsw	c	09/08/97	2:37	HLS	41 16.368N	072 05.060W	ST_II_TO_III	>4	4	>4	0	0.00	14.37	15.87	1.50	15.12	210.81	14.51	15.83	15.01
Seawolf	300w	a	09/08/97	2:29	HLS	41 16.456N	072 05.087W	ST_II	>4	3	4 to 3	0	0.00	7.91	8.79	0.87	8.35	0.00	0.00	0.00	0.00
Seawolf	300w	b	09/08/97	2:30	HLS	41 16.454N	072 05.088W	ST_II	>4	3	4 to 3	0	0.00	7.82	8.69	0.87	8.25	0.00	0.00	0.00	0.00
Seawolf	300w	c	09/08/97	2:30	HLS	41 16.455N	072 05.090W	ST_II_ON_III	>4	3	4 to 3	0	0.00	9.56	10.63	1.07	10.10	0.00	0.00	0.00	0.00
Seawolf	300nw	a	09/08/97	2:14	HLS	41 16.583N	072 05.018W	ST_I_TO_II	>4	4	>4	0	0.00	15.73	16.75	1.02	16.24	226.84	15.87	16.84	16.44
Seawolf	300nw	b	09/08/97	2:15	HLS	41 16.582N	072 05.022W	INDET	>4	4	>4	0	0.00	12.23	12.96	0.73	12.60	175.13	12.28	13.01	12.57
Seawolf	300nw	c	09/08/97	2:16	HLS	41 16.584N	072 05.024W	ST_II	>4	3	4 to 3	0	0.00	15.80	16.50	0.70	16.10	228.22	16.07	16.94	16.32
Seawolf	450n	a	09/08/97	5:05	HLS	41 16.697N	072 04.870W	ST_I_TO_II	>4	3	4 to 3	0	0.00	4.80	5.75	0.95	5.28	0.00	0.00	0.00	0.00
Seawolf	450n	b	09/08/97	5:05	HLS	41 16.687N	072 04.865W	ST_II	>4	3	4 to 3	0	0.00	5.15	6.05	0.90	5.60	83.05	5.75	6.20	5.92
Seawolf	450n	c	09/08/97	5:06	HLS	41 16.691N	072 04.863W	ST_II_ON_III	>4	3	4 to 3	0	0.00	11.90	12.80	0.90	12.35	173.82	12.00	12.70	12.33
Seawolf	450ne	a	09/10/97	6:07	HLS	41 16.620N	072 04.626W	ST_I	>4	3	4 to 3	0	0.00	3.50	4.50	1.00	4.00	60.48	3.95	4.85	4.29
Seawolf	450ne	b	09/10/97	6:08	HLS	41 16.621N	072 04.625W	ST_I_TO_II	>4	3	4 to 3	0	0.00	4.30	5.25	0.95	4.78	72.33	4.65	5.35	5.12
Seawolf	450wsw	a	09/08/97	2:42	HLS	41 16.329N	072 05.145W	ST_II	>4	4	>4	0	0.00	17.77	19.13	1.36	18.45	254.54	17.77	18.98	18.43
Seawolf	450wsw	b	09/08/97	2:42	HLS	41 16.332N	072 05.148W	ST_II_ON_III	>4	4	>4	0	0.00	11.89	13.50	1.60	12.69	171.68	11.84	13.54	12.33
Seawolf	450wsw	c	09/08/97	2:43	HLS	41 16.330N	072 05.152W	INDET	>4	4	>4	0	0.00	13.88	15.00	1.12	14.44	201.51	13.79	15.05	14.48
Seawolf	450nw	a	09/08/97	2:19	HLS	41 16.638N	072 05.076W	ST_III	>4	3	4 to 3	0	0.00	7.04	7.67	0.63	7.36	0.00	0.00	0.00	0.00
Seawolf	450nw	b	09/08/97	2:20	HLS	41 16.629N	072 05.073W	ST_II	>4	3	4 to 3	0	0.00	9.90	10.49	0.58	10.19	0.00	0.00	0.00	0.00
Seawolf	450nw	c	09/08/97	2:21	HLS	41 16.632N	072 05.082W	ST_II_TO_II	>4	3	4 to 3	0	0.00	7.86	8.59	0.73	8.23	0.00	0.00	0.00	0.00

Mound/ Ref. Area	Station	Rep.	Redox Rebound Min.	Redox Rebound Max.	Redox Rebound Mean	Apparent RPD Thickness Area	Apparent RPD Thickness Minimum	Apparent RPD Thickness Maximum	Apparent RPD Thickness Mean	OSI	Methane Count	Surface Disturbance	Low DO	Comments
Seawolf	ctr	a	0	0	0	NA	NA	NA	NA	NA	0	INDET	NO	dm>pen; gr clay w/bk RPD layers(surf wiper smear?)& br v.f.sand near bottom
Seawolf	ctr	b	0	0	0	NA	NA	NA	NA	NA	0	PHYSICAL	NO	dm>pen; gr clay/br-bk clay; M/S/M/S; fresh dm?
Seawolf	ctr	c	0	0	0	NA	NA	NA	NA	NA	0	PHYSICAL	NO	dm>pen; fresh dm?; gr clay w/bk patches; wiper artifact; shell; inf. burrow sectior
Seawolf	75n	a	0	0	0	NA	NA	NA	NA	NA	0	BIOGENIC	NO	dm>pen; burrows; feeding voids/fractures?; shell;lg tubes;& org matter on surf
Seawolf	75n	b	0	0	0	26.42	0.45	3.50	1.85	8	0	PHYSICAL	NO	dm>pen; S/M; shells-armoring?; ripped-up Ampelisca tubes;burrow and feeding void
Seawolf	75n	c	0	0	0	NA	NA	NA	NA	NA	0	PHYSICAL	NO	dm>pen; S/M; shell lag; ripped-up Amp. tube mat; Retro II?
Seawolf	75ne	a	0	0	0	NA	NA	NA	NA	NA	0	PHYSICAL	NO	dm>pen; S/M; gr clay w/bk streaks; sm Ampelisca tubes?
Seawolf	75ne	b	0	0	0	59.36	2.94	5.62	4.25	9	0	PHYSICAL	NO	dm>pen; S/M; wiper artifacts; surf Ampelisca tubes
Seawolf	75ne	c	0	0	0	NA	NA	NA	NA	NA	0	PHYSICAL	NO	dm>pen; S/M; diagonal bk layers; surf scour
Seawolf	75e	a	0	0	0	11.79	0.40	1.80	0.80	7	0	BIOGENIC	NO	dm>pen; S/M; shell lag; fractures
Seawolf	75e	b	0	0	0	9.06	0.25	1.60	0.61	4	0	INDET	NO	dm>pen; S/M; shell lag; variable RPD; only 1-2 Ampelisca
Seawolf	75e	c	0	0	0	NA	NA	NA	NA	NA	0	INDET	NO	dm>pen; gr clay w/bk streaks; wiper artifacts; sm surf tubes
Seawolf	75se	a	0	0	0	25.85	0.05	3.35	1.78	8	0	INDET	NO	dm>pen; gr clay; burrow and worm; amphipods?
Seawolf	75se	b	0	0	0	13.93	0.15	2.14	0.96	4	0	INDET	NO	dm>pen; S/M; 2 shells on surf; sm tubes on surf; gr clay
Seawolf	75se	c	0	0	0	25.47	1.41	2.38	1.80	6	0	PHYSICAL	NO	dm>pen; S/M; shell lag; surf scour; voids at depth are fractures?
Seawolf	75s	a	3.3	8.8	6.05	15.78	0.45	2.15	1.10	5	0	PHYSICAL	NO	dm>pen; thin S/M; shell lag;ripped-up tubemat; surf scour; Retro II?
Seawolf	75s	b	0	0	0	28.30	1.45	3.55	1.98	8	0	PHYSICAL	NO	dm>pen; S/M; Ampelisca tubes; feeding voids; Chaetopterus
Seawolf	75s	c	0	0	0	NA	NA	NA	NA	NA	0	PHYSICAL	NO	dm>pen; S/M; shell lag; feeding void
Seawolf	75wsw	a	0	0	0	15.62	0.53	2.04	1.08	6	0	PHYSICAL	NO	dm>pen; S/M; thin rpd/gr clay; feeding voids; Ampelisca tubes on surf
Seawolf	75wsw	b	0	0	0	6.86	0.10	0.78	0.46	5	0	PHYSICAL	NO	dm>pen; S/M; br/gr clay; thin RPD; shell lag; ripped-up Amp.tube mat
Seawolf	75wsw	c	0	0	0	22.02	0.80	2.30	1.55	NA	0	PHYSICAL	NO	dm>pen; S/M; wiper artifacts; shell lag
Seawolf	75w	a	0	0	0	NA	NA	NA	NA	NA	0	PHYSICAL	NO	dm>pen; S/M; gr clay; shell lag; burrow and feeding void
Seawolf	75w	b	0	0	0	14.13	0.34	1.65	0.98	7	0	PHYSICAL	NO	dm>pen; S/M; shell lag in sand; Amphipod tubemat?; bk patches
Seawolf	75w	c	0	0	0	NA	NA	NA	NA	NA	0	PHYSICAL	NO	dm>pen; wiper smears?; thin layer of S/M; sm tubes on surf
Seawolf	75nw	a	0	0	0	NA	NA	NA	NA	NA	0	PHYSICAL	NO	dm>pen; lg mussel & drag-down structure; rocks; shells; surf tubes; scourlag
Seawolf	75nw	b	0	0	0	19.42	0.60	2.40	1.36	5	0	PHYSICAL	NO	dm>pen; S/M; shell lag; surf scour;ripped-up Ampelisca tubemat;Retro II
Seawolf	75nw	c	0	0	0	22.95	0.60	2.80	1.60	7	0	PHYSICAL	NO	dm>pen; S/M; shell lag; sm surf tubes
Seawolf	150n	a	0	0	0	NA	NA	NA	NA	NA	0	PHYSICAL	NO	dm>pen; S/M; gr clay w/bk mottles
Seawolf	150n	b	0	0	0	NA	NA	NA	NA	NA	0	INDET	NO	dm>pen; gr clay; thin RPD; wiper clast at sed surf?; shell lag
Seawolf	150n	c	0	0	0	NA	NA	NA	NA	NA	0	PHYSICAL	YES	dm>pen; dense gr clay; wiper clast on surf; shell lag; ripped-up Ampelisca? tubemat
Seawolf	150ne	a	4.25	6.25	5.25	9.09	0.05	1.35	0.61	NA	0	INDET	NO	dm>pen; minor shell lag; surf mudclasts
Seawolf	150ne	b	0	0	0	9.58	0.15	1.50	0.63	6	0	PHYSICAL	NO	dm>pen; thin S/M; shell lag; eroded Chaetopterus tube(~1.5cm);feeding voids
Seawolf	150ne	c	5.15	9.4	7.28	38.07	0.70	4.40	2.68	6	0	PHYSICAL	NO	dm>pen; S/M; shell lag; ripped-up tubes on surf
Seawolf	150e	a	0	0	0	43.91	1.10	5.00	3.10	8	0	PHYSICAL	NO	dm>pen; S/M; shell lag; ripped-up Ampelisca tube mat; erosional
Seawolf	150e	b	0	0	0	5.02	0.05	1.50	1.03	6	0	PHYSICAL	NO	dm>pen; gr clay; minor shell lag; stranded Ampelisca tubes
Seawolf	150e	c	0	0	0	NA	NA	NA	NA	NA	0	INDET	NO	dm>pen; gr clay w/patchy RPD and mottled bk sed; wiper artifacts?
Seawolf	150se	a	0	0	0	93.84	5.07	9.30	6.70	9	0	BIOGENIC	NO	dm>pen?; br sand; wiper artifacts; surf tubes; sparse amphipods
Seawolf	150se	b	0	0	0	46.41	2.28	4.51	3.32	8	0	PHYSICAL	NO	?dm>pen; S/M; br sand/gr clay; Retro II; shells on surf; ripped-up tubes
Seawolf	150se	c	0	0	0	NA	NA	NA	NA	NA	0	INDET	NO	dm>pen; gr clay; wiper clasts and smear; shell and inf. feeding voids
Seawolf	150s	a	0	0	0	64.18	3.90	5.30	4.57	7	0	PHYSICAL	NO	dm>pen;shell lag; br sand; sm surf tubes; graded hedding
Seawolf	150s	b	0	0	0	69.65	3.95	6.45	4.97	11	0	PHYSICAL	NO	dm>pen; S/M; feeding voids; Chaetopterus; fractures at bottom; shell lag
Seawolf	150s	c	0	0	0	68.94	2.05	8.60	4.88	11	0	INDET	NO	dm>pen; S/M; Ampelisca tubemat?; lg feeding voids; erosion
Seawolf	150wsw	a	5.55	10.6	8.08	NA	NA	NA	NA	NA	0	PHYSICAL	NO	dm>pen;S/M;gr clay; Ampelisca tubes; scoured
Seawolf	150wsw	b	0	0	0	38.84	0.50	4.25	2.76	9	0	INDET	NO	dm>pen; S/M; feeding voids and fractures; Ampelisca tubemat?
Seawolf	150wsw	c	0	0	0	NA	NA	NA	NA	NA	0	INDET	NO	dm>pen; S/M; Chaetopterus; wiper smears
Seawolf	150w	a	0	0	0	NA	NA	NA	NA	NA	0	PHYSICAL	NO	dm>pen; S/M; gr clay; sm amphipod tubes on surf
Seawolf	150w	b	0	0	0	22.43	0.87	2.38	1.59	4	0	PHYSICAL	NO	dm>pen; S/M; gr clay w/ bk mottles; scour lag
Seawolf	150w	c	0	0	0	NA	NA	NA	NA	NA	0	PHYSICAL	NO	dm>pen; S/M; gr clay w/bk mottled; shell frag.; surf scour
Seawolf	150nw	a	0	0	0	NA	NA	NA	NA	NA	0	PHYSICAL	NO	dm>pen; shell lag; gr clay w/bk patches
Seawolf	150nw	b	0	0	0	NA	NA	NA	NA	NA	0	PHYSICAL	NO	dm>pen; gr clay w/bk patches; wiper smearing; Chaetopterus tube; scour lag
Seawolf	150nw	c	0	0	0	NA	NA	NA	NA	NA	0	PHYSICAL	NO	dm>pen; ol.gr/gr clay; wiper smear over RPD; feeding void 8.5cm; fractures at depth

Mound/ Ref. Area	Station	Rep.	Redox Rebound			Apparent RPD Thickness				OSI	Methane Count	Surface Disturbance	Low DO	Comments
			Min.	Max.	Mean	Area	Minimum	Maximum	Mean					
Seawolf	300n	a	2.55	6.75	4.65	31.73	1.35	3.55	2.25	6	0	BIOGENIC	NO	dm>pen;S/M; lg Chaetopterus tube; burrow; erosional (~3cm)
Seawolf	300n	b	9.55	11.75	10.65	NA	NA	NA	NA	NA	0	PHYSICAL	NO	dm>pen; S/M; wiper clasts;lg Chaetopterus tube; erosional (~2cm)
Seawolf	300n	c	0	0	0	NA	NA	NA	NA	NA	0	INDET	NO	dm>pen; S/M; wiper smearing/artifacts?; sm Amphipods? surf tubes
Seawolf	300ne	a	0	0	0	NA	NA	NA	NA	NA	0	BIOGENIC	NO	dm>pen; shell lag throughout; lg inf. feeding void or fracture?
Seawolf	300ne	b	0	0	0	70.23	1.40	8.65	5.00	11	0	BIOGENIC	NO	dm>pen; S/M; shell lag in the sand; surf tubes; feeding void
Seawolf	300ne	c	0	0	0	NA	NA	NA	NA	NA	0	BIOGENIC	NO	dm>pen; gr clay; burrow
Seawolf	300e	a	0	0	0	NA	NA	NA	NA	NA	0	PHYSICAL	NO	dm>pen;S/M;wiper artifacts?;br-gr sand/br clay/bk mud; rocks; ripped-up Amp.tubemat
Seawolf	300e	b	0	0	0	NA	NA	NA	NA	NA	0	BIOGENIC	NO	dm>pen; surf tubes; voids?; fracture at depth
Seawolf	300e	c	0	0	0	NA	NA	NA	NA	NA	0	INDET	NO	dm>pen;S/M; chaotic fabric;surf tubes &scour
Seawolf	300se	a	0	0	0	22.75	1.02	2.23	1.61	NA	0	PHYSICAL	NO	dm>pen; thin RPD; scourlag; armored surface- rocks and shells(moon and biv)
Seawolf	300se	b	4.98	8.12	6.55	33.49	1.99	3.45	2.36	8	0	BIOGENIC	NO	?dm>pen; br sandy silt/gr-bk clay;shell lag; feeding voids at depth; poss sm surf tubes
Seawolf	300se	c	0	0	0	NA	NA	NA	NA	NA	0	PHYSICAL	NO	?dm>pen; mottled sandy sed;Retro II; armored w/shell lag&lg shells(whelk/moonshell)
Seawolf	300s	b	0	0	0	106.28	6.05	8.50	7.67	9	0	INDET	NO	dm>pen; S/M; shell lag; Ampelisca tube mat
Seawolf	300s	c	7.48	9.13	8.3	22.75	1.02	2.23	1.61	8	0	PHYSICAL	NO	dm>pen; S/M; scourlag
Seawolf	300s	d	0	0	0	89 20	4.42	7.89	6.35	9	0	BIOGENIC	NO	dm>pen; S/M; shell lag; ripped-up tube mats; feeding void
Seawolf	300wsw	a	0	0	0	7.05	0.29	0.78	0.47	3	0	PHYSICAL	NO	dm>pen; gr clay; minor shell lag; surf tubes; poss. worm; Retro II?
Seawolf	300wsw	b	0	0	0	NA	NA	NA	NA	NA	0	BIOGENIC	NO	dm>pen; lg. surf tube; deep burrow?; RPD very thin?; wiper smearing;Retro II?
Seawolf	300wsw	c	0	0	0	NA	NA	NA	NA	NA	0	BIOGENIC	NO	dm>pen; gr clay; RPD thin and patchy; feeding voids; in-situ live amphipod tubes
Seawolf	300w	a	4.03	5.78	4.9	24.86	1.19	2.74	1.75	6	0	BIOGENIC	NO	ambient; br sandy silt;surf tubes; feeding voids at depth; Retro II?
Seawolf	300w	b	4.42	5.83	5.12	12.90	0.29	2.09	0.88	5	0	BIOGENIC	NO	ambient; decaying Ampelisca tubes; br sandy silt; RPD thin/faint
Seawolf	300w	c	3 35	5 87	4.61	22.09	0.87	3.11	1.57	8	0	BIOGENIC	NO	ambient;wiper artifacts?; Retro II?; Chaeotopterus?;feeding voids w/poss. worm
Seawolf	300nw	a	0	0	0	31.06	0.85	4.08	2.19	5	0	BIOGENIC	NO	dm>pen; thin S/M; sm tubes; o-gr clay w/thin patchy RPD
Seawolf	300nw	b	3.74	5.19	4.47	NA	NA	NA	NA	NA	0	PHYSICAL	NO	dm>pen; S/M;shell lag; thin/patchy RPD;wiper smearing;gr clay w/ bk banc
Seawolf	300nw	c	0	0	0	105.58	6.67	8.21	7.54	9	0	PHYSICAL	NO	dm>pen; S/M; sm worm?; wiper artifacts;Retro II?;ripped-up tubemat
Seawolf	450n	a	0	0	0	NA	NA	NA	NA	NA	0	PHYSICAL	NO	ambient; wiper artifacts; shell lag; surf tubes and scour
Seawolf	450n	b	0	0	0	34.85	1.05	4.55	2.45	7	0	PHYSICAL	NO	dm?/pen; S/M; shell lag; riped-up Ampelisca tubemat; Retro II?
Seawolf	450n	c	0	0	0	75.26	4.55	6.35	5.32	11	0	PHYSICAL	NO	dm>pen; S/M; shell lag; Ampelisca tubes; Retro II?
Seawolf	450ne	a	0	0	0	NA	NA	NA	NA	NA	0	BIOGENIC	NO	dm?/pen; worm; ripped-up tube mats?; gammarid auph. burrows below surf
Seawolf	450ne	b	0	0	0	28.06	1.20	2.90	1.96	5	0	PHYSICAL	NO	dm?>pen; br sand; ripped-up amphipod tube mat; poss.feeding voids?
Seawolf	450wsw	a	0	0	0	NA	NA	NA	NA	NA	0	BIOGENIC	NO	dm>pen; S/M; gr clay;wiper smearing; lg burrow; minor shell lag; live Amphipods
Seawolf	450wsw	b	0	0	0	8.88	0.15	1.17	0.82	7	0	PHYSICAL	NO	dm>pen; wiper clast;lg tubes on surf-Chaetopterus; feeding voids at depth; Retro II
Seawolf	450wsw	c	0	0	0	NA	NA	NA	NA	NA	0	PHYSICAL	NO	dm>pen; gr clay; thin layer of S/M
Seawolf	450nw	a	0	0	0	15.86	0.63	1.60	1.12	7	0	PHYSICAL	NO	ambient; feeding voids; surf tubes; erosional
Seawolf	450nw	b	0	0	0	95.27	5.19	8.69	7.10	9	0	BIOGENIC	NO	ambient; S/M; decaying but in-situ Ampelisca tube mat;feeding voids
Seawolf	450nw	c	0	0	0	51.61	2.29	4.83	3 67	9	0	BIOGENIC	NO	ambient; br sandy silt w/bk RPD; decaying amphipod tube mat; feeding void

B1b
1997 NLDS Reference Area Results

Mound/ Ref. Area	Station	Rep.	Date	TIME	ANALYST	LATITUDE	LONGITUDE	Successional Stage	Grain Size (phi)		Major	Mudclasts		Camera Penetration				Dredged Material Thickness			
									Minimum	Maximum	Mode	Count	Diameter	Minimum	Maximum	Range	Mean	Area	Minimum	Maximum	Mean
NLON Ref	sta1	a	09/06/97	12:10	HLS	41 16.70907	072 01.973W	ST_I_ON_III	>4	3	4 to 3	0	0.00	7.04	7.86	0.82	7.45	0.00	0.00	0.00	0.00
NLON Ref	sta1	b	09/06/97	12:11	HLS	41 16.704	072 01.971W	ST_II	>4	3	4 to 3	0	0.00	4.61	4.90	0.29	4.76	0.00	0.00	0.00	0.00
NLON Ref	sta1	c	09/06/97	12:12	HLS	41 16.70102	072 01.891W	ST_II	>4	3	4 to 3	0	0.00	3.83	4.13	0.29	3.98	0.00	0.00	0.00	0.00
NLON Ref	sta1	d	09/10/97	8:04	HLS	41 16.70335	072 01.959W	INDET	>4	3	4 to 3	0	0.00	4.65	5.05	0.40	4.85	0.00	0.00	0.00	0.00
NLON Ref	sta1	e	09/10/97	8:05	HLS	41 16.7084	072 01.952W	INDET	>4	3	4 to 3	0	0.00	3.94	4.39	0.45	4.17	0.00	0.00	0.00	0.00
NLON Ref	sta2	a	09/06/97	12:28	HLS	41 16.56542	072 02.051W	ST_II_ON_III	>4	4	>4	0	0.00	8.45	9.32	0.87	8.89	0.00	0.00	0.00	0.00
NLON Ref	sta2	b	09/06/97	12:29	HLS	41 16.55987	072 02.051W	ST_I_TO_II	>4	4	>4	0	0.00	8.84	10.05	1.21	9.44	0.00	0.00	0.00	0.00
NLON Ref	sta2	c	09/06/97	12:30	HLS	41 16.55702	072 02.052W	ST_II_ON_III	>4	3	4 to 3	0	0.00	11.26	11.50	0.24	11.38	0.00	0.00	0.00	0.00
NLON Ref	sta3	a	09/06/97	12:15	HLS	41 16.69302	072 01.891W	ST_II	>4	3	4 to 3	0	0.00	3.79	4.71	0.92	4.25	0.00	0.00	0.00	0.00
NLON Ref	sta3	b	09/06/97	12:15	HLS	41 16.692	072 01.891W	INDET	>4	3	4 to 3	0	0.00	2.44	2.74	0.30	2.59	0.00	0.00	0.00	0.00
NLON Ref	sta3	c	09/06/97	12:16	HLS	41 16.6911	072 01.889W	ST_II	>4	3	4 to 3	0	0.00	4.73	5.41	0.68	5.07	0.00	0.00	0.00	0.00
NLON Ref	sta3	d	09/10/97	8:09	HLS	41 16.69963	072 01.880W	ST_II	>4	3	4 to 3	0	0.00	5.40	5.91	0.51	5.66	0.00	0.00	0.00	0.00
NLON Ref	sta3	e	09/10/97	8:09	HLS	41 16.7014	072 01.877W	ST_II_TO_III	>4	3	4 to 3	0	0.00	5.40	5.86	0.45	5.63	0.00	0.00	0.00	0.00
NLON Ref	sta4	a	09/06/97	12:21	HLS	41 16.57097	072 01.818W	ST_II_ON_III	>4	3	4 to 3	0	0.00	9.08	9.37	0.29	9.23	0.00	0.00	0.00	0.00
NLON Ref	sta4	b	09/06/97	12:24	HLS	41 16.56073	072 01.833W	ST_I_TO_II	>4	4	>4	0	0.00	5.80	6.47	0.68	6.14	0.00	0.00	0.00	0.00
NLON Ref	sta4	c	09/06/97	12:24	HLS	41 16.55602	072 01.838W	ST_I_TO_II	>4	3	4 to 3	0	0.00	6.62	7.20	0.58	6.91	0.00	0.00	0.00	0.00
NE-Ref	sta5	a	09/06/97	1:25	HLS	41 16.66	072 03.303W	ST_I_TO_II	>4	3	4 to 3	0	0.00	6.28	6.67	0.39	6.47	0.00	0.00	0.00	0.00
NE-Ref	sta5	c	09/06/97	1:27	HLS	41 16.65988	072 03.316W	ST_II	>4	3	4 to 3	0	0.00	6.04	6.43	0.39	6.23	0.00	0.00	0.00	0.00
NE-Ref	sta5	d	09/10/97	7:54	HLS	41 16.6683	072 03.313W	ST_II_ON_III	>4	3	4 to 3	0	0.00	8.84	9.24	0.40	9.04	0.00	0.00	0.00	0.00
NE-Ref	sta6	a	09/06/97	1:30	HLS	41 16.67802	072 03.377W	ST_II	>4	3	4 to 3	0	0.00	7.92	8.55	0.63	8.24	0.00	0.00	0.00	0.00
NE-Ref	sta6	b	09/06/97	1:30	HLS	41 16.67283	072 03.371W	ST_II_TO_III	>4	3	4 to 3	0	0.00	4.20	6.47	2.27	5.34	0.00	0.00	0.00	0.00
NE-Ref	sta6	d	09/10/97	7:52	HLS	41 16.6823	072 03.380W	ST_II	>4	3	4 to 3	0	0.00	7.12	8.38	1.26	7.75	0.00	0.00	0.00	0.00
NE-Ref	sta7	a	09/06/97	1:34	HLS	41 16.76303	072 03.359W	ST_II	>4	3	4 to 3	0	0.00	8.89	9.71	0.82	9.30	0.00	0.00	0.00	0.00
NE-Ref	sta7	b	09/06/97	1:35	HLS	41 16.762	072 03.360W	ST_I	>4	3	4 to 3	0	0.00	8.12	8.50	0.39	8.31	0.00	0.00	0.00	0.00
NE-Ref	sta7	c	09/06/97	1:36	HLS	41 16.76005	072 03.361W	ST_I_TO_II	>4	3	4 to 3	0	0.00	7.68	8.21	0.53	7.95	0.00	0.00	0.00	0.00
NE-Ref	sta8	b	09/06/97	1:42	HLS	41 16.68898	072 03.551W	ST_I_TO_II	>4	3	4 to 3	0	0.00	8.74	9.18	0.43	8.96	0.00	0.00	0.00	0.00
NE-Ref	sta8	c	09/06/97	1:42	HLS	41 16.69	072 03.553W	ST_I_TO_II	>4	3	4 to 3	0	0.00	6.52	7.44	0.92	6.98	0.00	0.00	0.00	0.00
NE-Ref	sta8	d	09/10/97	7:48	HLS	41 16780	072 03.535W	ST_II	>4	3	4 to 3	0	0.00	8.59	9.04	0.45	8.81	0.00	0.00	0.00	0.00
NE-Ref	sta9	a	09/06/97	1:47	HLS	41 16.6762	072 03.271W	ST_II_ON_III	>4	3	4 to 3	0	0.00	9.08	9.47	0.39	9.28	0.00	0.00	0.00	0.00
NE-Ref	sta9	b	09/06/97	1:48	HLS	41 16.67035	072 03.271W	ST_III	>4	3	4 to 3	1	2.04	7.57	8.22	0.64	7.90	0.00	0.00	0.00	0.00
NE-Ref	sta9	c	09/06/97	1:49	HLS	41 16.66298	072 03.261W	ST_I_ON_III	>4	3	4 to 3	0	0.00	6.57	7.15	0.58	6.86	0.00	0.00	0.00	0.00
West-Ref	w10	a	09/06/97	3:29	HLS	41 16.19803	072 05.921W	ST_II	>4	2	4 to 3	0	0.00	8.01	8.59	0.58	8.30	0.00	0.00	0.00	0.00
West-Ref	w10	c	09/06/97	3:34	HLS	41 16.20593	072 05.927W	ST_II	>4	2	3 to 2	0	0.00	7.72	8.54	0.83	8.13	0.00	0.00	0.00	0.00
West-Ref	w10	d	09/10/97	6:28	HLS	41 16.2048	072 05.913W	ST_I	>4	3	4 to 3	0	0.00	4.06	4.95	0.89	4.50	0.00	0.00	0.00	0.00
West-Ref	w11	a	09/06/97	3:24	HLS	41 16.32692	072 05.848W	ST_II_TO_III	>4	3	4 to 3	0	0.00	9.81	10.44	0.63	10.12	0.00	0.00	0.00	0.00
West-Ref	w11	b	09/06/97	3:24	HLS	41 16.32608	072 05.842W	ST_II_ON_III	>4	3	4 to 3	0	0.00	11.26	12.09	0.83	11.67	0.00	0.00	0.00	0.00
West-Ref	w11	c	09/06/97	3:25	HLS	41 16.32615	072 05.835W	INDET	>4	3	4 to 3	0	0.00	8.54	9.56	1.02	9.05	0.00	0.00	0.00	0.00
West-Ref	w12	b	09/06/97	3:40	HLS	41 16.19737	072 05.967W	ST_II	>4	3	4 to 3	0	0.00	4.56	5.83	1.26	5.19	0.00	0.00	0.00	0.00
West-Ref	w12	c	09/06/97	3:40	HLS	41 16.20333	072 05.948W	ST_II	>4	3	4 to 3	0	0.00	6.70	7.43	0.73	7.06	0.00	0.00	0.00	0.00
West-Ref	w12	d	09/10/97	6:31	HLS	41 16.19585	072 05.970W	ST_II	>4	3	4 to 3	0	0.00	4.11	5.69	1.58	4.90	0.00	0.00	0.00	0.00
West-Ref	w13	a	09/06/97	3:44	HLS	41 16.16782	072 05.842W	ST_II	>4	3	4 to 3	0	0.00	6.26	7.38	1.12	6.82	0.00	0.00	0.00	0.00
West-Ref	w13	b	09/06/97	3:44	HLS	41 16.16378	072 05.841W	ST_II	>4	3	4 to 3	0	0.00	6.07	7.14	1.07	6.60	0.00	0.00	0.00	0.00
West-Ref	w13	c	09/06/97	3:45	HLS	41 16.15167	072 05.846W	ST_I_TO_II	>4	3	4 to 3	0	0.00	4.76	5.34	0.58	5.05	0.00	0.00	0.00	0.00

Mound/ Ref. Area	Station	Rep.	Redox Rebound			Apparent RPD Thickness				OSI	Methane	Surface	Low	Comments
			Min.	Max.	Mean	Area	Minimum	Maximum	Mean		Count	Disturbance	DO	
NLON Ref	sta1	a	0	0	0	NA	NA	NA	NA	NA	0	PHYSICAL	NO	ambient; minor shell lag; Chaetopterus tube; 2 blades of dead eelgrass
NLON Ref	sta1	b	0	0	0	NA	0.50	4.00	1.50	5	0	INDET	NO	ambient; shallow pen; RPD very faint; Retro II?
NLON Ref	sta1	c	0	0	0	14.98	0.58	1.60	1.04	5	0	PHYSICAL	NO	ambient; shallow pen; dead eel grass blade· RetroII?
NLON Ref	sta1	d	0	0	0	29.25	1.57	2.47	2.05	NA	0	PHYSICAL	NO	ambient; br sand; shell lag
NLON Ref	sta1	e	0	0	0	NA	NA	NA	NA	NA	0	PHYSICAL	NO	ambient; br sand; RPD>pen; dead eel grass blades in sed
NLON Ref	sta2	a	0	0	0	39.59	1.50	4.01	2.97	9	0	PHYSICAL	NO	ambient;S/M;surf scour&sm tubes;Chaetopterus far-field;worm;feeding void
NLON Ref	sta2	b	0	0	0	0.00	0.00	7.00	2.10	5	0	PHYSICAL	NO	ambient; Crepidula shell; ripped-up tube mat; burrow/drag-down?; wiper artifact
NLON Ref	sta2	c	0	0	0	26.77	0.10	4.69	2.57	9	0	BIOGENIC	NO	ambient; S/M;wiper artifact;juv.Amphipod tubemat; thin worm below RPD bound.
NLON Ref	sta3	a	0	0	0	43.53	1.02	4.90	3.21	8	0	INDET	NO	ambient; shallow pen; Retro II?
NLON Ref	sta3	b	0	0	0	21.95	1.19	1.89	1.54	NA	0	PHYSICAL	NO	ambient; underpen; shell lag; sm surf tube
NLON Ref	sta3	c	0	0	0	NA	0.68	4.00	2.70	7	0	PHYSICAL	NO	ambient; dead eel grass blade; Retro II?
NLON Ref	sta3	d	0	0	0	28.42	1.06	3.28	2.03	6	0	PHYSICAL	NO	ambient; br sand; eel grass on surf; Retro II; ripped-up Ampelisca tubemat
NLON Ref	sta3	e	0	0	0	33.60	1.21	4.04	2.53	8	0	PHYSICAL	NO	ambient; br sand; Ampelisca? tubemat; sm feeding voids;rippled?
NLON Ref	sta4	a	0	0	0	0.00	0.68	9.54	2.50	9	0	BIOGENIC	NO	ambient; sm.tube mat of juvenil amphipods
NLON Ref	sta4	b	0	0	0	14.91	0.68	1.40	1.04	4	0	PHYSICAL	NO	ambient;S/M; sm tubes on surf(juv. amphipods?)
NLON Ref	sta4	c	0	0	0	NA	0.34	4.00	1.90	5	0	PHYSICAL	NO	ambient; S/M; Chaetoterus; erosional?
NE-Ref	sta5	a	0	0	0	39.94	0.69	5.35	2.86	6	0	INDET	NO	ambient; mottled RPD-wiper artifacts?;sm surf tubes(amphipods?);worm 7 cm depth
NE-Ref	sta5	c	0	0	0	13.72	0.48	1.69	0.95	5	0	PHYSICAL	NO	ambient; ripped-up amphipod tube mats on surf; Retro II?
NE-Ref	sta5	d	0	0	0	28.20	0.86	2.98	1.96	8	0	BIOGENIC	NO	ambient; br sand; feeding void w/worm; Amphipod tubes on surf
NE-Ref	sta6	a	0	0	0	38.25	1.26	5.12	2.90	7	0	PHYSICAL	NO	ambient;S/M; lg worm(6cm- >pen.limit); RetroII?
NE-Ref	sta6	b	0	0	0	NA	NA	NA	NA	NA	0	PHYSICAL	NO	ambient; surf scour; ripped-up Ampelisca tube mat; Retro II
NE-Ref	sta6	d	3.13	7.22	5.18	27.80	1.41	2.58	1.95	6	0	INDET	NO	ambient; br sand/bkM; drag-down; amphipod tubes on; minor shell lag
NE-Ref	sta7	a	0	0	0	34.74	1.24	4.03	2.46	7	0	PHYSICAL	NO	ambient;S/M; Chaetopterus tube&ripped-up amphipod tube mat
NE-Ref	sta7	b	0	0	0	NA	1.50	5.50	2.00	4	0	PHYSICAL	NO	ambient; wiper artifacts; Amphipods present?; borrow
NE-Ref	sta7	c	0	0	0	46.49	1.59	4.83	3.32	7	0	PHYSICAL	NO	ambient; RPD patchy; surf scour; Retro II?
NE-Ref	sta8	b	0	0	0	47.67	2.17	4.54	3.54	7	0	PHYSICAL	NO	ambient;S/M;sm surf tubes(juv amphipods?); minor surf scour
NE-Ref	sta8	c	0	0	0	44.76	2.04	5.37	3.18	7	0	PHYSICAL	NO	ambient; wiper artifacts; Ampelisaca tubes;RetroII?
NE-Ref	sta8	d	3.48	6.62	5.05	17.54	0.86	1.77	1.22	5	0	INDET	NO	ambient; br sand/bkM; amphipod tubemats; worm at 8cm
NE-Ref	sta9	a	0	0	0	34.63	0.75	4.13	2.46	9	0	PHYSICAL	NO	ambient;S/M;minor shell lag; surf scour;feeding void
NE-Ref	sta9	b	0	0	0	29.60	0.74	4.11	2.08	8	0	PHYSICAL	NO	ambient; S/M; mudclast on surf
NE-Ref	sta9	c	0	0	0	23.98	0.60	3.03	1.68	8	0	PHYSICAL	NO	ambient; burrow/feeding deposit; feeding voids?
West-Ref	w10	a	0	0	0	44.62	2.28	4.08	3.20	8	0	PHYSICAL	NO	ambient; shell lag and frg at surf;ripped-up Ampelisca tube mat
West-Ref	w10	c	0	0	0	30.60	1.65	2.91	2.16	6	0	PHYSICAL	NO	ambient; shell-rich sand; tube mat
West-Ref	w10	d	0	0	0	27.14	1.34	2.67	1.90	4	0	PHYSICAL	NO	shallow pen; ambient;S/M; shell lag; sm surf tubes
West-Ref	w11	a	0	0	0	65.45	3.09	7.21	4.70	10	0	PHYSICAL	NO	ambient?; wiper artifacts; feeding void at depth; ripped-up tube mat
West-Ref	w11	b	0	0	0	43.96	1.41	7.62	3.13	10	0	PHYSICAL	NO	ambient; ripped-up Ampelisca tube mat; feeding voids
West-Ref	w11	c	0	0	0	36.63	1.62	3.97	2.61	NA	0	PHYSICAL	NO	ambient; wiper smearing?; Ampelisca tube mat?
West-Ref	w12	b	0	0	0	NA	NA	NA	NA	NA	0	PHYSICAL	NO	ambient; shell lag; shell-rich sand w/scourlag; RPD faint
West-Ref	w12	c	0	0	0	30.93	1.65	2.62	2.18	6	0	PHYSICAL	NO	ambient; shell lag; ripped-up Ampelisca tube mat
West-Ref	w12	d	0	0	0	28.32	0.84	3.12	2.01	6	0	PHYSICAL	NO	ambient; S; shell lag; ripped-up tube mats; Retro II?
West-Ref	w13	a	0	0	0	NA	0.00	4.00	1.50	5	0	PHYSICAL	NO	ambient; shell-rich sand;surf scour; sparse Ampelisca
West-Ref	w13	b	0	0	0	34.04	0.78	5.83	2.43	7	0	PHYSICAL	NO	ambient;shell lag; ripped-up Amp.tubemat; RPD faint/patchy
West-Ref	w13	c	0	0	0	13.66	0.05	2.50	1.31	4	0	PHYSICAL	NO	ambient; partially low oxygen; patchy RPD; shell lag&sm.tube; retro II

B2a
1998 Seawolf Disposal Mound
Results

Mound/ Ref. Area	Station	Rep.	Date	TIME	ANALYST	LATITUDE	LONGITUDE	Successional Stage	Grain Size (phi)		Major	Mudclasts		Camera Penetration				Dredged Material Thickness			
									Minimum	Maximum	Mode	Count	Diameter	Minimum	Maximum	Range	Mean	Area	Minimum	Maximum	Mean
Seawolf	CTR	A	07/30/98	15:29	MCS	41 16.458N	072 04.882W	ST_I_ON_III	>4	2	>4	0	0	16.18	16.18	0	16.18	220.14	7.89	16.33	15.67
Seawolf	CTR	D	08/01/98	9:53	HLS	41 16.460N	072 04.856W	ST_I	>4	3	>4	0	0	14.02	14.48	0.46	14.25	197.47	13.76	14.59	14.15
Seawolf	CTR	E	08/01/98	9:54	HLS	41 16.454N	072 04.854W	ST_II	>4	3	>4	0	0	15.41	16.24	0.82	15.82	220.12	15.41	16.08	15.64
Seawolf	75N	A	07/30/98	16:24	HLS	41 16.492N	072 04.860W	ST_II	>4	3	>4	0	0	13.78	14.35	0.57	14.07	196.48	13.78	14.56	14.14
Seawolf	75N	B	07/30/98	16:25	HLS	41 16.490N	072 04.854W	ST_I	>4	4	4 to 3	0	0	10.16	12.8	2.64	11.48	152.82	10.16	12.28	10.92
Seawolf	75N	C	07/30/98	16:26	HLS	41 16.491N	072 04.856W	ST_I	>4	3	>4	0	0	12.54	13.32	0.78	12.93	178.85	12.49	13.21	12.81
Seawolf	75NE	C	07/30/98	15:36	MCS	41 16.491N	072 04.825W	ST_III	>4	3	>4	0	0	15.28	15.78	0.5	15.53	213.39	11.46	15.73	15.32
Seawolf	75NE	E	08/01/98	10:00	HLS	41 16.475N	072 04.817W	ST_I_ON_III	>4	4	>4	0	0	14.23	14.54	0.31	14.38	201.25	14.18	14.59	14.43
Seawolf	75NE	F	08/01/98	10:04	HLS	41 16.483N	072 04.827W	ST_I	>4	3	>4	0	0	14.95	16.13	1.19	15.54	217.52	14.85	16.08	15.45
Seawolf	75E	A	07/31/98	17:01	HLS	41 16.455N	072 04.819W	INDET	>4	3	>4	0	0	14.27	14.79	0.52	14.53	202.62	14.2	14.8	14.5
Seawolf	75E	B	07/31/98	17:02	HLS	41 16.466N	072 04.818W	ST_II_ON_III	>4	3	>4	0	0	13.54	14.85	1.31	14.19	195.82	13.43	14.8	13.93
Seawolf	75E	C	07/31/98	17:02	HLS	41 16.446N	072 04.823W	ST_II_ON_III	>4	3	>4	0	0	15.49	16.15	0.67	15.82	216.77	15.33	16.05	15.48
Seawolf	75SE	A	07/31/98	16:47	HLS	41 16.426N	072 04.837W	ST_I_ON_III	>4	3	>4	0	0	14.46	15.08	0.62	14.77	205.79	14.61	14.97	14.74
Seawolf	75SE	B	07/31/98	16:48	HLS	41 16.429N	072 04.836W	ST_I_ON_III	>4	3	>4	0	0	12.18	12.8	0.62	12.49	174.72	12.18	13.06	12.39
Seawolf	75SE	C	07/31/98	16:48	HLS	41 16.432N	072 04.823W	ST_I_TO_II	>4	4	>4	0	0	13.06	13.83	0.78	13.45	185.77	13.01	13.89	13.24
Seawolf	75S	A	07/30/98	16:31	HLS	41 16.416N	072 04.870W	ST_II	>4	3	4 to 3	0	0	13.47	14.15	0.67	13.81	194.24	13.42	14.35	13.85
Seawolf	75S	B	07/30/98	16:32	HLS	41 16.415N	072 04.875W	ST_II	>4	3	4 to 3	0	0	12.31	15.44	3.13	13.87	197.4	12.15	15.33	14.17
Seawolf	75S	C	07/30/98	16:33	HLS	41 16.416N	072 04.875W	ST_I	>4	3	4 to 3	0	0	14.97	16	1.03	15.49	216.3	15.49	16.1	15.63
Seawolf	75WSW	A	07/30/98	15:21	MCS	41 16.440N	072 04.898W	ST_I_ON_III	>4	3	>4	0	0	12.01	13.92	1.91	12.96	180.43	12.36	13.92	12.98
Seawolf	75WSW	C	07/30/98	15:23	MCS	41 16.446N	072 04.906W	ST_I	>4	3	>4	0	0	12.41	12.86	0.45	12.64	173.56	10.1	13.47	12.51
Seawolf	75W	A	07/30/98	15:24	MCS	41 16.453N	072 04.910W	ST_I	>4	3	- 4	0	0	14.37	15.08	0.7	14.72	203.19	14.42	14.97	14.57
Seawolf	75W	D	08/01/98	9:49	HLS	41 16.453N	072 04.909W	ST_I_TO_II	>4	2	>4	0	0	13.95	14.62	0.67	14.28	200.82	14.05	14.87	14.4
Seawolf	75W	F	08/01/98	9:51	HLS	41 16.448N	072 04.912W	ST_II	>4	3	>4	0	0	14.79	15.93	1.13	15.36	212.28	14.28	15.98	15.15
Seawolf	75NW	A	07/31/98	16:42	HLS	41 16.479N	072 04.908W	ST_I_ON_III	>4	3	>4	0	0	12.23	13.21	0.98	12.72	178.96	12.33	13.26	12.76
Seawolf	75NW	B	07/31/98	16:43	HLS	41 16.477N	072 04.907W	ST_I_ON_III	>4	3	4 to 3	0	0	7.72	11.97	4.25	9.84	141.51	7.67	12.18	10.14
Seawolf	75NW	C	07/31/98	16:43	HLS	41 16.482N	072 04.902W	ST_I	>4	3	>4	0	0	13.94	14.4	0.47	14.17	195.33	13.89	14.35	13.93
Seawolf	150N	A	07/30/98	16:17	HLS	41 16.542N	072 04.861W	ST_I	>4	4	>4	0	0	11.5	14.4	2.9	12.95	180.49	11.4	14.3	13.03
Seawolf	150N	B	07/30/98	16:18	HLS	41 16.545N	072 04.863W	AZOIC	>4	2	3 to 2	0	0	11.61	13.94	2.33	12.77	180.49	11.4	14.3	13.03
Seawolf	150N	C	07/30/98	16:19	HLS	41 16.535N	072 04.874W	ST_I	>4	4	>4	0	0	13.26	14.25	0.98	13.76	191.2	13.16	14.4	13.76
Seawolf	150NE	A	07/30/98	15:48	MCS	41 16.513N	072 04.792W	ST_I	>4	3	>4	0	0	12.81	13.82	1.01	13.32	188.34	5.08	13.72	13.46
Seawolf	150NE	D	08/01/98	10:08	HLS	41 16.511N	072 04.767W	ST_III	>4	3	>4	0	0	8.45	9.69	1.24	9.07	126.23	8.56	9.54	9.07
Seawolf	150NE	E	08/01/98	10:09	HLS	41 16.509N	072 04.772W	ST_II_ON_III	>4	3	>4	0	0	13.3	14.38	1.08	13.84	191.09	12.89	14.23	13.63
Seawolf	150E	A	07/31/98	16:56	HLS	41 16.461N	072 04.761W	ST_I	>4	3	>4	0	0	17.66	18.65	0.99	18.15	248.09	17.5	18.65	17.95
Seawolf	150E	B	07/31/98	16:57	HLS	41 16.452N	072 04.775W	ST_II_TO_III	>4	3	>4	0	0	14.58	15.36	0.78	14.97	205.79	14.53	15.26	14.77
Seawolf	150E	C	07/31/98	16:58	HLS	41 16.465N	072 04.761W	ST_I	>4	4	>4	0	0	13.91	14.53	0.63	14.22	196.22	13.85	14.69	14.05
Seawolf	150SE	A	07/31/98	16:51	HLS	41 16.399N	072 04.793W	ST_I_TO_II	>4	3	>4	0	0	12.8	13.73	0.93	13.26	185.05	12.95	13.73	13.25
Seawolf	150SE	B	07/31/98	16:51	HLS	41 16.399N	072 04.798W	ST_I_ON_III	>4	3	>4	0	0	11.92	13.06	1.14	12.49	171.88	9.9	13.21	12.23
Seawolf	150SE	C	07/31/98	16:52	HLS	41 16.396N	072 04.790W	ST_I	>4	3	>4	0	0	12.97	13.59	0.63	13.28	183.76	13.18	13.75	13.34
Seawolf	150S	A	07/30/98	16:37	HLS	41 16.377N	072 04.845W	ST_II_ON_III	>4	3	>4	0	0	14.26	14.87	0.62	14.56	202.42	14.26	15.18	14.45
Seawolf	150S	C	07/30/98	16:38	HLS	41 16.373N	072 04.868W	ST_II_ON_III	>4	3	>4	0	0	13.85	14.31	0.46	14.08	198.66	14	14.77	14.18
Seawolf	150S	E	08/01/98	9:41	HLS	41 16.361N	072 04.858W	ST_II	>4	2	3 to 2	0	0	11.38	12.51	1.13	11.95	157.75	10.92	12.36	11.3
Seawolf	150WSW	A	07/30/98	15:16	MCS	41 16.409N	072 04.955W	ST_I_ON_III	>4	3	>4	0	0	14.05	14.97	0.92	14.51	202.1	4.41	14.82	13.97
Seawolf	150WSW	B	07/30/98	15:17	MCS	41 16.410N	072 04.955W	ST_I_ON_III	>4	3	>4	0	0	14.26	14.56	0.31	14.41	198.31	9.64	14.62	14.31
Seawolf	150WSW	C	07/30/98	15:18	MCS	41 16.412N	072 04.953W	ST_I_ON_III	>4	3	>4	0	0	14	14.41	0.41	14.21	197.62	14	14.51	14.31
Seawolf	150W	A	07/31/98	17:06	HLS	41 16.456N	072 04.971W	ST_I_ON_III	>4	3	>4	0	0	14.14	15.15	1.01	14.65	202.84	14.04	15.3	14.5
Seawolf	150W	B	07/31/98	17:07	HLS	41 16.454N	072 04.973W	ST_I	>4	3	>4	0	0	13.64	14.09	0.45	13.86	191.18	13.43	14.04	13.61
Seawolf	150W	C	07/31/98	17:08	HLS	41 16.454N	072 04.978W	ST_I_ON_III	>4	4	>4	0	0	14.6	15.2	0.61	14.9	205.14	14.44	15.05	14.67
Seawolf	150NW	A	07/31/98	16:37	HLS	41 16.516N	072 04.944W	INDET	>4	4	>4	0	0	13.45	13.71	0.26	13.58	183.23	13.04	13.71	13.25
Seawolf	150NW	B	07/31/98	16:37	HLS	41 16.522N	072 04.941W	ST_I	>4	3	>4	0	0	13.76	15.15	1.39	14.46	200.68	13.71	15.31	14.42
Seawolf	150NW	C	07/31/98	16:38	HLS	41 16.524N	072 04.940W	ST_I	>4	3	>4	0	0	15.26	15.77	0.52	15.52	219.15	15.41	16.08	15.72

Mound/ Ref. Area	Station	Rep.	Date	TIME	ANALYST	LATITUDE	LONGITUDE	Successional Stage	Grain Size (phi)		Major	Mudclasts		Camera Penetration				Dredged Material Thickness			
									Minimum	Maximum	Mode	Count	Diameter	Minimum	Maximum	Range	Mean	Area	Minimum	Maximum	Mean
Seawolf	300N	B	07/30/98	16:13	HLS	41 16.617N	072 04.864W	ST_I_ON_III	>4	4	>4	0	0	14.66	16.53	1.87	15.6	210.87	14.61	16.48	15.17
Seawolf	300N	E	08/01/98	10:22	HLS	41 16.604N	072 04.853W	ST_I_ON_III	>4	4	>4	0	0	15.36	16.08	0.72	15.72	217.06	14.69	15.93	15.42
Seawolf	300N	F	08/01/98	10:22	HLS	41 16.609N	072 04.857W	ST_I	>4	3	>4	0	0	14.23	15	0.77	14.61	204.62	14.18	15.05	14.6
Seawolf	300NE	A	07/30/98	15:53	HLS	41 16.566N	072 04.715W	ST_II_ON_III	>4	4	>4	0	0	13.42	15.75	2.33	14.59	202.97	13.63	15.7	14.26
Seawolf	300NE	B	07/30/98	15:54	HLS	41 16.567N	072 04.720W	ST_II_ON_III	>4	4	>4	0	0	15.44	16.01	0.57	15.73	224.45	15.49	16.06	15.72
Seawolf	300NE	C	07/30/98	15:55	HLS	41 16.572N	072 04.717W	ST_I_TO_II	>4	4	>4	0	0	15.6	18.29	2.69	16.94	238.31	15.65	18.24	16.61
Seawolf	300E	A	07/31/98	17:22	HLS	41 16.459N	072 04.678W	ST_I_TO_II	>4	3	4 to 3	0	0	13.89	16.26	2.37	15.08	209.34	14.14	16.11	14.91
Seawolf	300E	B	07/31/98	17:23	HLS	41 16.450N	072 04.655W	ST_II	>4	3	4 to 3	0	0	5.4	7.37	1.97	6.39	90.48	5.3	7.37	6.46
Seawolf	300E	C	07/31/98	17:24	HLS	41 16.459N	072 04.663W	ST_II_ON_III	>4	3	4 to 3	1	5.4	12.98	14.44	1.46	13.71	186.83	12.63	14.29	13.48
Seawolf	300SE	A	07/30/98	16:50	HLS	41 16.336N	072 04.728W	ST_II	>4	3	4 to 3	0	0	9.38	10.57	1.19	9.97	142.43	9.18	10.77	10.25
Seawolf	300SE	B	07/30/98	16:51	HLS	41 16.338N	072 04.730W	INDET	>4	3	4 to 3	0	0	12.73	13.66	0.93	13.2	178.03	12.58	13.61	12.81
Seawolf	300SE	C	07/30/98	16:52	HLS	41 16.339N	072 04.710W	ST_I	>4	3	>4	0	0	6.49	6.91	0.41	6.7	92.83	6.34	7.06	6.66
Seawolf	300S	A	07/30/98	16:44	MCS	41 16.297N	072 04.867W	ST_II	>4	3	3 to 2	0	0	7.64	9.9	2.26	8.77	110.96	7.23	9.74	7.94
Seawolf	300S	B	07/30/98	16:44	MCS	41 16.296N	072 04.869W	ST_I	>4	3	4 to 3	0	0	7.69	10.15	2.46	8.92	116.61	7.79	10.1	8.41
Seawolf	300S	C	07/30/98	16:45	HLS	41 16.296N	072 04.867W	ST_I_TO_II	>4	3	4 to 3	0	0	7.95	8.62	0.67	8.28	114.37	7.9	8.67	8.28
Seawolf	300WSW	B	07/30/98	15:12	MCS	41 16.372N	072 05.047W	ST_I	>4	3	>4	0	0	14.36	14.92	0.56	14.64	199.55	7.33	14.87	14.37
Seawolf	300WSW	C	07/30/98	15:13	MCS	41 16.374N	072 05.051W	ST_I	>4	3	>4	1	0.68	12.77	14.05	1.28	13.41	188.14	6.51	13.95	13.48
Seawolf	300WSW	E	08/01/98	9:37	HLS	41 16.369N	072 05.017W	ST_II_ON_III	>4	3	4 to 3	0	0	14.77	16.26	1.49	15.51	148.8	14.8	16.3	15.5
Seawolf	300W	A	07/31/98	17:11	HLS	41 16.458N	072 05.086W	ST_I_TO_II	>4	3	>4	0	0	7.12	8.28	1.16	7.7	104.54	6.82	8.18	7.52
Seawolf	300W	B	07/31/98	17:12	HLS	41 16.458N	072 05.090W	ST_I_TO_II	>4	3	4 to 3	0	0	5.76	7.53	1.77	6.64	87.7	5.66	7.47	6.24
Seawolf	300W	C	07/31/98	17:13	HLS	41 16.459N	072 05.096W	ST_I_TO_II	>4	3	4 to 3	0	0	10.15	11.87	1.72	11.01	152.43	10.15	11.77	10.88
Seawolf	300NW	A	07/31/98	16:31	HLS	41 16.572N	072 05.029W	ST_I_ON_III	>4	3	>4	0	0	14.33	15.67	1.34	15	206.59	14.18	15.77	14.84
Seawolf	300NW	B	07/31/98	16:32	HLS	41 16.568N	072 05.029W	ST_III	>4	3	>4	0	0	12.99	14.9	1.91	13.94	198.7	10.05	15.21	14.08
Seawolf	300NW	C	07/31/98	16:32	HLS	41 16.568N	072 05.019W	ST_I_TO_II	>4	3	>4	0	0	12.99	13.76	0.77	13.38	186.77	13.2	14.07	13.38
Seawolf	450N	A	07/30/98	16:04	HLS	41 16.701N	072 04.862W	ST_II_ON_III	>4	3	4 to 3	0	0	12.89	13.5	0.61	13.2	182.33	12.84	13.3	13.09
Seawolf	450N	B	07/30/98	16:05	HLS	41 16.699N	072 04.867W	ST_II	>4	3	>4	0	0	5.94	8.07	2.13	7.01	92.73	5.89	7.92	6.72
Seawolf	450N	C	07/30/98	16:05	HLS	41 16.701N	072 04.874W	ST_I	>4	3	>4	0	0	8.53	9.19	0.66	8.86	123.6	8.48	9.14	8.86
Seawolf	450NE	B	07/30/98	15:58	HLS	41 16.625N	072 04.653W	ST_II	>4	3	4 to 3	0	0	10.76	11.68	0.91	11.22	156.69	11.07	11.47	11.29
Seawolf	450NE	D	08/01/98	10:27	HLS	41 16.633N	072 04.632W	ST_II	>4	3	4 to 3	0	0	13.2	14.85	1.65	14.02	0	0	0	0
Seawolf	450NE	F	08/01/98	10:28	HLS	41 16.626N	072 04.624W	ST_II_ON_III	>4	3	4 to 3	0	0	10.41	11.08	0.67	10.74	0	0	0	0
Seawolf	450WSW	A	07/30/98	15:06	MCS	41 16.334N	072 05.155W	ST_I	>4	3	>4	0	0	16.1	16.77	0.67	16.44	227.94	16.05	16.97	16.39
Seawolf	450WSW	B	07/30/98	15:07	MCS	41 16.343N	072 05.146W	ST_II_ON_III	>4	3	4 to 3	0	0	17.13	17.74	0.62	17.44	247.52	17.18	17.69	17.17
Seawolf	450WSW	C	07/30/98	15:08	MCS	41 16.344N	072 05.138W	ST_I_ON_III	>4	3	>4	0	0	13.33	14.62	1.28	13.97	189.29	6.82	14.67	13.57
Seawolf	450NW	A	07/31/98	16:25	HLS	41 16.637N	072 05.094W	ST_I_TO_II	>4	3	4 to 3	0	0	9.33	10.82	1.49	10.08	142.27	9.64	10.67	10.14
Seawolf	450NW	B	07/31/98	16:26	HLS	41 16.630N	072 05.105W	ST_II_ON_III	>4	3	4 to 3	0	0	9.38	11.29	1.91	10.34	148.92	9.59	11.24	10.66
Seawolf	450NW	C	07/31/98	16:27	HLS	41 16.629N	072 05.108W	ST_I	>4	3	4 to 3	0	0	4.95	5.88	0.93	5.41	74.54	4.85	6.19	5.36

Mound/ Ref. Area	Station	Rep.	Redox Rebound			Apparent RPD Thickness				OSI	Methane Count	Surface Disturbance	Additional Measurements	(cm)	Low DO	Comments
			Min.	Max.	Mean	Area	Minimum	Maximum	Mean							
Seawolf	CTR	A	0	0	0	18.244	0.65	2.81	1.66	8	0	PHYSICAL	NOADDM	0	NO	DM>P, PATCH OF SULFIDIC,GR CLAY, S/MUD, WELL SORTED, VOIDS, BURROW, ORG DETRIUS, SHELL FRAGS @ SURF, SCOURLAG
Seawolf	CTR	D	8.25	10.72	9.48	NA	NA	NA	NA	NA	0	INDET	NOADDM	0	NO	DM>PEN, DM LAYERS,3CM SULFIDIC LAYER@ SURF,BK/GR CLAY, SCOUR?
Seawolf	CTR	E	0	0	0	12.151	0.21	1.96	0.82	5	0	PHYSICAL	NOADDM	0	NO	DM>PEN, THIN RPD,SULFIDIC SED., CHAOTIC FABRIC, RETRO II?, HYDRROIDS
Seawolf	75N	A	0	0	0	19.976	0.67	2.07	1.37	5	0	INDET	NOADDM	0	NO	DM>PEN,GR CLAY, S/MUD,AMPELISCA TUBES, HYDROIDS, SHELLS AND FRAGS,DRAG-DOWN
Seawolf	75N	B	0	0	0	NA	NA	NA	NA	NA	0	PHYSICAL	NOADDM	0	NO	DM>PEN, S/MUD,POOR SORTING, LG BURROW, HYDROIDS, SHELL ARMORING
Seawolf	75N	C	0	0	0	16 812	0.47	1.97	1.15	3	0	BIOGENIC	NOADDM	0	NO	DM>PEN,GR CLAY, WELL SORTED, ROCKS W/HYDROIDS, SHEL FRAG@SURF
Seawolf	75NE	C	0	0	0	7.235	0.05	2.56	0.6	6	0	PHYSICAL	NOADDM	0	NO	DM>PEN,GR CLAY, S/MUD,WELL SORTED, VOIDS, SHELL FRAGS @ SURF
Seawolf	75NE	E	0	0	0	15.432	0.67	1.6	1.05	7	0	INDET	NOADDM	0	NO	DM>PEN,LAYERING, GR CLAY, GR CLAY, WELL SORTED, VOIDS,CHAETOPTERUS
Seawolf	75NE	F	0	0	0	28.638	1.29	4.18	1.99	4	0	PHYSICAL	NOADDM	0	NO	DM>PEN, S/GR CLAY, S/GR CLAY, SHELL FRAG, SURF SCOUR, DRAG-DOWN, CLAM?&SHELL@SURF
Seawolf	75E	A	0	0	0	26.119	1.33	2.82	1.82	NA	0	BIOGENIC	NOADDM	0	NO	DM>PEN,GR CLAY, S/MUD, VOIDS, HYRDOIDS, DEAD YOLDIZ LIMATUL,
Seawolf	75E	B	0	0	0	24.907	0.96	3.03	1.74	8	0	INDET	NOADDM	0	NO	DM>PEN, PATCHY SULFIDIC,GR CLAY, S/MUD, POSS. WIPER SMEARS, FEEDING VOID
Seawolf	75E	C	0	0	0	19.112	0.56	1.9	1.32	7	0	BIOGENIC	NOADDM	0	NO	DM>PEN, MOTTLED SED, PATCHY SULFIDIC,GR CLAY, S/MUD, AMPELISCA TUBES, VOIDS
Seawolf	75SE	A	0	0	0	22.155	0.31	4.25	1.54	8	0	BIOGENIC	NOADDM	0	NO	DM>PEN, S/MUD, SM SURF TUBES, VOIDS
Seawolf	75SE	B	0	0	0	NA	0.26	2.5	2	8	0	BIOGENIC	DEPTH OF SAND	1.55	NO	DM>PEN,GR CLAY, S/MUD, WIPER SMEARS, TUBEMAT, VOIDS, HYDROIDS
Seawolf	75SE	C	0	0	0	11.406	0.36	1.3	0.77	4	0	PHYSICAL	NOADDM	0	NO	DM>PEN,GR CLAY, S/MUD, WELL-SORTED, VOIDS, EROSIONAL?
Seawolf	75S	A	0	0	0	NA	0.88	5.23	4.51	9	0	BIOGENIC	NOADDM	0	NO	DM>PEN,Partial GR CLAY, S/MUD, AMPELISCA TUBEMAT, SHELL FRAG@SURF
Seawolf	75S	B	0	0	0	19.119	0.36	2.36	1.35	5	0	BIOGENIC	NOADDM	0	NO	DM>PEN,Partial GR CLAY, S/MUD, WIPER CLASTS/SMEARS, TUBEMAT, BURROW,
Seawolf	75S	C	0	0	0	NA	0	5.2	4	7	0	BIOGENIC	DEPTH OF SAND	4.36	NO	DM>PEN,Partial GR CLAY, S/MUD
Seawolf	75WSW	A	0	0	0	NA	0.1	0.7	0.3	6	0	PHYSICAL	NOADDM	0	NO	DM>PEN,GR CLAY, S/MUD, WELL SORTED, VOIDS, BURROW, ORG FLOC, ARMORING(PEBBLES, SHELL), RPD?
Seawolf	75WSW	C	0	0	0	NA	NA	NA	NA	NA	0	PHYSICAL	NOADDM	0	NO	DM>PEN,GR CLAY,MASSIVE BURROW,CHAETOPTERUS W/ HYDROIDS?
Seawolf	75W	A	0	0	0	13.733	0.1	2.81	0.97	3	0	PHYSICAL	NOADDM	0	NO	DM>PEN, LAYERED DM,GR CLAY, S/MUD, WELL SORTED,VOIDS?, SHELL FRAGS @ SURF, SCOURLAG
Seawolf	75W	D	0	0	0	32.754	1.49	3.79	2.29	6	0	PHYSICAL	NOADDM	0	NO	DM>PEN,S/GR CLAY, SM TUBES, SURF SCOUR
Seawolf	75W	F	0	0	0	24.598	0.93	2.89	1.73	6	0	BIOGENIC	NOADDM	0	NO	DM>PEN, PATCHY SULFIDIC,S/GR CLAY, S/MUD, AMPELISCA TUBES?, VOIDS?, BURROW,SURF SCOUR
Seawolf	75NW	A	0	0	0	17.436	0.47	2.59	1.21	7	0	PHYSICAL	NOADDM	0	NO	DM>PEN, PATCHY SULFIDIC,GR CLAY, S/MUD, VOIDS, BURROWS, HYDROIDS, SHELLS&FRAGS@SURF(ARMORED), SCOURLAG
Seawolf	75NW	B	0	0	0	NA	NA	NA	NA	NA	0	PHYSICAL	NOADDM	0	NO	DM>PEN, S/MUD, MOD SORTING, VOIDS, BURROW, SHELL FRAGS, SCOURLAG
Seawolf	75NW	C	0	0	0	13.702	0.05	2.64	0.92	3	0	PHYSICAL	NOADDM	0	NO	DM>PEN,GR CLAY, S/MUD, WIPER SMEAR,SHELL@SURF, SCOURLAG
Seawolf	150N	A	0	0	0	NA	NA	NA	NA	NA	0	BIOGENIC	NOADDM	0	NO	DM>PEN,GR CLAY, WELL-SORTED, HYDROIDS, MYTILUS SHELLS@SURF
Seawolf	150N	B	0	0	0	NA	NA	NA	NA	NA	0	PHYSICAL	NOADDM	0	NO	DM>PEN, FRESH DM, POOR-SORTING, CHAOTIC FABRIC, DEWATERING PIPES
Seawolf	150N	C	0	0	0	24.334	0.52	3.78	1.76	4	0	PHYSICAL	NOADDM	0	NO	DM>PEN, PATCHY SULFIDIC,GR CLAY, WELL SORTED, SURF TUBES
Seawolf	150NE	A	0	0	0	7.235	0.05	2.56	0.6	2	0	PHYSICAL	NOADDM	0	NO	DM>P,GR CLAY, S/MUD, WELL SORTED,BURROWS, SHELL FRAGS @ SURF
Seawolf	150NE	D	0	0	0	11.581	0.05	1.13	0.77	7	0	PHYSICAL	NOADDM	0	NO	DM>PEN,GR CLAY,WELL SORTED,AMP TUBES?, VOIDS?, HYDROIDS, SHELLS@SURF, SCOURLAG
Seawolf	150NE	E	0	0	0	15.641	0.36	1.65	1.07	7	0	PHYSICAL	NOADDM	0	NO	DM>PEN,GR CLAY, WELL SORTED, TUBES?, VOIDS, SURFSCOUR
Seawolf	150E	A	0	0	0	22.911	0.68	3.44	1.6	4	0	BIOGENIC	NOADDM	0	NO	DM>PEN, DM LAYERING, PATCHY SULFIDIC,GR CLAY, MOD SORTED, POSS. VOID NEAR SURF
Seawolf	150E	B	0	0	0	20.27	0.42	4.79	1.4	6	0	BIOGENIC	NOADDM	0	NO	DM>PEN, PATCHY SULFIDIC,GR CLAY, WELL SORTED, RIPPED-UP TUBEMAT, POSS. VOID, BURROW
Seawolf	150E	C	0	0	0	8.66	0.26	1.15	0.58	2	0	INDET	NOADDM	0	NO	DM>PEN,GR CLAY, WELL SORTED,VOIDS?,SCOURED?, DRAG-DOWN,
Seawolf	150SE	A	0	0	0	23.271	0.62	3.47	1.62	5	0	PHYSICAL	DEPTH OF SAND	3.58	NO	DM>PEN, PATCHY SULFIDIC,GR CLAY, S/MUD, TUBEMAT(RETRO II), HYDROIDS, EROSIONAL
Seawolf	150SE	B	0	0	0	20.616	0.31	2.59	1.41	7	0	INDET	NOADDM	0	NO	DM>PEN, PATCHY SULFIDIC,GR CLAY, S/MUD, VOIDS, BURROWS, HYDROIDS, SHELLS@SURF, SCOURED?
Seawolf	150SE	C	0	0	0	19.403	0.47	2.19	1.36	3	0	PHYSICAL	NOADDM	0	NO	DM>PEN,GR CLAY, S/MUD, WELL-SORTED, TUBES @SURF, SCOURLAG
Seawolf	150S	A	0	0	0	NA	1.82	6	4	11	0	BIOGENIC	DEPTH OF SAND	1.85	NO	DM>PEN,Partial GR CLAY, S/MUD, AMEPLISCA TUBEMATS, VOIDS
Seawolf	150S	C	0	0	0	21.361	0.87	2.26	1.5	7	0	PHYSICAL	DEPTH OF SAND	1.59	NO	DM>PEN,GR CLAY, S/MUD, RIPPED-UP AMPELISCA TUBEMAT, VOIDS
Seawolf	150S	E	0	0	0	80.491	3.79	7.49	5.75	9	0	PHYSICAL	NOADDM	0	NO	DM>PEN,SAND, MOD SORTED, HYDROIDS, SHELL&SURF SCOUR
Seawolf	150WSW	A	0	0	0	NA	NA	NA	NA	NA	0	PHYSICAL	NOADDM	0	NO	DM>PEN,Partial GR CLAY, S/MUD, WELL SORTED, VOID
Seawolf	150WSW	B	0	0	0	10.155	0.05	3.54	0.7	6	0	PHYSICAL	NOADDM	0	NO	DM>PEN,GR CLAY, S/MUD, WELL SORTED,VOIDS
Seawolf	150WSW	C	0	0	0	6.432	0.1	2.15	0.69	6	0	PHYSICAL	NOADDM	0	NO	DM>PEN,GR CLAY, S/MUD, WIPER CLAST, WELL SORTED, VOIDS
Seawolf	150W	A	0	0	0	15.356	0.2	2.17	1.05	7	0	INDET	NOADDM	0	NO	DM>PEN,GR CLAY, S/MUD,SM SURF TUBES,FEEDING VOIDS
Seawolf	150W	B	0	0	0	12.936	0.35	1.62	0.88	3	0	BIOGENIC	NOADDM	0	NO	DM>PEN,GR CLAY, S/MUD, SM SURF TUBES,SM BURROW@SURF
Seawolf	150W	C	0	0	0	16.171	0.35	2.22	1.11	7	0	BIOGENIC	NOADDM	0	NO	DM>PEN,GR CLAY, S/MUD, WELL-SORTED, FEEDING VOIDS
Seawolf	150NW	A	0	0	0	11.597	0.41	1.13	0.78	NA	0	PHYSICAL	NOADDM	0	NO	DM>PEN,GR CLAY, S/MUD,SHELL OR ROCK @SURF, EROISIONAL
Seawolf	150NW	B	0	0	0	9.116	0.15	1.19	0.61	2	0	PHYSICAL	NOADDM	0	NO	DM>PEN,GR CLAY, RIPPED-UP AMPHIPOD TUBEMAT?,BURROW,EROSIONAL, DRAGDOWN
Seawolf	150NW	C	0	0	0	41.197	1.44	4.02	2.91	5	0	BIOGENIC	NOADDM	0	NO	DM>PEN,GR CLAY, S/MUD, RIPPED-UP TUBEMAT, RETRO II?, SHELL& FRAGS @SURF(ARMORED), DRAG-DOWN

Mound/ Ref. Area	Station	Rep.	Redox Rebound Min.	Max.	Mean	Apparent RPD Thickness Area	Minimum	Maximum	Mean	OSI	Methane Count	Surface Disturbance	Additional Measurements	(cm)	Low DO	Comments
Seawolf	300N	B	0	0	0	13.695	0.05	1.92	0.91	7	0	PHYSICAL	NOADDM	0	NO	DM>PEN, PATCHY SULFIDIC SED.,GR CLAY, MUD/WIPERCLAST, WELL SORTED, VOIDS,
Seawolf	300N	E	0	0	0	13.077	0.26	1.44	0.88	7	0	BIOGENIC	NOADDM	0	NO	DM>PEN, GR CLAY, SM SURF TUBES, VOIDS, BURROW,
Seawolf	300N	F	0	0	0	13.113	0.41	1.65	0.88	3	0	PHYSICAL	NOADDM	0	NO	DM>PEN, MOTTLED, PATCHY SULFIDIC,GR CLAY, WELL SORTED, RIPPED-UP TUBE MAT, HYRDOIDS, SURF SCOUR,
Seawolf	300NE	A	0	0	0	NA	NA	NA	NA	NA	0	PHYSICAL	NOADDM	0	NO	DM>PEN,GR CLAY, WELL SORTED VOIDS, SCOURLAG (SHELLS & ORG DETRIUS),
Seawolf	300NE	B	0	0	0	8.741	0.16	1.76	0.57	6	0	BIOGENIC	NOADDM	0	NO	DM>PEN,GR CLAY, WIPER CLASTS?, WELL SORTED, TUBEMAT, VOIDS, SHELL@SURF,
Seawolf	300NE	C	0	0	0	19.001	0.36	2.49	1.29	4	0	PHYSICAL	NOADDM	0	NO	DM>PEN, MULT DM LAYERS?,GR CLAY, WELL SORTED, RIPPED-UP TUBEMAT,
Seawolf	300E	A	4.8	10.56	7.68	22.531	0.76	2.68	1.58	5	0	INDET	NOADDM	0	NO	DM>PEN, SULFIDIC SED, S/MUD,RIPPED-UP TUBEMAT, HYDROIDS, SURF SCOUR,
Seawolf	300E	B	0	0	0	NA	3.5	4.5	4	9	0	BIOGENIC	NOADDM	0	NO	DM>PEN, SAND, TUBEMAT?, HYDROIDS, DEATERING PIPE
Seawolf	300E	C	0	0	0	35.906	1.26	3.69	2.62	9	0	BIOGENIC	NOADDM	0	NO	DM>PEN, SAND,LG CLAY CLAST ONSURF, FEEDING VOIDS,
Seawolf	300SE	A	0	0	0	NA	2.03	3.5	1.98	6	0	INDET	NOADDM	0	NO	DM>PEN, S/MUD, RIPPED-UP TUBEMAT,SHELL@SURF,SHELL FRAGS, GAMMARID BURROWS?,
Seawolf	300SE	B	0	0	0	24.661	0.98	3.3	1.73	NA	0	PHYSICAL	NOADDM	0	NO	DM>PEN, SULFIDIC SED, VOIDS, FLOC LAYER@SURF, WORMS,
Seawolf	300SE	C	0	0	0	31.892	0.72	4.43	2.25	4	0	PHYSICAL	NOADDM	0	NO	DM>PEN, TUBES?, HYDROIDS, SCOURLAG, PEBBLES@SURF
Seawolf	300S	A	0	0	0	NA	1.5	5	4	9	0	PHYSICAL	DEPTH OF SAND	5.54	NO	DM>PEN,S/SULFIDIC CLAY, S/MUD, POOR SORTING, RIPPED-UP AMPELISCA TUBEMAT, SHELL FRAG @SURF, PEBBLES, RIPPLED?
Seawolf	300S	B	0	0	0	NA	1.5	6.5	3	5	0	PHYSICAL	NOADDM	0	NO	DM>PEN,S/SULFIDIC CLAY, S/MUD, WIPER SMEARS, HYDROIDS,SHELL, SCOURLAG, PEBBLES, RPD EXTRAPOLATED
Seawolf	300S	C	0	0	0	NA	1.3	5	3.8	8	0	INDET	DEPTH OF SAND	4.21	NO	DM>PEN,S/SULFIDIC CLAY, S/MUD, AMPELISCA TUBES?, HYDROIDS,
Seawolf	300WSW	B	0	0	0	6.334	0.51	3.44	1.28	3	0	PHYSICAL	NOADDM	0	NO	DM>PEN,PATCH OF SULFIDIC SED,GR CLAY, S/MUD, WIPER CLAST, WELL SORTED, PODOCERID?,
Seawolf	300WSW	C	0	0	0	6.494	0.1	1.18	0.59	2	0	PHYSICAL	NOADDM	0	NO	DM>PEN, LAYERED DM,PATCH OF SULFIDIC SED,GR CLAY, S/MUD, WELL SORTED, SHELL @ SURF,
Seawolf	300WSW	E	0	0	0	60.295	3.54	4.82	4.3	11	0	PHYSICAL	NOADDM	0	NO	DM>PEN,DM/OLD DM, S/MUD, RIPPED-UP TUBE MAT, VOIDS?, BURROW, SHELL HASH THROUGHOUT,
Seawolf	300W	A	0	0	0	18.901	0.25	2.17	1.33	4	0	BIOGENIC	NOADDM	0	NO	DM>PEN, SULFIDIC SED, S/MUD, RIPPED-UP TUBE MAT, POSS. VOID,
Seawolf	300W	B	0	0	0	34.534	0.56	4.85	2.46	6	0	PHYSICAL	NOADDM	0	NO	DM>PEN, SULFIDIC SED, S/MUD, ASTURTE, SURF SCOUR
Seawolf	300W	C	5.2	7.12	6.16	18.958	0.4	2.27	1.32	4	0	BIOGENIC	NOADDM	0	NO	DM>PEN, SULFIDIC SED, S/MUD, RIPPED-UP TUBEMATS, RETROII, WORM@DEPTH,
Seawolf	300NW	A	0	0	0	24.554	0.72	3.25	1.71	8	0	PHYSICAL	NOADDM	0	NO	DM>PEN,GR CLAY, S/MUD, VOIDS, HYDROIDS, SHELL FRAGS, SCOURED?,
Seawolf	300NW	B	0	0	0	32.267	0.72	3.81	2.26	9	0	PHYSICAL	DEPTH OF SAND	4.39	NO	DM>PEN,GR CLAY, S/MUD, WIPER SMEAR, VOIDS, SHELL FRAGS, SCOURLAG, WORMS,
Seawolf	300NW	C	0	0	0	NA	NA	NA	NA	NA	0	PHYSICAL	NOADDM	0	NO	DM>PEN, FRESH DM, RETROGRADE RIPPED-UP AMELISCA MAT,HYDROIDS, SHELL SCOURLAG, CHAOTIC FABRIC, DEWATERING PIPE
Seawolf	450N	A	0	0	0	31.723	0.91	3.55	2.26	9	0	BIOGENIC	NOADDM	0	NO	DM>PEN, DM/OLD DM?, S/MUD, RIPPED-UP TUBEMAT, SM VOIDS, BURROW, HYDROIDS,
Seawolf	450N	B	2.84	6.04	4.44	20.138	0.36	2.34	1.42	5	0	PHYSICAL	NOADDM	0	NO	DM>PEN, DM/OLD DM?, WIPER SMEARS, AMPELISCA TUBES, HYDROIDS, SHELLS@SURF, SULFIDIC
Seawolf	450N	C	3.71	6.19	4.95	29.32	1.02	3.45	2.07	4	0	INDET	NOADDM	0	NO	DM>PEN, DM/OLD DM?, S/MUD, TUBEMAT, SHELLS@SURF, WORM,
Seawolf	450NE	B	0	0	0	46.338	1.93	4.72	3.31	8	0	BIOGENIC	NOADDM	0	NO	DM>PEN, DM/OLD DM?, S/MUD, TUBEMATS, HYDROIDS?,PODOCERIDS,
Seawolf	450NE	D	0	0	0	61.356	2.22	6.8	4.37	9	0	BIOGENIC	NOADDM	0	NO	AMB, S/MUD, RIPPED-UP TUBE MAT, SHELL HASH THROUGHOUT,
Seawolf	450NE	F	0	0	0	30.108	1.38	3.23	2.13	8	0	PHYSICAL	NOADDM	0	NO	AMB, S/MUD, TUBEMAT, VOIDS, HYDROIDS, SURFACE SCOUR, STRANDED TUBES,
Seawolf	450WSW	A	0	0	0	5.631	0.05	1.33	0.5	2	0	PHYSICAL	NOADDM	0	NO	DM>P, DISTINCT LAYERS OF DM, S/MUD, WELL SORTED, SURF SCOUR?, RPD?,
Seawolf	450WSW	B	0	0	0	7.97	0.15	4.15	1.45	7	0	PHYSICAL	NOADDM	0	NO	DM>PEN, DISTINCT LAYERS OF DM, S/MUD, MOD SORTED, RIPPED-UP TUBEMAT, VOID,
Seawolf	450WSW	C	0	0	0	NA	NA	NA	NA	NA	0	PHYSICAL	NOADDM	0	NO	DM>P,GR CLAY, S/MUD, WELL SORTED, VOID, OCCUPIED BURROW, CHAETOPETERUS, HYDROIDS, SCOURED?,
Seawolf	450NW	A	0	0	0	55.796	2.37	6.29	4.14	8	0	BIOGENIC	NOADDM	0	NO	DM>PEN,PATCHY SULFIDIC, RIPPED-UP TUBEMAT?, HYDROIDS, GAMMORIDS?, PODOCERIDS
Seawolf	450NW	B	0	0	0	30.927	0.36	5.1	2.17	8	0	PHYSICAL	NOADDM	0	NO	DM>PEN, RIPPED-UP AMPELISCA TUBES, VOIDS,
Seawolf	450NW	C	0	0	0	21.343	0.77	2.63	1.51	4	0	PHYSICAL	NOADDM	0	NO	DM>PEN, S/MUD, HYDROIDS, SHELL FRAGS, SCOURLAG, EROSIONAL,

B2b
1998 NLDS Reference Area Results

Mound/ Ref. Area	Station	Rep.	Date	TIME	ANALYST	LATITUDE	LONGITUDE	Successional Stage	Grain Size (phi)		Major	Mudclasts		Camera Penetration				Dredged Material Thickness				Redox Rebound			App
									Minimum	Maximum	Mode	Count	Diameter	Minimum	Maximum	Range	Mean	Area	Minimum	Maximum	Mean	Min.	Max.	Mean	Area
NLON Ref	NLRF01	A	07/30/98	11:03	MCS	41 16.658N	072 01.951W	ST_I	>4	3	4 to 3	0	0	5.73	6.08	0.35	5.9	0	0	0	0	0	0	0	47.548
NLON Ref	NLRF01	B	07/30/98	11:04	MCS	41 16.658N	072 01.951W	ST_I	>4	3	4 to 3	0	0	6.33	6.68	0.35	6.51	0	0	0	0	0	0	0	38.349
NLON Ref	NLRF01	C	07/30/98	11:04	MCS	41 16 658N	072 01.951W	ST_II	>4	3	4 to 3	0	0	5.53	6.08	0.55	5.8	0	0	0	0	0	0	0	46.984
NLON Ref	NLRF02	A	07/30/98	11:11	MCS	41 16.658N	072 01.951W	ST_II_ON_III	>4	3	4 to 3	0	0	7.39	8.49	1.11	7.94	0	0	0	0	0	0	0	31.615
NLON Ref	NLRF02	B	07/30/98	11:12	MCS	41 16.658N	072 01.951W	INDET	>4	3	>4	0	0	10.95	11.81	0.85	11.38	0	0	0	0	0	0	0	NA
NLON Ref	NLRF02	C	07/30/98	11:13	MCS	41 16.658N	072 01.951W	ST_II	>4	3	4 to 3	0	0	7.49	8.49	1.01	7.99	0	0	0	0	0	0	0	38.948
NLON Ref	NLRF03	A	07/30/98	11:22	MCS	41 16.663N	072 02.091W	ST_I_ON_III	>4	3	4 to 3	0	0	6.27	7.31	1.04	6.79	0	0	0	0	0	0	0	34.713
NLON Ref	NLRF03	B	07/30/98	11:23	MCS	41 16.657N	072 02.092W	ST_I	>4	3	4 to 3	0	0	3 28	4.73	1.44	4	0	0	0	0	0	0	0	27.284
NLON Ref	NLRF03	C	07/30/98	11:24	MCS	41 16 656N	072 02.096W	ST_I	>4	3	4 to 3	0	0	5.47	6.27	0.8	5.87	0	0	0	0	0	0	0	37.126
NLON Ref	NLRF04	A	07/30/98	11:17	MCS	41 16.658N	072 01.951W	ST_II	>4	3	4 to 3	0	0	5.88	6.23	0.35	6.06	0	0	0	0	0	0	0	33.172
NLON Ref	NLRF04	B	07/30/98	11:17	MCS	41 16.653N	072 01.947W	ST_I_TO_II	>4	3	4 to 3	0	0	7.06	7.61	0.55	7.34	0	0	0	0	0	0	0	12.026
NLON Ref	NLRF04	C	07/30/98	11:18	MCS	41 16.654N	072 01.946W	ST_II	>4	3	4 to 3	0	0	7.11	7.81	0.7	7.46	0	0	0	0	0	0	0	33.628
NE-Ref	NERF09	A	07/30/98	11:46	MCS	41 16.661N	072 03.331W	INDET	>4	2	4 to 3	0	0	6.42	7.11	0.7	6.77	0	0	0	0	0	0	0	24.048
NE-Ref	NERF09	B	07/30/98	11:47	MCS	41 16.658N	072 03.323W	ST_II	>4	2	4 to 3	0	0	8.21	8.51	0.3	8.36	0	0	0	0	0	0	0	22.271
NE-Ref	NERF09	C	07/30/98	11:47	MCS	41 16.654N	072 03.321W	ST_I_TO_II	>4	2	4 to 3	0	0	7.76	8.51	0.75	8.13	0	0	0	0	0	0	0	23 999
NE-Ref	NERF10	A	07/30/98	11:34	MCS	41 16.715N	072 03.325W	ST_II	>4	3	>4	0	0	8.16	8.71	0.55	8.43	0	0	0	0	0	0	0	20.599
NE-Ref	NERF10	D	08/01/98	8:14	MCS	41 16.719N	072 03.325W	ST_II	>4	3	>4	0	0	7.73	8.48	0.76	8.11	0	0	0	0	1.5	5.5	4.5	27.231
NE-Ref	NERF10	E	08/01/98	8:15	HLS	41 16.714N	072 03.316W	ST_II	>4	3	>4	0	0	8.64	9.09	0.45	8.86	0	0	0	0	0	0	0	NA
NE-Ref	NERF11	A	07/30/98	12:07	MCS	41 16.744N	072 03.557W	ST_I_TO_II	>4	2	4 to 3	0	0	7.06	8.16	1.09	7.61	0	0	0	0	0	0	0	37.324
NE-Ref	NERF11	B	07/30/98	12:08	MCS	41 16.741N	072 03.565W	ST_I_ON_III	>4	3	4 to 3	0	0	6.37	7.11	0.75	6.74	0	0	0	0	0	0	0	20.946
NE-Ref	NERF11	C	07/30/98	12:09	MCS	41 16.740N	072 03.571W	ST_I	>4	3	4 to 3	0	0	10.7	11.94	1.24	11.32	0	0	0	0	0	0	0	22.262
NE-Ref	NERF12	C	07/30/98	12:00	MCS	41 16.673N	072 03.390W	ST_II	>4	2	>4	0	0	6.47	8.21	1.74	7.34	0	0	0	0	0	0	0	20.992
NE-Ref	NERF12	D	08/01/98	8:18	HLS	41 16.681N	072 03.380W	ST_I_ON_III	>4	3	>4	0	0	7.27	7.42	0.15	7.35	0	0	0	0	2.5	4.75	3.5	23.433
NE-Ref	NERF12	E	08/01/98	8:19	HLS	41 16.676N	072 03.374W	ST_II_ON_III	>4	4	>4	0	0	6.97	7.83	0.86	7.4	0	0	0	0	0	0	0	21.168
NE-Ref	NERF13	A	07/30/98	11:39	MCS	41 16.679N	072 03.335W	ST_I	>4	3	4 to 3	0	0	5.37	6.52	1.14	5.95	0	0	0	0	0	0	0	24.725
NE-Ref	NERF13	B	07/30/98	11:39	MCS	41 16.678N	072 03.346W	INDET	>4	2	4 to 3	0	0	7.16	7.66	0.5	7.41	0	0	0	0	0	0	0	22.503
NE-Ref	NERF13	C	07/30/98	11:40	MCS	41 16 684N	072 03.344W	ST_II	>4	2	4 to 3	0	0	7.66	8.91	1.24	8.28	0	0	0	0	0	0	0	22.491
West-Ref	WREF05	B	07/30/98	14:42	MCS	41 16.249N	072 06.022W	ST_II_TO_III	>4	3	4 to 3	0	0	11.33	13.23	1.9	12.28	0	0	0	0	0	0	0	49.923
West-Ref	WREF05	C	07/30/98	14:43	MCS	41 16.253N	072 06.023W	ST_I_ON_III	>4	3	4 to 3	0	0	12.82	13.38	0.56	13.1	0	0	0	0	0	0	0	55.945
West-Ref	WREF05	E	08/01/98	9:27	HLS	41 16.240N	072 06.020W	ST_II	>4	3	4 to 3	0	0	9.18	10	0.82	9.59	0	0	0	0	0	0	0	39.725
West-Ref	WREF06	D	08/01/98	9:18	HLS	41 16.074N	072 05.890W	ST_II	>4	3	4 to 3	0	0	7.69	9.23	1.54	8.46	0	0	0	0	0	0	0	39.213
West-Ref	WREF06	E	08/01/98	9:20	HLS	41 16.067N	072 05.884W	ST_I_TO_II	>4	3	4 to 3	0	0	7.18	8.26	1.08	7.72	0	0	0	0	0	0	0	NA
West-Ref	WREF06	F	08/01/98	9:20	HLS	41 16.065N	072 05.897W	ST_II	>4	3	4 to 3	0	0	7.69	8.56	0.87	8.13	0	0	0	0	0	0	0	40.904
West-Ref	WREF07	A	07/30/98	14:34	MCS	41 16.210N	072 06.046W	INDET	>4	2	3 to 2	0	0	5.18	6	0.82	5.59	0	0	0	0	0	0	0	45.93
West-Ref	WREF07	B	07/30/98	14:35	MCS	41 16.209N	072 06.052W	INDET	>4	2	3 to 2	0	0	6.77	7.18	0.41	6.97	0	0	0	0	0	0	0	70.355
West-Ref	WREF07	C	07/30/98	14:38	MCS	41 16.207N	072 06.039W	INDET	>4	2	3 to 2	0	0	6.36	7.28	0.92	6.82	0	0	0	0	0	0	0	43.035
West-Ref	WREF08	B	07/30/98	14:50	MCS	41 16.270N	072 06.112W	ST_II	>4	2	3 to 2	0	0	8.87	10.31	1.44	9.59	0	0	0	0	0	0	0	40.342
West-Ref	WREF08	C	07/30/98	14:51	MCS	41 16.262N	072 06.090W	INDET	>4	3	4 to 3	0	0	6.46	8.41	1.95	7.44	0	0	0	0	0	0	0	29.79

Mound/ Ref. Area	Station	Rep.	arent RPD Thickness Minimum	Maximum	Mean	OSI	Methane Count	Surface Disturbance	Additional Measurements	(cm)	Low DO	Comments
NLON Ref	NLRF01	A	1.81	4.67	3.56	6	0	PHYSICAL	NOADDM	0	NO	,S>P, MOD SORTED, ORG DETRITUS @ SURF, SHELL, SCOURED?,
NLON Ref	NLRF01	B	0.85	3.92	2.82	5	0	BIOGENIC	NOADDM	0	NO	,S>P, MOD SORTED, TUBE MATS, ORG DETRITUS @ SURF,
NLON Ref	NLRF01	C	2.06	5.83	3.5	8	0	BIOGENIC	NOADDM	0	NO	,S/MUD, MOD SORTED, TUBE MATS, ORG DETRITUS @ SURF,
NLON Ref	NLRF02	A	0.85	3.52	2.31	9	0	BIOGENIC	NOADDM	0	NO	,S/MUD, MOD SORTED, TUBE MAT, POSS VOID, SHELL FRAG,
NLON Ref	NLRF02	B	NA	NA	NA	NA	0	INDET	NOADDM	0	NO	,S/MUD, RECENTLY DISTURBED DM?, MOD SORTED,
NLON Ref	NLRF02	C	1.76	4.32	2.81	7	0	BIOGENIC	NOADDM	0	NO	,S/MUD, MOD SORTED, AMPHIPOD MATS, ORG DETRITUS @ SURF,
NLON Ref	NLRF03	A	1.24	3.63	2.57	9	0	PHYSICAL	NOADDM	0	NO	,S/MUD, MOD SORTED, SCOURED, VOID, SHELL FRAGS @ DEPTH, BRICK?,
NLON Ref	NLRF03	B	0.6	3.43	2.18	4	0	PHYSICAL	NOADDM	0	NO	,S/MUD, MOD SORTED, BURROW OPENING, POSS VOID, SHELL FRAG @ SURF, SCOURED, RIPPLED,
NLON Ref	NLRF03	C	1.49	4.83	2.81	5	0	PHYSICAL	NOADDM	0	NO	,S/MUD, MOD SORTED, SHELL @ SURF, SHELL FRAGS @ Z, SCOURED?,
NLON Ref	NLRF04	A	1.46	4.52	2.42	7	0	PHYSICAL	NOADDM	0	NO	,S/MUD, MOD SORTED, RIPPED-UP TUBE MATS,
NLON Ref	NLRF04	B	0.4	3.68	2.46	6	0	BIOGENIC	NOADDM	0	NO	,S/MUD, WIPER CLAST, MOD SORTED, SCOURED?,
NLON Ref	NLRF04	C	0.15	4.18	2.61	7	0	BIOGENIC	NOADDM	0	NO	,S/MUD, MOD SORTED, DEAD EEL GRASS BLADE,
NE-Ref	NERF09	A	0.65	3.73	1.82	NA	0	PHYSICAL	NOADDM	0	NO	,S/MUD, WIPER CLASTS, MOD SORTED, HYDROIDS, SHELL FRAGS, RIPPLED?,
NE-Ref	NERF09	B	0.35	2.84	1.9	6	0	PHYSICAL	NOADDM	0	NO	,S/MUD, WIPER CLAST, MOD SORTED, RIPPED-UP TUBE MAT,
NE-Ref	NERF09	C	0.25	2.69	1.9	5	0	PHYSICAL	NOADDM	0	NO	,S/MUD, MOD SORTED, RIPPED-UP TUBE MAT,
NE-Ref	NERF10	A	0.9	2.29	1.52	6	0	BIOGENIC	NOADDM	0	NO	,S/MUD, MOD SORTED, AMPHIPOD TUBE MAT,
NE-Ref	NERF10	D	1.06	2.42	1.93	6	0	PHYSICAL	NOADDM	0	NO	AMB,BR S/BK MUD,SM AMPELISCA TUBES,SURF SCOUR,PODOCERID "STALKS",
NE-Ref	NERF10	E	0.71	3	2.1	6	0	PHYSICAL	NOADDM	0	NO	AMB, BR SILT/BK MUD, RETRO II, SURF SCOUR,
NE-Ref	NERF11	A	0.8	4.33	2.79	6	0	INDET	NOADDM	0	NO	,S/MUD, MOD SORTED, AMPHIPOD STALKS?, ORG DETRITUS, SCOURED?,
NE-Ref	NERF11	B	0.1	2.59	1.57	8	0	PHYSICAL	NOADDM	0	NO	,S/MUD, MOD SORTED, AMPHIPOD STALKS?, VOIDS, HYDROIDS,
NE-Ref	NERF11	C	0.85	2.34	1.68	4	0	BIOGENIC	NOADDM	0	NO	,S/MUD, MOD SORTED, HYDROIDS ON CHAETOPTERUS, FRACTURES AT DEPTH,
NE-Ref	NERF12	C	0.55	2.79	1.54	6	0	PHYSICAL	NOADDM	0	NO	,S/MUD, MOD SORTED, RIPPED-UP TUBEMAT, HYDROIDS, ORG FLOC,
NE-Ref	NERF12	D	0.97	2.21	1.64	8	0	INDET	NOADDM	0	NO	AMB, SULFIDIC SED, BR/BK MUD, SURF TUBES?,
NE-Ref	NERF12	E	1.01	2.27	1.48	7	0	PHYSICAL	NOADDM	0	NO	AMB, SULFIDIC SED, BR/BK MUD, WELL-SORTED, RIPPED-UP TUBEMAT, FEEDING VOIDS, HYDROIDS,
NE-Ref	NERF13	A	1.09	2.59	1.81	4	0	PHYSICAL	NOADDM	0	NO	,S/MUD, MOD SORTED, POSS BURROW, SHELL FRAG @ SURF, SCOURED,
NE-Ref	NERF13	B	0.3	2.44	1.65	NA	0	PHYSICAL	NOADDM	0	NO	,S/MUD, MOD SORTED, ORG DETRITUS, HYDROIDS, RIPPLED?,
NE-Ref	NERF13	C	0.65	3.68	1.68	6	0	PHYSICAL	NOADDM	0	NO	,S/MUD, MOD SORTED, RIPPLED, ORG DETRITUS, HYDROID, PODOCERID,
West-Ref	WREF05	B	1.69	5.85	3.73	10	0	BIOGENIC	NOADDM	0	NO	,S/MUD, POOR SORTED, VOID, ORG DETRIUS, HYDROID, SCOUR?, SHELL HASH @ Z
West-Ref	WREF05	C	2	7.64	4.52	11	0	PHYSICAL	NOADDM	0	NO	,S/MUD, WIPER CLASTS, POOR SORTED, ORG DETRITUS, SCOUR?, SHELL HASH @ Z
West-Ref	WREF05	E	1.95	3.74	2.8	7	0	BIOGENIC	NOADDM	0	NO	AMB, MOD SORTED, RIPPED-UP TUBEMAT, VOID, CERIANTURES@DEPTH, SHELL HASH THROUGHOUT
West-Ref	WREF06	D	1.54	4.1	2.8	7	0	PHYSICAL	NOADDM	0	NO	AMB, WELL SORTED, DENSE RIPPED-UP TUBEMAT, SCOURED, SHELL HASH THROUGHOUT
West-Ref	WREF06	E	0.56	5	3	6	0	PHYSICAL	NOADDM	0	NO	AMB, MOD-SORTED, SURF SCOUR, DEAD EEL GRASSBLADES, SHELL HADH THROUGHOUT
West-Ref	WREF06	F	2	4.05	2.9	7	0	PHYSICAL	NOADDM	0	NO	AMB, MOD SORTED, RIPPED-UP TUBEMAT, HYDROIDS, SHELL HASH THROUGHOUT
West-Ref	WREF07	A	2.21	5.44	3.38	NA	0	PHYSICAL	NOADDM	0	NO	,S/MUD, POORLY SORTED, ORG DETRIUS, SHELL FRAGS, SCOURLAG, SHELL HASH @ Z
West-Ref	WREF07	B	3.28	6.51	5.2	NA	0	PHYSICAL	NOADDM	0	NO	,S/MUD, POORLY SORTED, RIPPED-UP TUBEMAT, SHELL FRAGS, SHELL HASH @ Z
West-Ref	WREF07	C	1.74	4.77	3.36	NA	0	PHYSICAL	NOADDM	0	NO	,S/MUD, POOR SORTED, SHELL FRAGS @ SURF, SHELL HASH @ Z
West-Ref	WREF08	B	0.05	5.85	3.14	8	0	INDET	NOADDM	0	NO	,S/MUD, POOR SORTED, AMPHIPOD MAT?, ORG DETRITUS, HYDROIDS, SCOUR?, SHELL HASH @ Z
West-Ref	WREF08	C	0.05	3.74	2.34	NA	0	PHYSICAL	NOADDM	0	NO	,S/MUD, POORLY SORTED, RIPPED-UP TUBE MAT, ORG DETRITUS, SCOURLAG, SHELL HASH @ Z

Appendix C
September 1997 Benthic Survey Report

ENSR 1997

Draft Report

New London
Seawolf Disposal Mound
Benthic Survey
September 1997

submitted to

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23 December 1997

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1.0 Introduction

As part of the current DAMOS monitoring program designed to assess benthic community structure of disposal mounds in Long Island Sound, infaunal studies were planned that would permit comparison of results obtained from analysis of grab samples with the corresponding REMOTS® data analyzed by SAIC. Infaunal analyses were planned for six stations to be established on the Seawolf dredged material disposal mound at the New London Disposal Site. The grab samples were to be collected on the same day that the REMOTS® sediment-profile images were acquired.

2.0 Methods

At each of six stations, CENTER, 75E, 150N, 150W, 300SE, and 300WSW (named in reference to their distance in meters and direction away from the center of the disposal mound), one grab sample for benthic infauna was obtained with a 0.04-m^2 Ted Young grab. Upon retrieval, the benthic infaunal samples were visually inspected for depth of the apparent RPD layer, sediment color and texture, and penetration depth of the grab which gave an approximate sample volume. The samples were then washed into a bucket, sieved through 500-μm mesh screen, transferred into 1-l wide-mouth plastic containers, and fixed in 10% buffered formalin. After 48 h of fixation, the samples were resieved with fresh water, transferred to 70% alcohol for preservation, and shipped to Cove Corporation for sorting and species identification. Most identifications of small *Crepidula* and *Ampelisca* individuals were made by the author. For ease and accuracy of sorting the samples were stained with Rose Bengal.

Each taxon and its abundance for each sample was recorded electronically into a database. All raw data were compiled in a QuattroPro spreadsheet in order of NODC codes (Appendix A). Total faunal abundances and number of species were calculated for each station, the ten most abundant species were determined for each station, and a species list was generated (Table 1). Juvenile and indeterminable organisms were included in calculations of density, but were excluded from diversity analyses unless no other species belonging to those taxa were present in the sample.

Diversity was calculated as Shannon-Wiener index H' and the associated evenness J' and by the rarefaction method (Sanders, 1968). The Shannon-Wiener index was calculated using the base $\log_2$; for the rarefaction, the number of individuals was set at defined points between 25 and 800.

3.0 Results

A total of 100 (70 good species, 16 species identified to unique genera or major group suitable for diversity analysis, 5 species used selectively for diversity analyses, and 9 taxa unsuitable for use in diversity analyses, e.g. *Odostomia* spp.) taxa were identified from the samples (Table 1). Of species consistently used for all analyses nearly half were polychaetes (39 species); the remainder included amphipods (11 species), bivalves (12 species), gastropods (9 species), decapods (6 species), isopods (2 species), a mysid (1 species), and small numbers of nemerteans, oligochaetes, phoronids, echinoderms, hemichordates, and chordates that were treated as one taxon each.

The total number of individuals sorted out of the 6 samples was 2,600. The station with the lowest faunal abundance was the CENTER station, with only 50 individuals belonging to 17 taxa. Moving 75 m away from the center, station 75E had 200 individuals belonging to 26 taxa. Nearly twice as many species were found at stations 150 m (50 taxa at 150N and 46 taxa at 150W) away from the center as at 75 m away from the center, although there was a two-fold difference in abundance at these two stations. Station 150N had more than twice as many animals, mostly *Nucula annulata* (301 individuals), as station 150W. A few more species were seen in the samples taken 300 m away from the mound center, 66 and 54 taxa, respectively, from stations 300SE and 300WSW; faunal abundances were also greater (1118 animals from 300SE and 518 animals from 300WSW). The number of taxa, including unidentified and juvenile specimens, ranged from 17 at station CENTER to 66 at station 300SE. Densities ranged from a low of 1.25×10^3 individuals/m^2 at the CENTER station to 2.795×10^4 individuals/m^2 at station 300SE.

The ten most abundant species at each station are listed in Tables 2-4. The most ubiquitous dominant species were the bivalve *Nucula annulata* and the polychaete *Prionospio steenstrupi* which were among the top six dominants at all six stations. The polychaete *Mediomastus ambiseta* was among the ten most abundant species at all stations, ranking within the top three species at five stations. The amphipod *Ampelisca vadorum* and the gastropod *Crepidula plana* were among the top ten dominants at five stations. The polychaete *Tharyx acutus* was represented among the top ten dominants at four stations.

Overall, polychaetes with 12 species, belonging to nine different families, constituted the largest taxonomic group to be found among the top ten dominants at the six New London stations. The second largest groups were bivalves (4 species), with *Nucula annulata* extremely abundant and amphipods (4 species) mostly belonging to the genus *Ampelisca*. Two gastropod taxa, *Ilyanassa trivittata* and *Crepidula plana,* one decapod, *Pagurus* spp., and oligochaeta spp. complete the list of dominant species; *Ilyanassa* was among the dominants at two stations, while *Pagurus* spp. and oligochaeta spp. were among the dominants at one station.

Diversities (H') ranged from a low of 2.65 at station 150N to a high of 4.10 at station 150W (Table 5). The low value at station 150N may not be too surprising, since the sample was dominated by *Nucula annulata*. These stage II deposit-feeding bivalves stir up the surficial layers of the sediment thus decreasing the availability of suitable benthic habitat for colonization (Don Rhoads, pers. comm.). The diversity at the CENTER station was relatively high, considering the very low abundance of individuals (50) present in the sample. This is a situation where diversity is high when the number of species is low and the community is in an early stage of succession (Pearson and Rosenberg, 1978). Evenness (J') ranged from a low of 0.48 at station 150N to a high of 0.82 at the CENTER station (Table 5).

Density measures (Figure 1) show increasing numbers of species and individuals as stations are located further from the center of the site. Other community parameters tend to show three pairs of stations. The CENTER station and 75E combine low numbers of species and individuals with similar low diversity (3.27 and 3.16) and high to moderate evenness (0.82 and 0.68); rarefaction curves for these stations are well below those of the 150m and 300m stations. Stations 150N and 300SE combine high numbers of species and individuals with very low to moderate diversity (2.65 and 3.66) values and low evenness values (0.48 and 0.63); rarefaction curves for these stations lie between the central and western stations. The more westerly stations, 150W and 300WSW, combine moderate to high numbers of species and individuals with the highest diversity values (4.10 and 3.91) and similar moderately high evenness (0.76 and 0.70); rarefaction curves for these stations lie slightly above those for 150N and 300SE.

4.0 References

Pearson, T.H. and R. Rosenberg, 1978. Macrobenthic succession in relation to organic enrichment and pollution of the marine environment. Oceanogr. mar. Biol. Ann. Rev., 16:229-311.

Sanders, H.L. 1968. Marine benthic diversity: a comparative study. Am. Nat., 102:243-282.

Table 1. List of species identified from the New London Seawolf Disposal Mound samples

- NEMERTEA
    - Nemertea spp.

- ANNELIDA
    - Polychaeta
        - Ampharetidae
            - *Ampharete finmarchica* (Sars, 1865)
            - *Asabellides oculata* (Webster, 1879)
            - Ampharetidae spp.
        - Capitellidae
            - *Capitella capitata* complex (Fabricius, 1780)
            - *Mediomastus ambiseta* (Hartman, 1947)
            - *Notomastus luridus* Verrill, 1873
        - Chaetopteridae
            - *Chaetopterus variopedatus* (Renier, 1804)
            - *Spiochaetopterus costarum* (Claparède, 1870)
        - Cirratulidae
            - *Monticellina baptisteae* Blake, 1991
            - *Tharyx acutus* Webster & Benedict, 1887
            - *Tharyx* sp. A
            - *Tharyx* spp.
        - Cossuridae
            - *Cossura longocirrata* Webster & Benedict, 1887
        - Dorvilleidae
            - Dorvilleidae sp. A
        - Eunicidae
            - *Marphysa* sp.
            - Eunicidae spp.
        - Flabelligeridae
            - Flabelligeridae sp.
            - *Pherusa affinis* (Leidy, 1855)
        - Glyceridae
            - *Glycera americana* Leidy, 1855
            - *Glycera* spp.
        - Lumbrineridae
            - *Scoletoma hebes* (Verrill, 1880)
            - *Ninoe nigripes* Verrill, 1873
            - Lumbrineridae spp.
        - Maldanidae
            - *Macroclymene zonalis* (Verrill, 1874)
            - Maldanidae spp.
        - Nephtyidae
            - *Nephtys incisa* Malmgren 1865
        - Oweniidae
            - *Owenia fusiformis* Delle Chiaje, 1844
        - Paraonidae
            - *Aricidea catherinae* Laubier, 1967
            - *Levinsenia gracilis* (Tauber, 1879)
        - Pectinariidae
            - *Pectinaria gouldii* (Verrill, 1873)
        - Pholoidae
            - *Pholoe minuta* (Fabricius, 1780)
        - Phyllodocidae
            - *Phyllodoce maculata* (Linnaeus, 1767)
        - Polynoidae
            - *Harmothoe extenuata* (Grube, 1840)
        - Sabellidae
            - *Euchone elegans* Verrill, 1873
        - Sabellariidae
            - *Sabellaria vulgaris* Verrill, 1873
        - Sigalionidae
            - *Sthenelais boa* (Johnston, 1873)
        - Idoteidae
            - *Edotia triloba* (Say, 1818)
        - Spionidae
            - *Dipolydora socialis* (Schmarda, 1861)
            - *Prionospio steenstrupi* Malmgren, 1867
            - *Spiophanes bombyx* Claparède, 1870
        - Syllidae
            - Autolytinae spp.
            - *Brania clavata* (Claparède, 1863)
            - *Exogone dispar* (Webster, 1879)
            - *Exogone hebes* (Webster & Benedict, 1884)
        - Terebellidae
            - *Pista* sp.
            - *Polycirrus* cf. *haematodes* (Claparède, 1864)
            - *Polycirrus* spp.
            - Terebellidae spp.
        - Trichobranchidae
            - *Terebellides stroemi* Sars, 1835
    - Oligochaeta
        - Oligochaeta spp.

- CRUSTACEA
    - Amphipoda
        - Ampeliscidae
            - *Ampelisca abdita* Mills, 1964
            - *Ampelisca vadorum* Mills, 1963
        - Aoridae
            - *Leptocheirus pinguis* (Stimpson, 1853)
            - *Unciola irrorata* Say, 1818
        - Corophiidae
            - *Corophium* spp.
            - *Monocorophium sextonae* (Crawford, 1937)
        - Caprellidae
            - *Luconacia incerta* Mayer, 1903
        - Isaeidae
            - *Photis dentata* Shoemaker, 1945
        - Ischyroceridae
            - *Erichthonius brasiliensis* (Dana, 1853)
            - *Jassa marmorata* Holmes, 1903
        - Phoxocephalidae
            - *Eobrolgus spinosus* (Holmes, 1905)
            - *Phoxocephalus holbolli* (Krøyer, 1842)

    - Decapoda
        - Cancridae
            - *Cancer irroratus* Say, 1817
        - Crangonidae
            - *Crangon septemspinosa* Say, 1818
        - Majidae
            - *Libinia* spp.
        - Paguridae
            - *Pagurus longicarpus* Say, 1817
            - *Pagurus* spp.
        - Pinnotheridae
            - *Pinnixa chaetopterana* Stimpson, 1859
        - Thalassinidea
            - Thalassinidea spp.

    - Isopoda
        - Anthuriidae
            - *Ptilanthura tenuis* Harger, 1879

            - *Heteromysis formosa* S.I. Smith, 1873
    - Mysidacea
- MOLLUSCA
    - Bivalvia

Arcidae
Anadara transversa (Say, 1822)
Astartidae
Astarte undata Gould, 1841
Astarte spp.
Cardiidae
Cerastoderma pinnulatum (Conrad, 1831)
Carditidae
Cyclocardia borealis (Conrad, 1831)
Lyonsiidae
Lyonsia spp.
Mytilidae
Musculus sp.
Nuculidae
Nucula annulata Hampson, 1971
Pandoridae
Pandora gouldiana Dall, 1886
Petricolidae
Petricola pholadiformis (Lamarck, 1818)
Pholadidae
Barnea sp.
Tellinidae
Tellina agilis Stimpson, 1857
Veneridae
Pitar morrhuanus Linsley, 1848

Gastropoda
Prosobranchia
Calyptraeidae
Crepidula fornicata (Linnaeus, 1758)
Crepidula plana Say, 1822
Crepidula spp.
Columbellidae
Anachis sp.
Astyris lunata (Say, 1826)
Nassariidae
Ilyanassa trivittata (Sars, 1822)
Pyramidellidae
Boonea seminuda (C.B. Adams, 1837)
Odostomia engonia Bush, 1885
Odostomia spp.
Turbonilla interrupta (Totten, 1835)
Vitrinellidae
Vitrinellidae spp.

PHORONIDA
Phoronis sp.

ECHINODERMATA
Ophiuroidea spp.

HEMICHORDATA
Enteropneusta spp.

CHORDATA
Ascidiacea spp.

Table 2. Ten most abundant taxa at Seawolf Disposal Mound - Center and 75E, September 1997

Seawolf Disposal Mound - Center			
Rank	**Species**	**Percent of Total Fauna**	**Density (Ind. 0.04 m^{-2})**
1	*Nucula annulata* (Stage II bivalve)	36.00	18
2	*Ampelisca vadorum* (Stage II amphipod)	12.00	6
3	*Ampharete finmarchica* (Stage I polychaete)	6.00	3
4	*Crepidula plana* (gastropod)	6.00	3
5	*Leptocheirus pinguis* (Stage II amphipod)	6.00	3
6	*Prionospio steenstrupi* (Stage I polychaete)	4.00	2
7	*Spiochaetopterus costarum* (Stage II/III polychaete)	4.00	2
8	*Mediomastus ambiseta* (Stage I polychaete)	4.00	2
9	*Petricola pholadiformis* (bivalve)	4.00	2
10	*Barnea* sp. (bivalve)	4.00	2
	Total - 10 Taxa	86.00	43
	Remaining Fauna - 7 Taxa	14.00	7
	Total Fauna - 17 Taxa	100.00	50

Seawolf Disposal Mound - 75E			
Rank	**Species**	**Percent of Total Fauna**	**Density (Ind. 0.04 m^{-2})**
1	*Nucula annulata* (Stage II bivalve)	29.50	59
2	*Prionospio steenstrupi* (Stage I polychaete)	24.50	49
3	*Mediomastus ambiseta* (Stage I polychaete)	12.00	24
4	*Crepidula plana* (gastropod)	8.00	16
5	*Ampelisca vadorum* (Stage II amphipod)	4.00	8
6	*Tharyx acutus* (Stage I polychaete)	3.00	6
7	*Monticellina baptisteae* (Stage I polychaete)	2.50	5
8	*Spiochaetopterus costarum* (Stage II/III polychaete)	2.00	4
9	Ampharetidae spp.* (Stage I polychaete)	2.00	4
10	*Anadara transversa* (bivalve)	1.50	3
10	*Ampelisca abdita* (Stage II amphipod)	1.50	3
	Remaining Fauna - 15 Taxa	9.50	19
	Total Fauna - 26 Taxa	100.00	200

* Taxon excluded from diversity analysis. Incompletely identified taxa were used in diversity analyses only when species belonging to those taxa were absent from the sample.

Table 3. Ten most abundant taxa at Seawolf Disposal Mound - 150N and 150W, September 1997

Rank	Species	Percent of Total Fauna	Density (Ind. 0.04 m^{-2})
1	*Nucula annulata* (Stage II bivalve)	59.84	301
2	*Mediomastus ambiseta* (Stage I polychaete)	8.55	43
3	*Prionospio steenstrupi* (Stage I polychaete)	6.76	34
4	*Anadara transversa* (bivalve)	2.58	13
5	Ampharetidae spp.* (Stage I polychaete)	1.79	9
6	*Nephtys incisa* (Stage II/III polychaete)	1.59	8
7	*Crepidula plana* (gastropod)	1.59	8
8	*Levinsenia gracilis* (Stage III polychaete)	1.39	7
9	*Ilyanassa trivittata* (gastropod)	1.19	6
10	*Pagurus* spp. (hermit crab)	0.99	5
	Total - 10 Taxa	86.28	434
	Remaining Fauna - 40 Taxa	13.72	69
	Total Fauna - 50 Taxa	100.00	503

Seawolf Disposal Mound - 150W

Rank	Species	Percent of Total Fauna	Density (Ind. 0.12m^{-2})
1	*Prionospio steenstrupi* (Stage I polychaete)	26.07	55
2	*Nucula annulata* (Stage II bivalve)	13.74	29
3	*Mediomastus ambiseta* (Stage I polychaete)	10.43	22
4	*Tharyx acutus* (Stage I polychaete)	4.27	9
5	*Crepidula plana* (gastropod)	4.27	9
6	*Ampelisca vadorum* (Stage II amphipod)	3.32	7
7	*Erichthonius brasiliensis* (amphipod)	3.32	7
8	*Dipolydora socialis* (Stage I polychaete)	2.84	6
9	*Nephtys incisa* (Stage II/III polychaete)	2.37	5
10	*Ilyanassa trivittata* (gastropod)	2.37	5
10	*Ampelisca abdita* (Stage II amphipod)	2.37	5
	Total - 11 Taxa	75.36	159
	Remaining Fauna - 35 Taxa	24.64	52
	Total Fauna - 46 Taxa	100.00	211

* Taxon excluded from diversity analysis. Incompletely identified taxa were used in diversity analyses only when species belonging to those taxa were absent from the sample.

Table 4. Ten most abundant taxa at Seawolf Disposal Mound - 300SE and 300WSW, September 1997

Rank	Species	Percent of Total Fauna	Density (Ind. 0.04 m^{-2})
1	*Monticellina baptisteae* (Stage I polychaete)	31.40	351
2	*Mediomastus ambiseta* (Stage I polychaete)	15.47	173
3	*Ampelisca vadorum* (Stage II amphipod)	8.77	98
4	Oligochaeta spp. (Stage I oligochaete)	8.68	97
5	*Prionospio steenstrupi* (Stage I polychaete)	5.28	59
6	*Nucula annulata* (Stage II bivalve)	5.19	58
7	*Tharyx acutus* (Stage I polychaete)	3.58	40
8	*Leptocheirus pinguis* (Stage II amphipod)	2.15	24
9	*Scoletoma hebes* (Stage III polychaete)	1.61	18
10	*Anadara transversa* (bivalve)	1.34	15
	Total - 10 Taxa	83.45	933
	Remaining Fauna - 56 Taxa	16.55	185
	Total Fauna - 66 Taxa	100.00	1118

Seawolf Disposal Mound - 300WSW

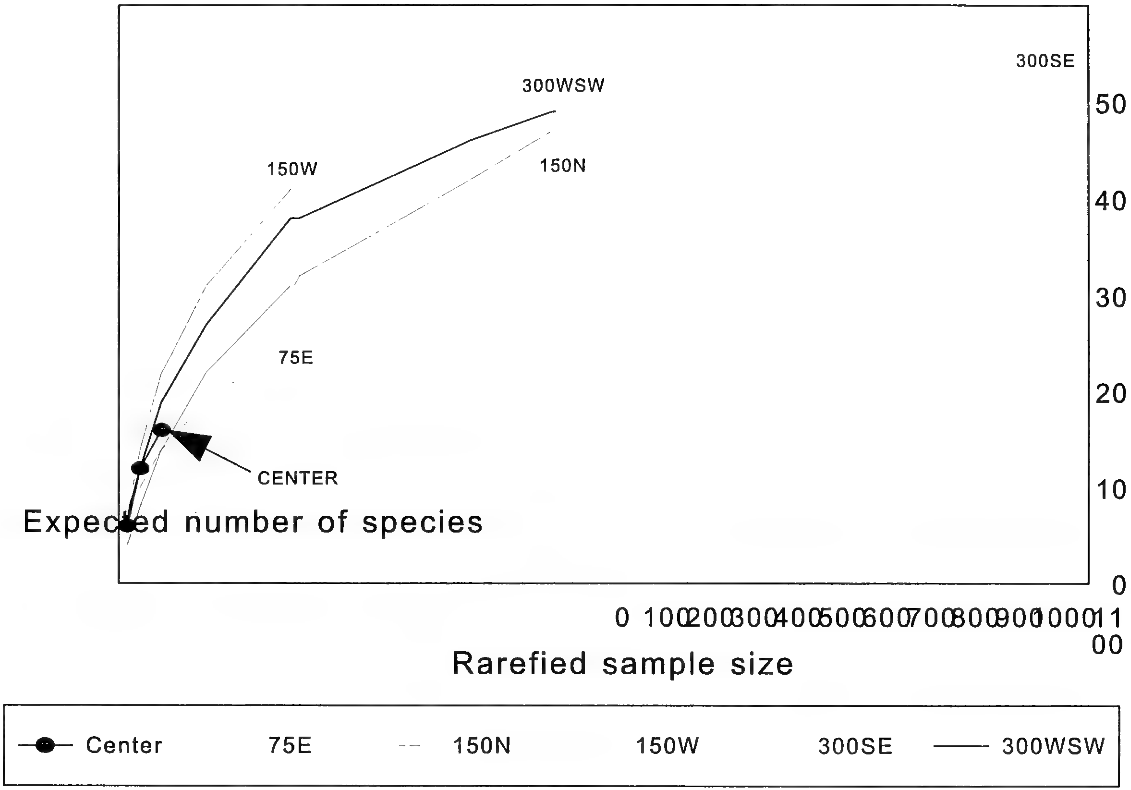
Rank	Species	Percent of Total Fauna	Density (Ind. 0.12m^{-2})
1	*Prionospio steenstrupi* (Stage I polychaete)	25.10	130
2	*Mediomastus ambiseta* (Stage I polychaete)	13.51	70
3	*Nucula annulata* (Stage II bivalve)	11.78	61
4	*Ampelisca vadorum* (Stage II amphipod)	8.30	43
5	*Tharyx acutus* (Stage I polychaete)	7.53	39
6	*Monticellina baptisteae* (Stage I polychaete)	3.28	17
7	*Dipolydora socialis* (Stage I polychaete)	2.32	12
8	Ampharetidae spp.* (Stage I polychaete)	2.12	11
9	*Polycirrus* cf. *haematodes* (Stage I polychaete)	2.12	11
10	*Crepidula plana* (gastropod)	1.93	10
	Total - 10 Taxa	77.99	404
	Remaining Fauna - 44 Taxa	22.01	114
	Total Fauna - 54 Taxa	100.00	518

* Taxon excluded from diversity analysis. Incompletely identified taxa were used in diversity analyses only when species belonging to those taxa were absent from the sample.

Table 5. Benthic Community Parameters, New London Seawolf Disposal Mound, September 1997

Station	Number of Species	Number of Individuals	Diversity (Hurlbert's Rarefaction)							Shannon-Wiener Diversity Index	Evenness
	(0.04m^2)	(0.04m^2)	spp./10 ind.	spp./25 ind.	spp./50 ind.	spp./100 ind.	spp./200 ind.	spp./400 ind.	spp./800 ind.	H'	J'
Center	16	49	7	13	-	-	-	-	-	3.27	0.82
75E	25	196	6	10	14	19	-	-	-	3.16	0.68
150N	47	493	4	8	14	22	31	42	-	2.65	0.48
150W	42	206	7	14	22	31	41	-	-	4.10	0.76
300SE	57	1093	7	11	16	24	34	45	53	3.66	0.63
300WSW	49	496	7	12	19	27	38	46	-	3.91	0.70

- Sample too small to measure this parameter


300SE
300WSW
150W
150N
75E
CENTER
Expected number of species
50
40
30
20
10
0
0 100200300400500600700800900100011
00
Rarefied sample size
Center
75E
150N
150W
300SE
300WSW

Appendix A

Benthic Infaunal Data

New London Seawolf Disposal Mound, September 1997, 0.5 mm, All Species

Taxon	NODC Code	Center	75E	150N	150W	300SE	300WSW	Total
Nemertea spp.	4300000000			1	1	5	5	12
Harmothoe extenuata	5001020803		1		2	3	1	7
Pholoe minuta	5001060101					4	2	6
Stenelais boa	5001060302			1	1	4		6
Phyllodoce maculata	5001130106					4	1	5
Exogone dispar	5001230701			1	2	3	3	9
Exogone hebes	5001230707					1		1
Brania clavata	5001230902					3	1	4
Autolytinae spp.	5001239000				1	1		2
Nephtys incisa	5001250115		2	8	5	10	3	28
Glycera spp.	5001270100				1	1	2	4
Glycera americana	5001270104			1	1		1	3
Eunicidae spp.	5001300000					1		1
Marphysa sp.	5001300200					1		1
Lumbrineridae spp.	5001310000					7		7
Scoletoma hebes	5001310140			1		18		19
Ninoe nigripes	5001310204			1		6	6	13
Dorvilleidae sp. A	5001360098				1			1
Aricidea (Acmira) catherinae	5001410208			1	1	8		10
Levinsenia gracilis	5001410801	1		7		11	3	22
Dipolydora socialis	5001430402	1	1	3	6	10	12	33
Prionospio steenstrupi	5001430506	2	49	34	55	59	130	329
Spiophanes bombyx	5001431001				1			1
Chaetopterus variopedatus	5001490101						3	3
Spiochaetopterus costarum	5001490302	2	4	3	2	4	8	23
Tharyx spp.	5001500300			1	1	5		7
Tharyx acutus	5001500305		6	4	9	40	39	98
Tharyx sp. A	5001500398			1		1		2
Monticellina baptisteae	5001501101		5	3	3	351	17	379
Cossura longocirrata	5001520101			2	1	2		5
Flabelligeridae spp.	5001540000			1		1		2
Pherusa affinis	5001540304			1				1
Capitella capitata complex	5001600100						3	3
Notomastus luridus	5001600305					1		1
Mediomastus ambiseta	5001600401	2	24	43	22	173	70	334
Maldanidae spp.	5001630000		1	1	1	2	5	10
Macroclymene zonalis	5001632101						2	2
Owenia fusiformis	5001640102			1				1
Sabellaria vulgaris	5001650202		1					1
Pectinaria gouldii	5001660302						1	1
Ampharetidae spp.	5001670000	1	4	9	3	4	11	32
Ampharete finmarchica	5001670201	3	2	4	3	9	9	30
Asabellides oculata	5001670802					1		1
Terebellidae spp.	5001680000					1		1
Pista sp.	5001680700			2		1		3
Polycirrus spp.	5001680800			3		2	3	8
Polycirrus cf. haematodes	5001680805					2	11	13
Terebellides stroemi	5001690101					1		1
Euchone elegans	5001700205					2	1	3
Oligochaeta spp.	5004000000			1		97	2	100
Vitrinellidae spp.	5103230000			1	1			2
Crepidula spp.	5103640200					1		1

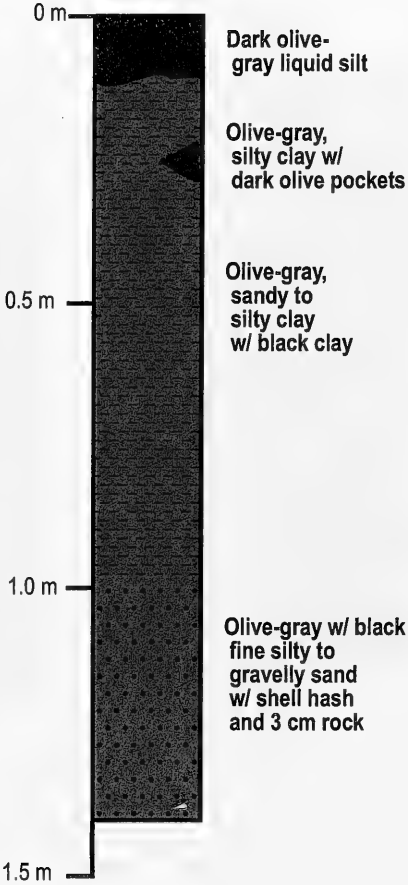
New London Seawolf Disposal Mound, September 1997, 0.5 mm, All Species

Taxon	NODC Code	Center	75E	150N	150W	300SE	300WSW	Total
Crepidula fornicata	5103640204	1	1			1	2	5
Crepidula plana	5103640207	3	16	8	9	3	10	49
Astyris lunata	5105030207			1	2	5	3	11
Anachis sp.	5105030300				1			1
Ilyanassa trivittata	5105080103	1	1	6	5		2	15
Odostomia spp.	5108010100						1	1
Boonea seminuda	5108010135			4	3		1	8
Odostomia engonia	5108010136					2	2	4
Turbonilla interrupta	5108010209			1		2	2	5
Nucula annulata	5502020205	18	59	301	29	58	61	526
Anadara transversa	5506010201		3	13	3	15	4	38
Musculus spp.	5507010400			1		2		3
Cyclocardia borealis	5515170106		1		1	3		5
Astarte spp.	5515190100					1		1
Astarte undata	5515190113					6		6
Cerastoderma pinnulatum	5515220601			1			1	2
Tellina agilis	5515310205			4	1			5
Pitar morrhuana	5515471201		1		1	6		8
Petricola pholadiformis	5515480102	2				1		3
Barnea sp.	5518010400	2						2
Pandora gouldiana	5520020107				1		3	4
Lyonsia spp.	5520050200		1	4		4		9
Heteromysis formosa	6153010802						1	1
Ptilanthura tenuis	6160010301						1	1
Edotia triloba	6162020703			1				1
Ampelisca abdita	6169020108		3	1	5		2	11
Ampelisca vadorum	6169020109	6	8	4	7	98	43	166
Leptocheirus pinguis	6169060702	3	2	1		24	5	35
Corophium spp.	6169150200				2	3	2	7
Monocorophium sextonae	6169150217				1			1
Erichthonius brasiliensis	6169150302				7			7
Unciola irrorata	6169150703	1				9	6	16
Photis dentata	6169260207					2		2
Jassa marmorata	6169270303						1	1
Phoxocephalus holbolli	6169420702			2	2	3	2	9
Eobolgus spinosus	6169420928			1				1
Luconacia incerta	6171011101				1			1
Crangon septemspinosa	6179220103		1		1		1	3
Thalassinidea spp.	6183010000					1		1
Pagurus spp.	6183060200			5	1	3	3	12
Pagurus longicarpus	6183060230	1	1	1		1		4
Libinia spp.	6187010900						1	1
Cancer irroratus	6188030108			1				1
Pinnixa chaetopterana	6189060405				1			1
Phoronis sp.	7700010200				3		2	5
Ophiuroidea spp.	8120000000					1		1
Enteropneusta spp.	8201000000		2					2
Ascidiacea spp.	8401000000			2		3	1	6
	Total	50	200	503	211	1118	518	2600

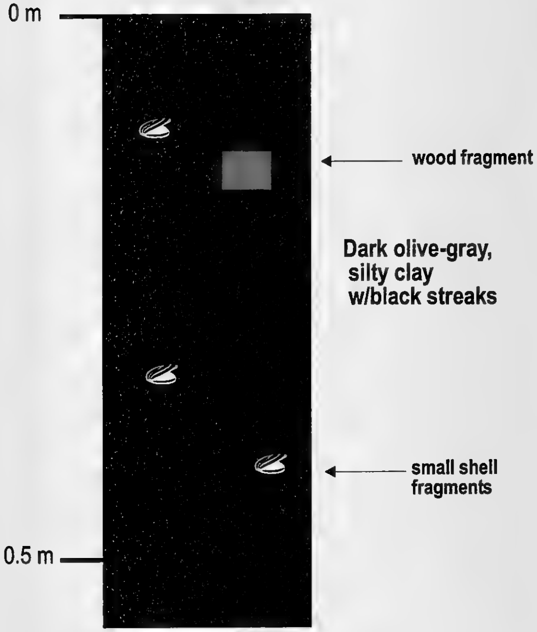
Appendix D
Sediment Core Descriptions

D1
1997 Core Descriptions

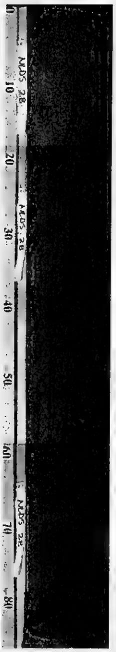
1997 Seawolf Short Cores
Core 1A

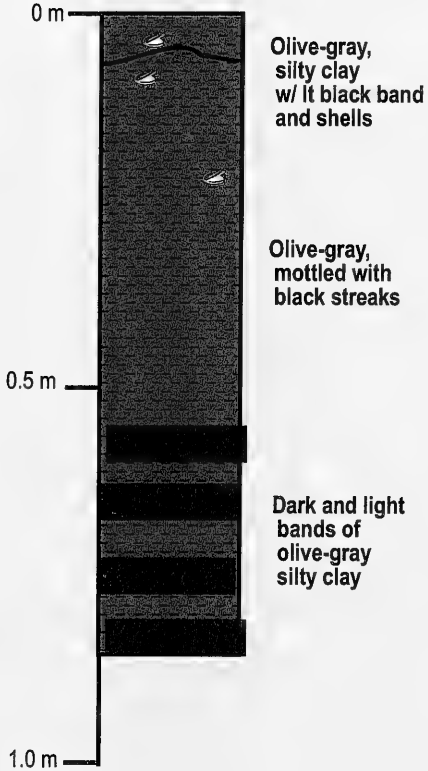


1997 Seawolf Short Cores
Core 2A

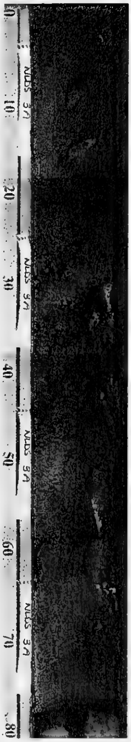


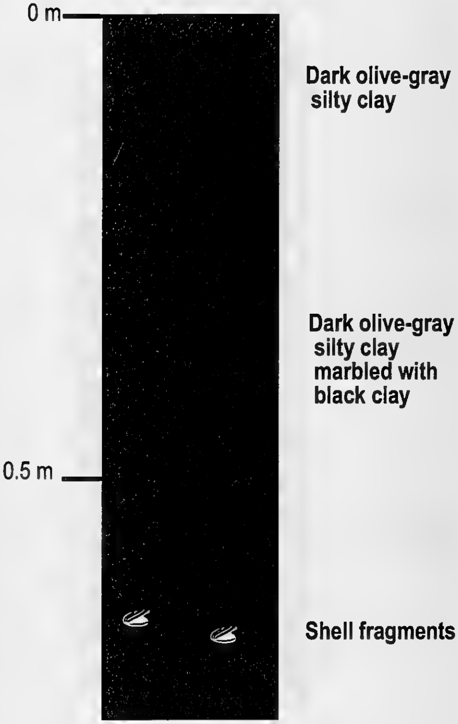
1997 Seawolf Short Cores
Core 2B



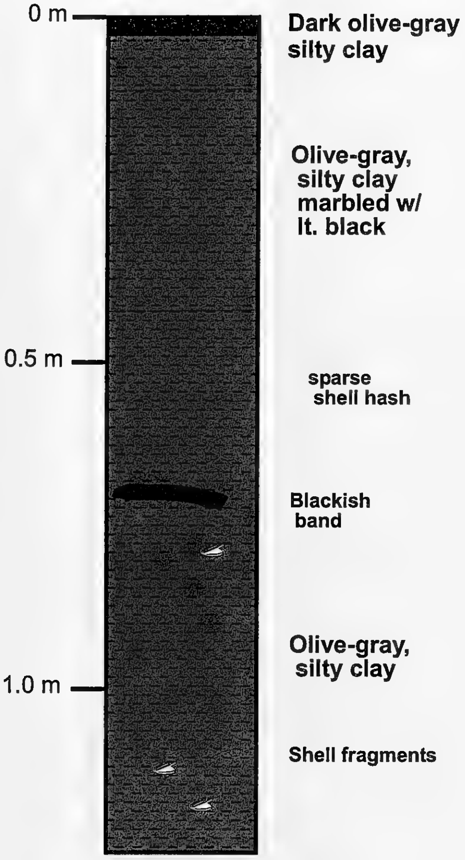


1997 Seawolf Short Cores
Core 3A

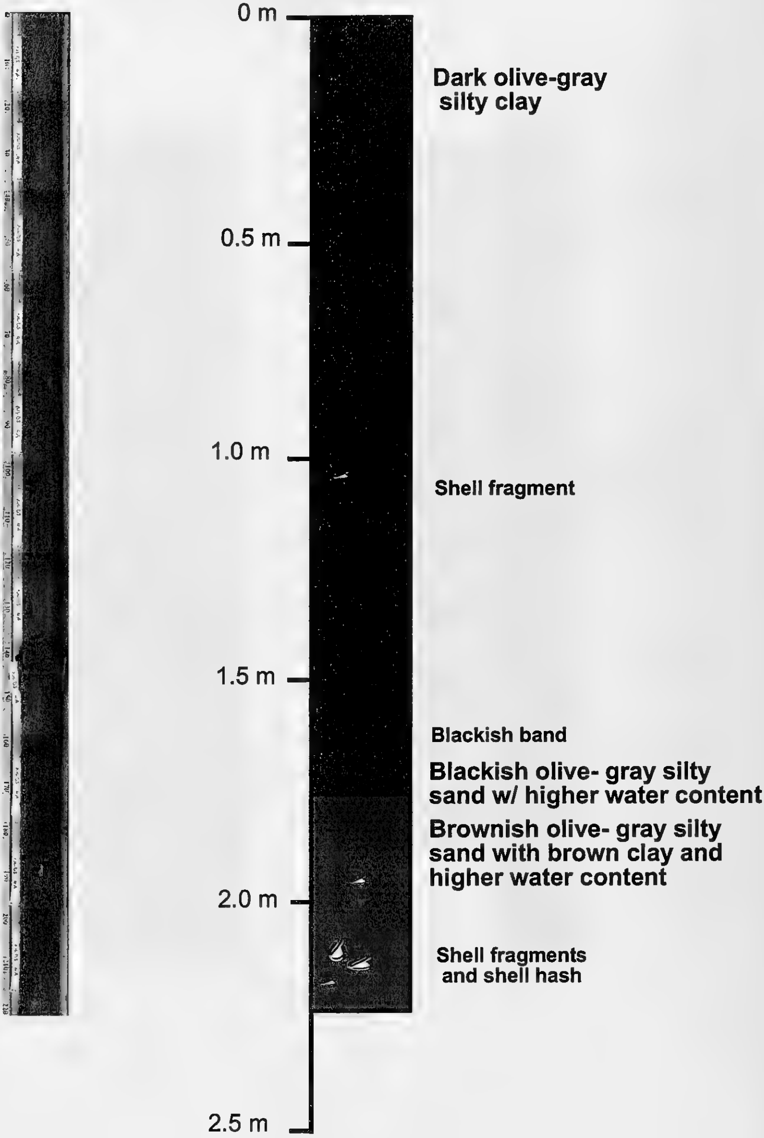




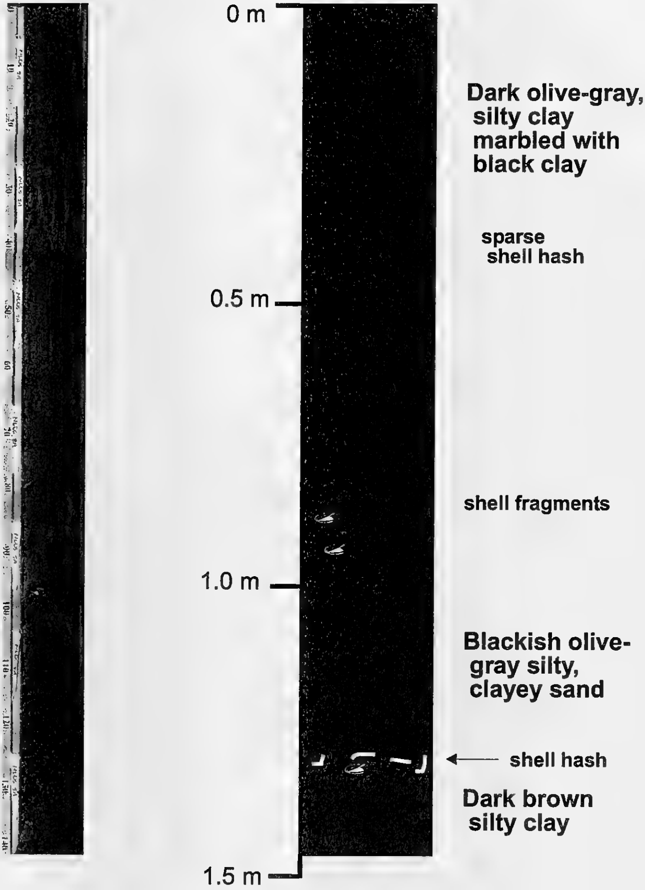
1997 Seawolf Short Cores
Core 3B



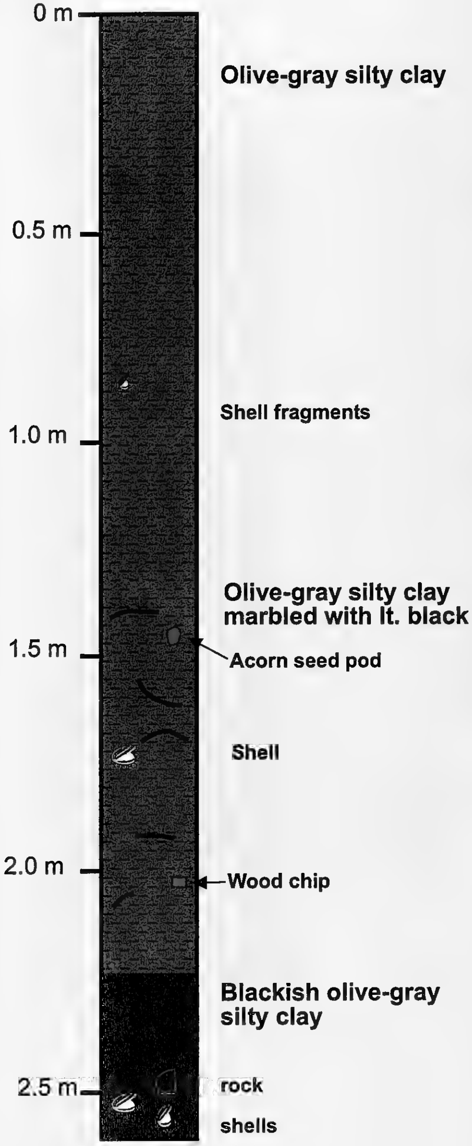
1997 Seawolf Long Cores
Core 4A



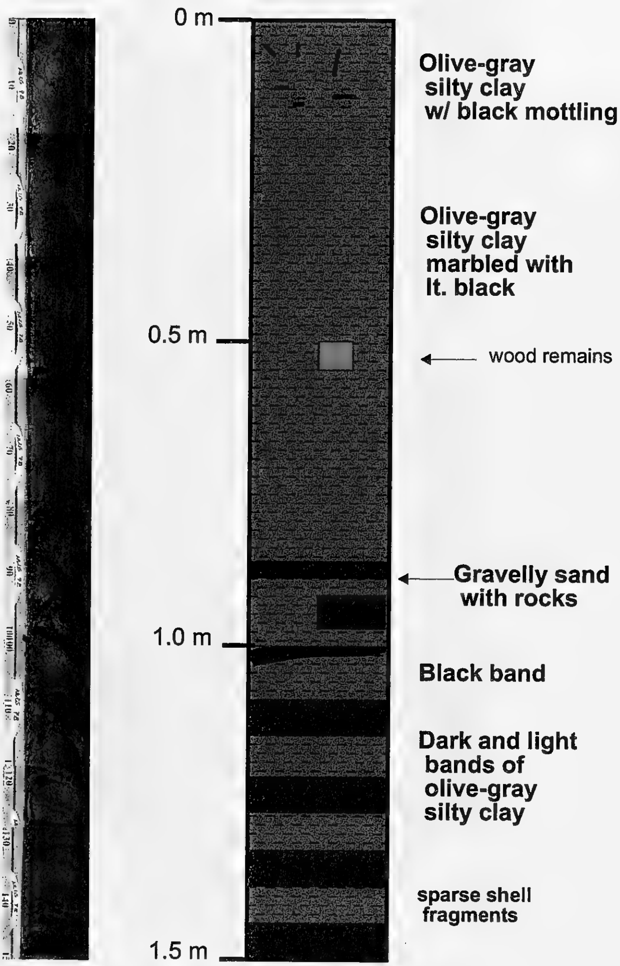
1997 Seawolf Short Cores
Core 5A



1997 Seawolf Long Cores
Core 6A



1997 Seawolf Short Cores
Core 7A



Olive-gray silty clay w/ black mottling

Olive-gray silty clay marbled with lt. black

wood remains

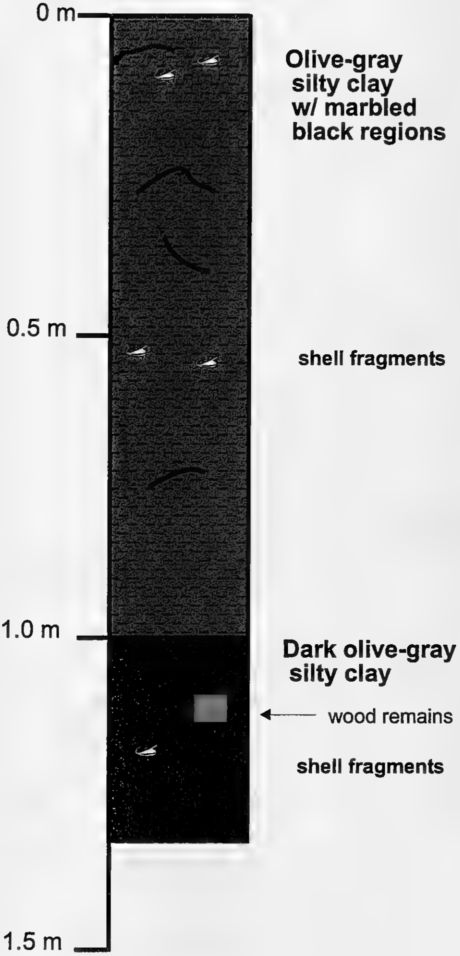
Gravelly sand with rocks

Black band

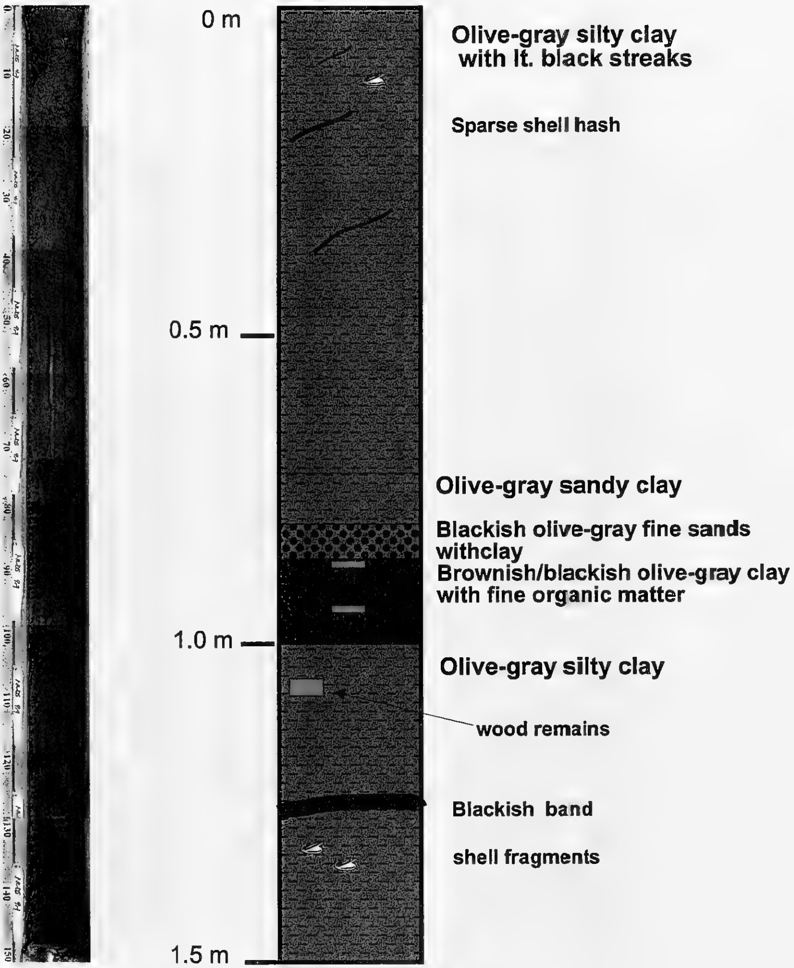
Dark and light bands of olive-gray silty clay

sparse shell fragments

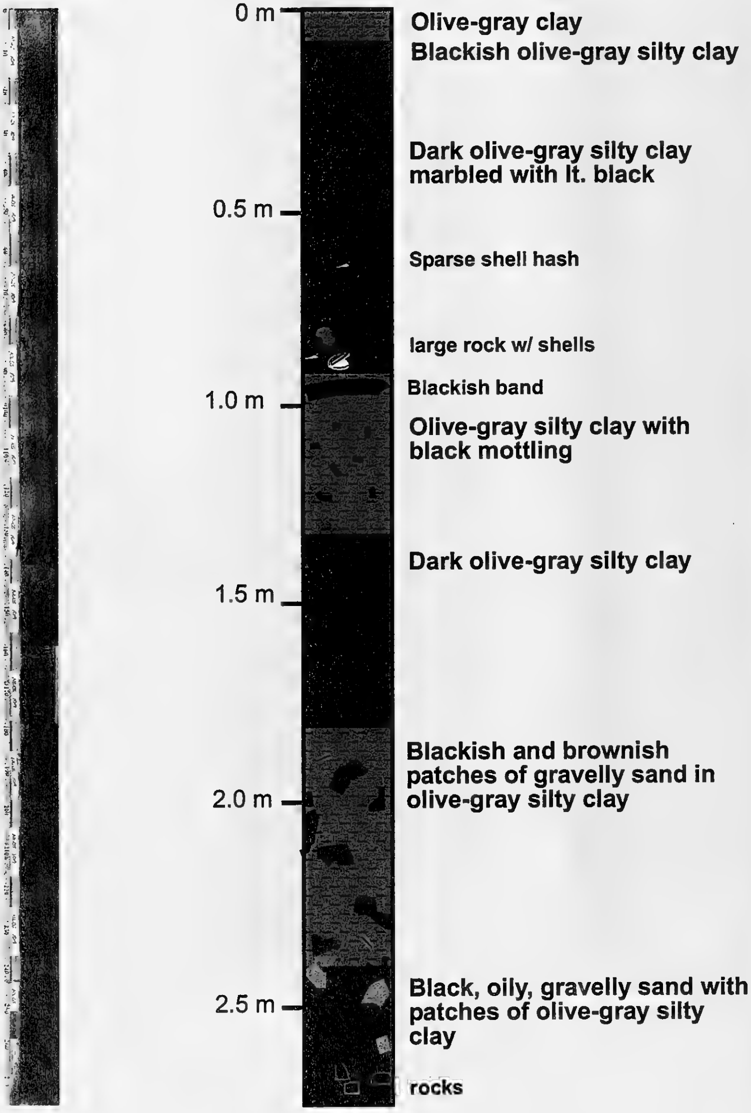
1997 Seawolf Short Cores
Core 8A



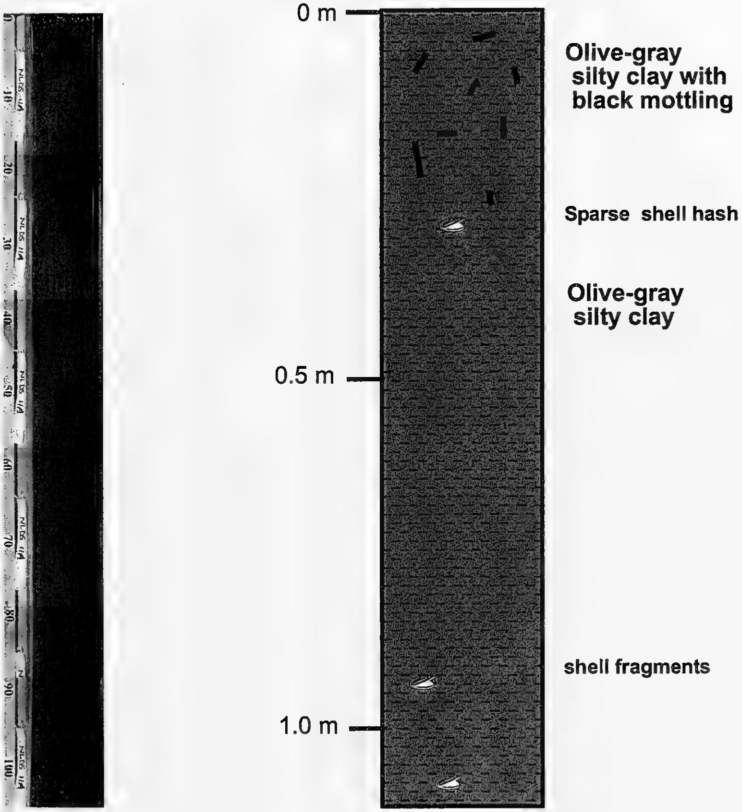
1997 Seawolf Short Cores
Core 9A



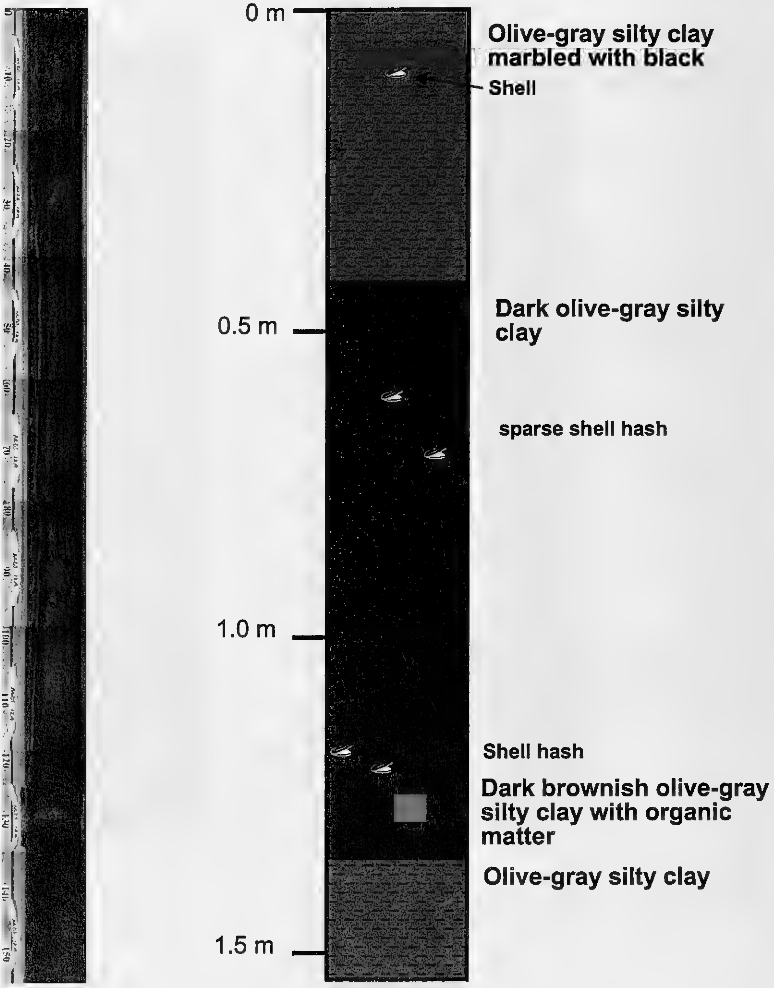
1997 Seawolf Long Cores
Core 10A



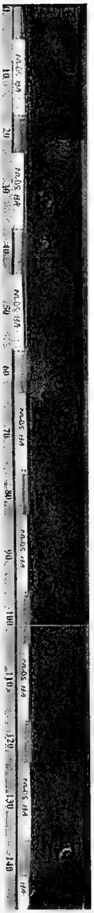
1997 Seawolf Short Cores
Core 11A

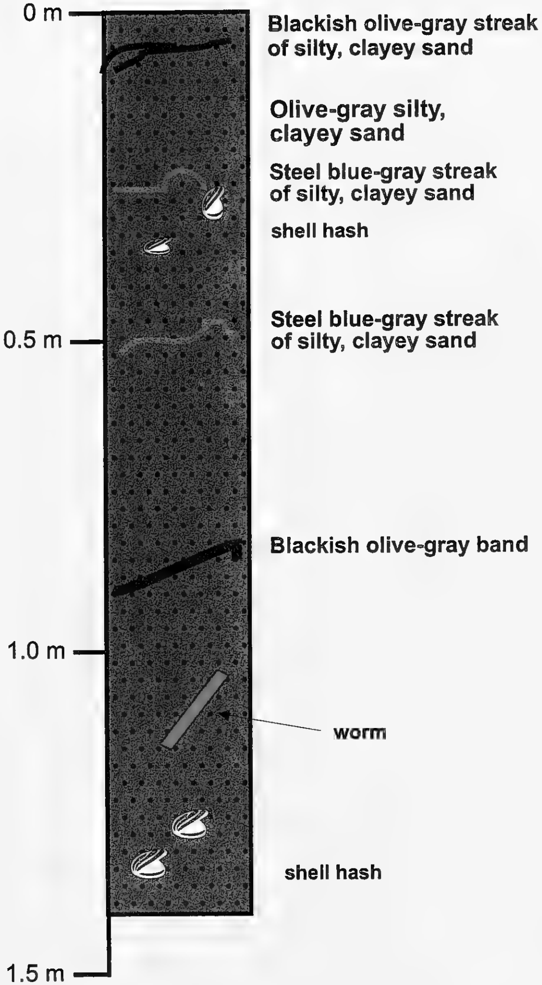


1997 Seawolf Short Cores
Core 12A



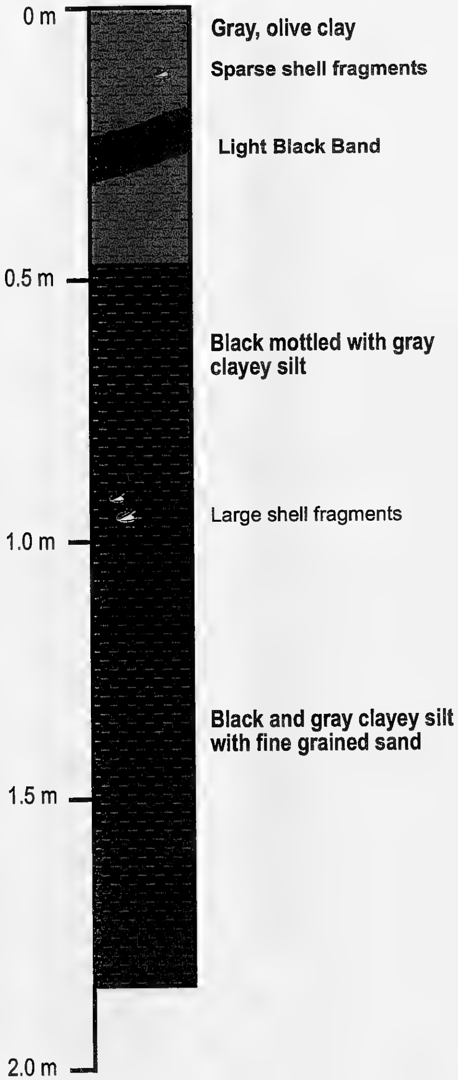
1997 Seawolf Short Cores
Core 13A



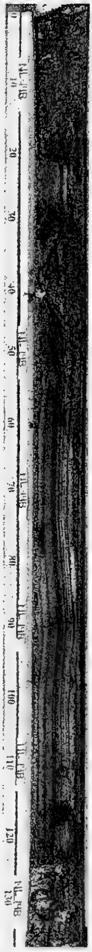


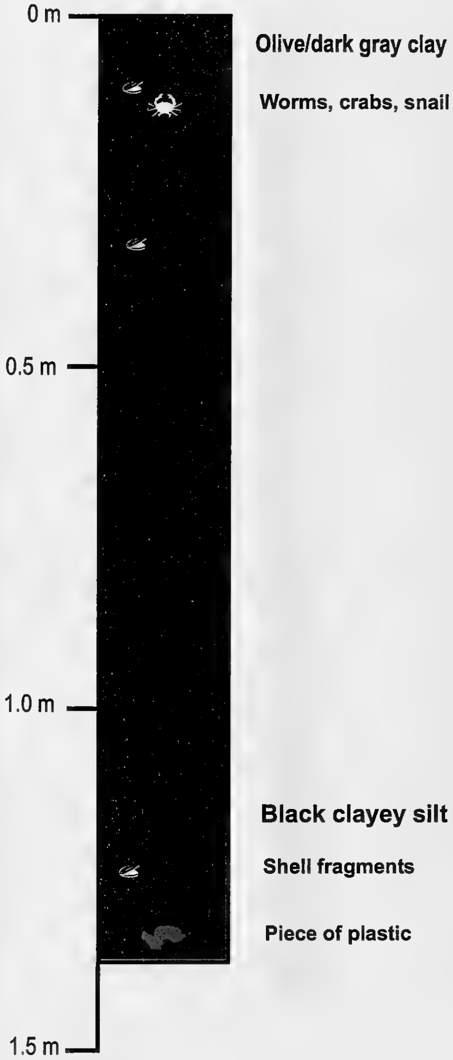
D2
1998 Core Descriptions

1998 Seawolf Short Cores
Core 14A

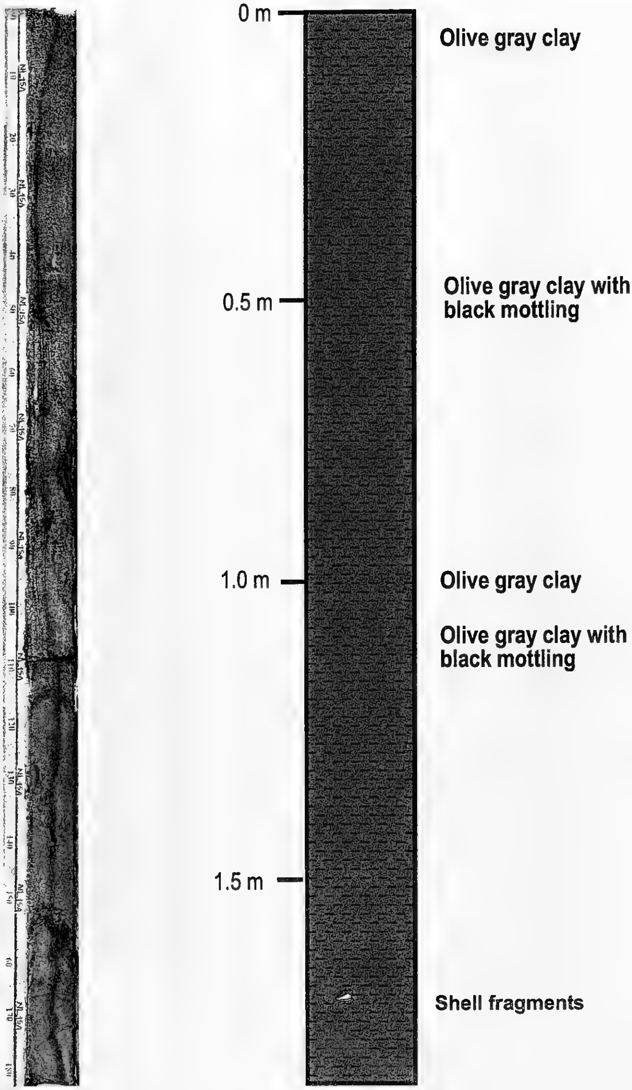


1998 Seawolf Short Cores
Core 14B

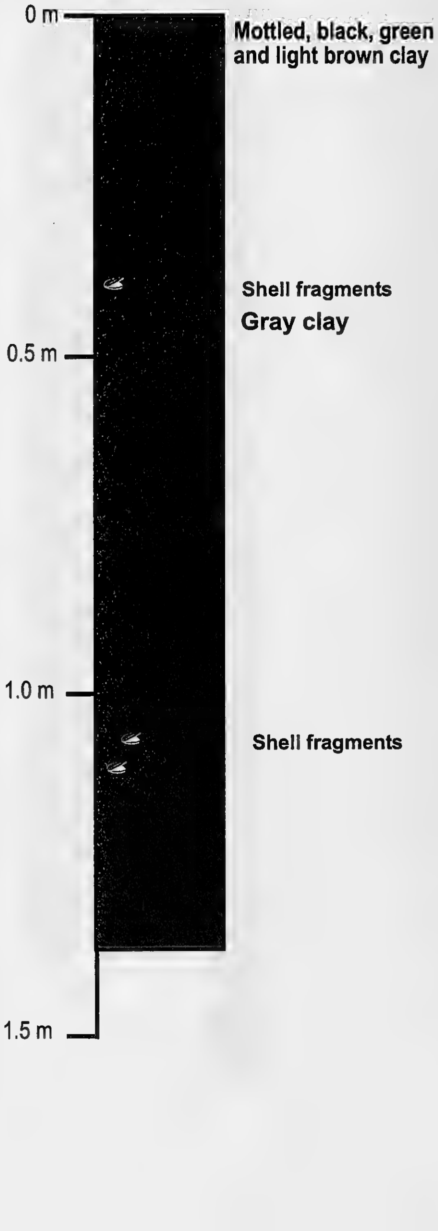




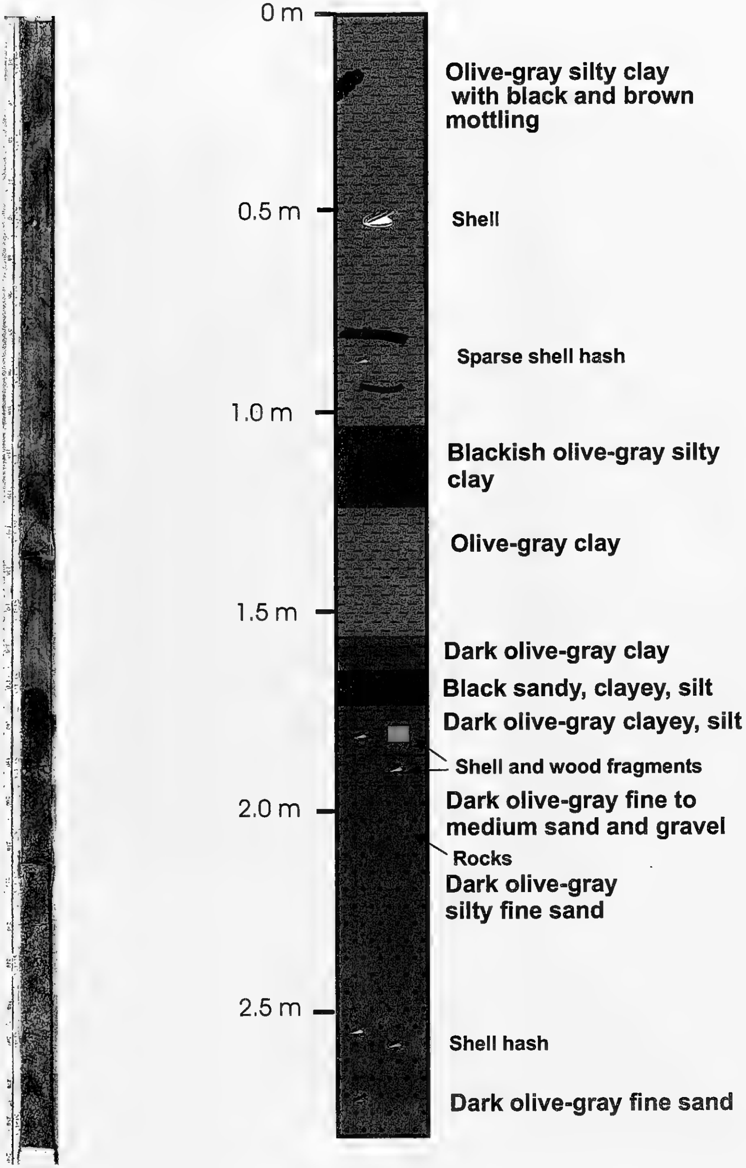
1998 Seawolf Short Cores
Core 15A



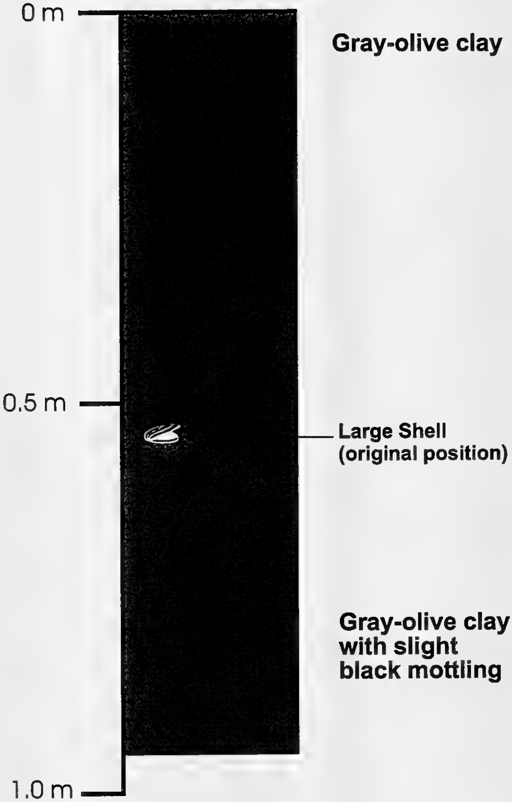
1998 Seawolf Short Cores
Core 16A



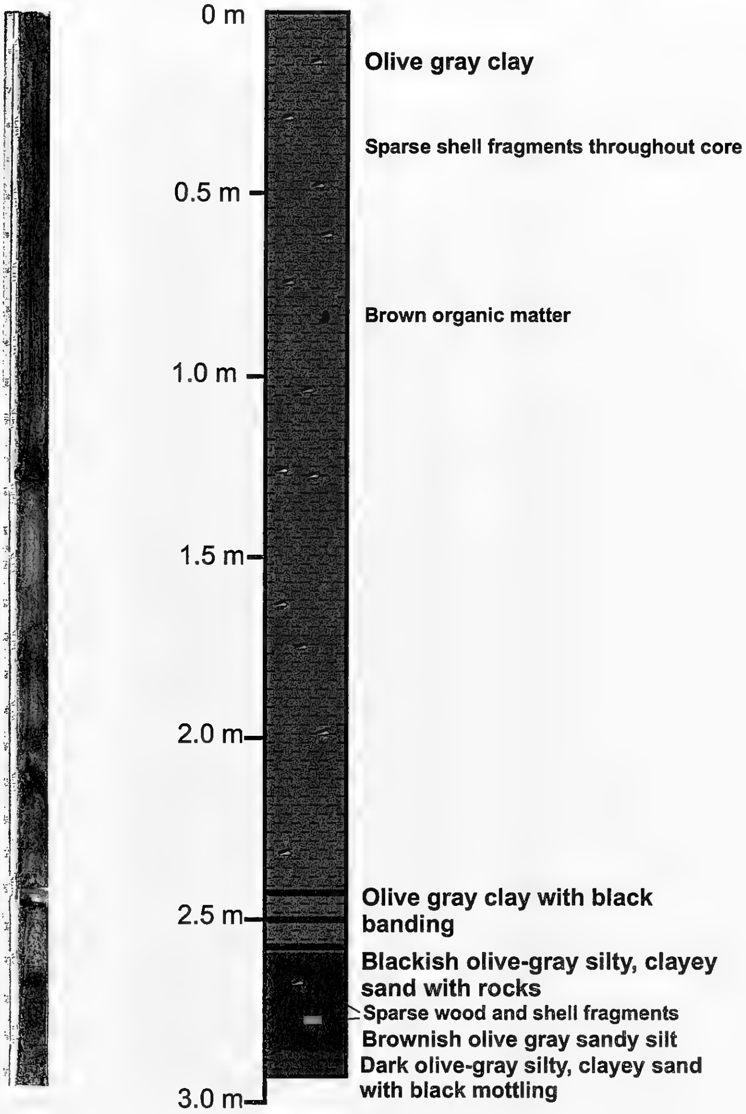
1998 Seawolf Long Cores
Core 17A



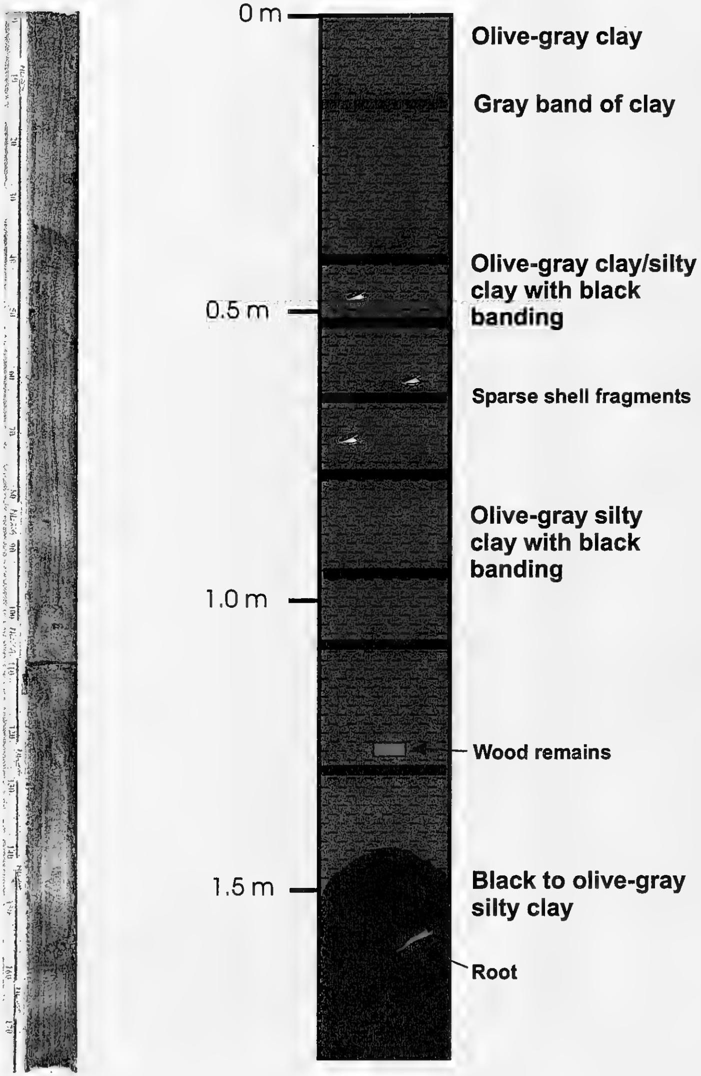
1998 Seawolf Short Cores
Core 18A



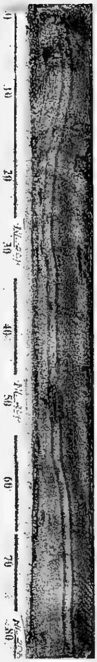
1998 Seawolf Long Cores
Core 19A

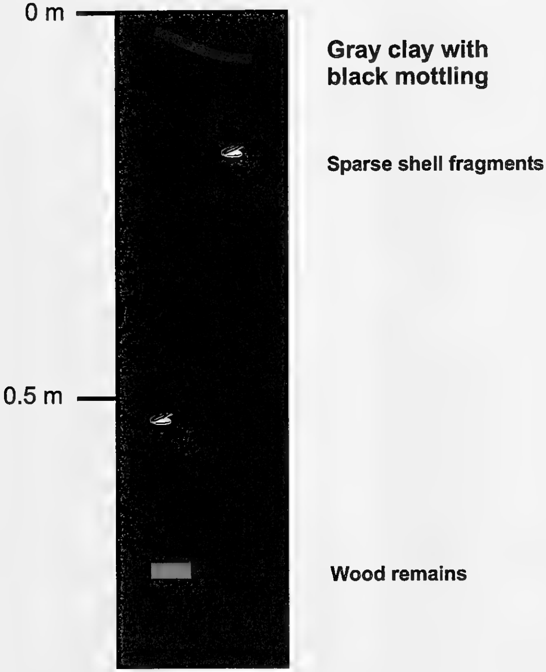


1998 Seawolf Short Cores
Core 20A

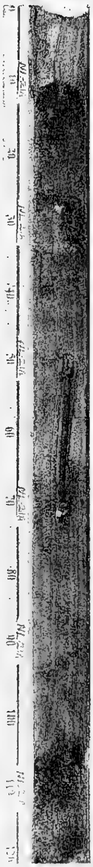


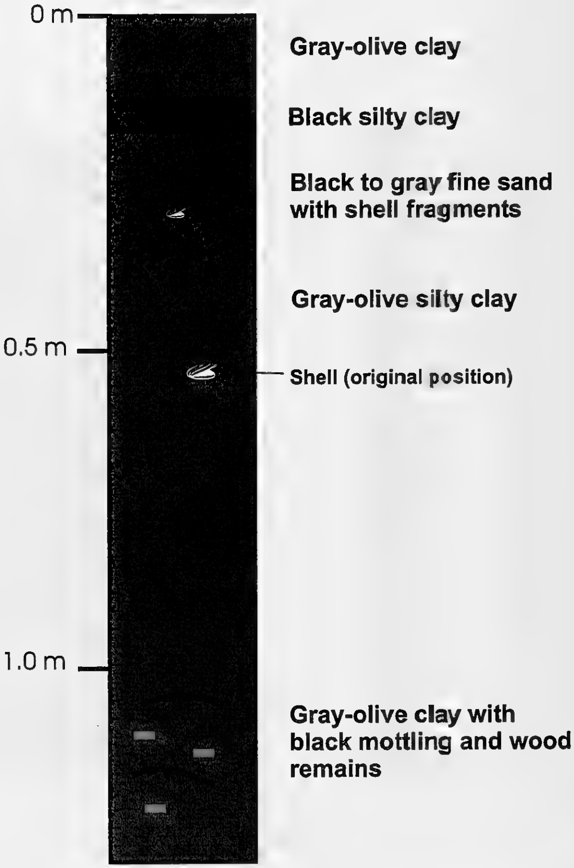
1998 Seawolf Short Cores
Core 20B



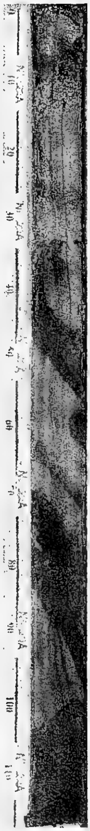


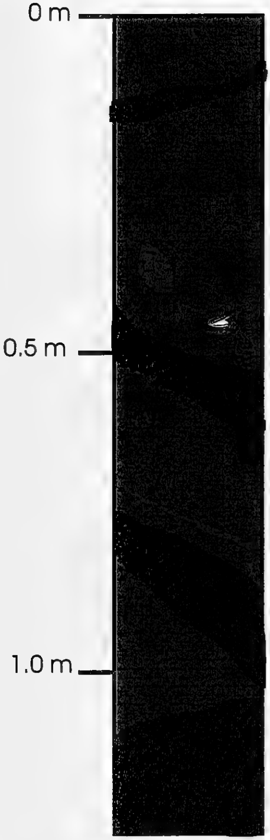
1998 Seawolf Short Cores
Core 21A



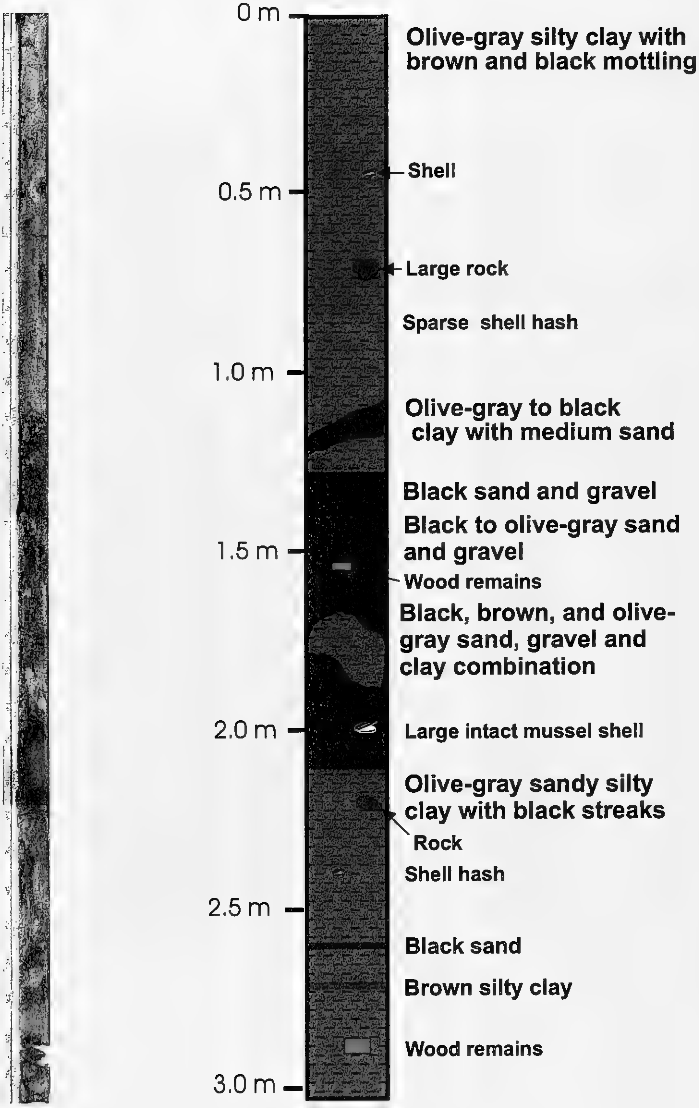


1998 Seawolf Short Cores
Core 22A

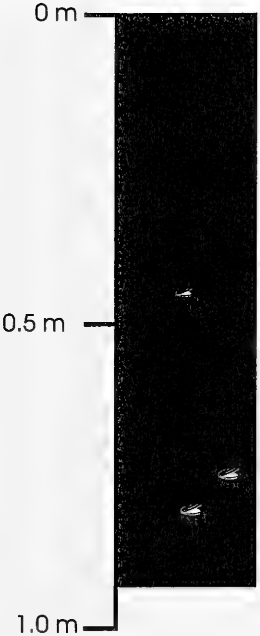




1998 Seawolf Long Cores
Core 23A



1998 Seawolf Short Cores
Core 24A

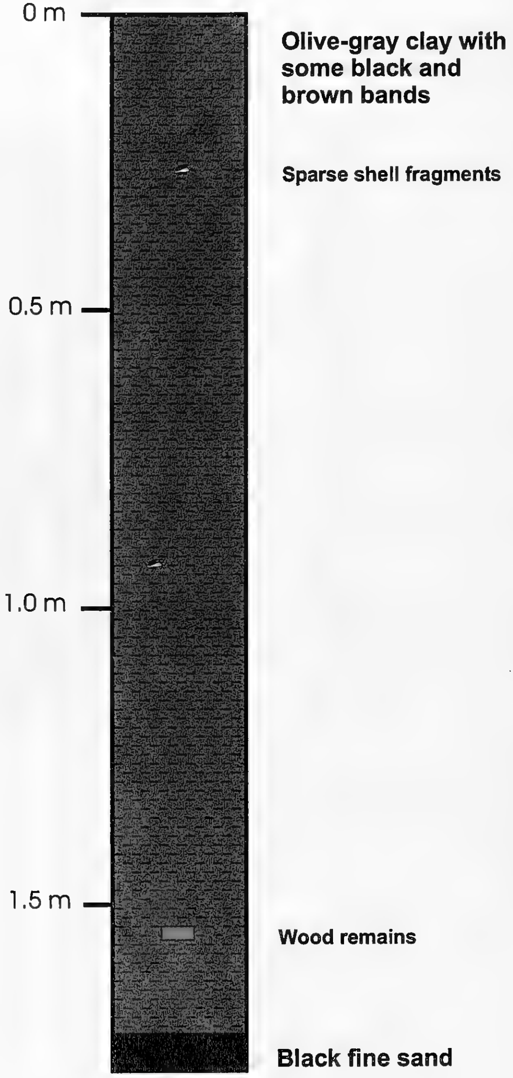


Gray clay mottled with brown and black clay nodules

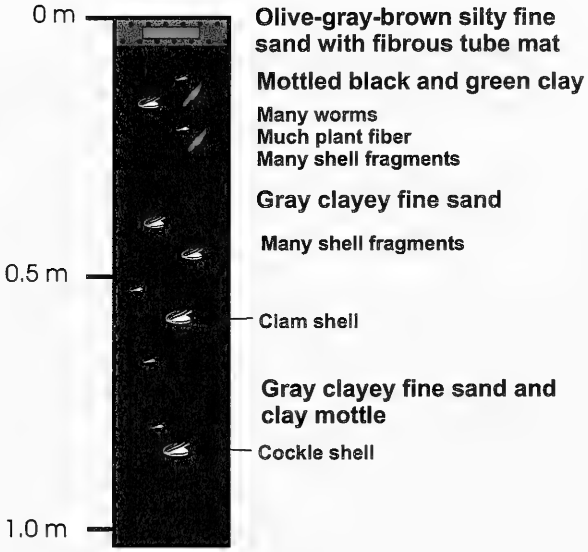
Minor shell hash

Large shell fragments

1998 Seawolf Short Cores
Core 25A



1998 Seawolf Short Cores
Core 26A



Appendix E
Pre-dredging Sediment Chemistry Results

Maguire 1995

Appendix E, CDM Pre-dredging PAHs Data (Maguire 1995)

Designated Region	Dredging Area	Sample	Year	Fluoranthene	Benzoanthracene	Pyrene	Chrysene	Phenanthrene
CDM	Area 2	5	1990	<20	<20	88	67	<20
CDM	Area 2	6	1990	85	483	<20	70	<20
CDM	Area 2	7	1990	211	467	133	109	<20
CDM	Area 4	10	1990	<20	<20	<20	<20	<20
CDM	Area 4	13	1990	<20	<20	<20	44	<20
CDM	Area 4	14	1990	<20	<20	37	<20	<20
CDM	Area 4	15	1990	<20	<20	<20	<20	<20
CDM	Area 4	16	1990	<20	<20	<20	86	<20
CDM	Area 4	17	1990	<20	<20	<20	<20	<20
CDM	Area 4	18	1990	<20	<20	<20	<20	<20
CDM	Area 4	19	1990	<20	<20	<20	74	<20
CDM	Area 4	20	1990	1100	649	1024	567	87
CDM		**Mean**	**1990**	**124**	**141**	**114**	**89**	**16**
CDM		Minimum	1990	85	141	37	44	16
CDM		Maximum	1990	1100	649	1024	567	87
CDM		**Mean**	**1994**	**33.5**	**16.6**	**35.0**	**18.6**	**13.6**
CDM	**Mean of 1990 and 1994 averages**			**78.7**	**78.7**	**74.3**	**53.8**	**15.0**

Appendix E, UDM Pre-dredging PAHs Data (Maguire 1995)

Designated Region	Dredging Area	Sample	Year	Fluoranthene	Benzoanthracene	Pyrene	Chrysene	Phenanthrene
UDM	Area 1	1	1990	378	500	192	155	<20
UDM	Area 1	2	1990	<20	<20	103	<20	<20
UDM	Area 1	3	1990	<20	<20	106	<20	<20
UDM	Area 1	4	1990	221	223	347	108	117
UDM	Area 3	8	1990	<20	<20	<20	<20	<20
UDM	Area 3	9	1990	<20	77	<20	87	<20
UDM	Area 3	11	1990	463	548	187	310	157
UDM	Area 3	12	1990	202	160	185	<20	<20
UDM		**Mean**	**1990**	**163**	**192**	**143**	**88**	**42**
UDM		Minimum	1990	202	77	103	87	117
UDM		Maximum	1990	463	548	347	310	157
UDM		**Mean**	**1994**	**110**	**44**	**100**	**58**	**46**
UDM	**Mean of 1990 and 1994 averages**			**137**	**118**	**121**	**73**	**44**
UDM	Area 1	P1 0-3 ft	1992	1000	50	1300	800	430
UDM	Area 1	P1 >3 ft	1992	50	50	50	50	50
UDM	Area 1	P2 0-3 ft	1992	1100	970	2400	1200	750
UDM	Area 1	P2 >3 ft	1992	890	420	890	550	300
UDM	Area 3	M1 0-3 ft	1992	1600	1400	2700	1500	700
UDM	Area 3	M1 >3 ft	1992	3000	2900	5200	3100	1900
UDM	Area 3	M2 0-3 ft	1992	790	540	1050	680	340
UDM	Area 3	M2 >3 ft	1992	50	50	50	50	50
UDM		Mean 0-3 ft	1992	1123	740	1863	1045	555
UDM		Mean >3 ft	1992	998	855	1548	938	575
UDM		**Mean**	**1992**	**1060**	**798**	**1705**	**991**	**565**
UDM		Minimum	1992	50	50	50	50	50
UDM		Maximum	1992	3000	2900	5200	3100	1900

Appendix E, CDM Pre-dredging Trace Metals Data (Maguire 1995)

Designated Region	Dredging Area	Sample	Year	As	Cd	Cr	Cu	Pb	Hg	Ni	Zn	% Fines
CDM	Area 2	5	1990	4.8	1.2	31.5	25.5	33.5	0.1	13.2	49.7	NA
CDM	Area 2	6	1990	4.6	2.2	34.4	24.1	35.9	0.1	16.8	61.3	NA
CDM	Area 2	7	1990	6.4	1.5	35.4	24.5	34.6	<0.02	15.9	54.7	NA
CDM	Area 4	10	1990	4.3	1.3	24.9	10.0	24.4	0	15.5	43.2	NA
CDM	Area 4	13	1990	5.8	1.3	30.4	21.2	31.4	0.1	16.3	55.0	NA
CDM	Area 4	14	1990	8.7	1.4	29.0	21.3	31.0	0	15.3	56.3	NA
CDM	Area 4	15	1990	4.3	1.0	27.5	18.8	28.0	<0.02	13.8	67.9	NA
CDM	Area 4	16	1990	6.8	0.8	26.8	18.3	21.1	0.1	16.0	46.3	NA
CDM	Area 4	17	1990	5.4	0.7	20.7	10.4	20.4	0	10.2	38.7	NA
CDM	Area 4	18	1990	7.9	0.9	25.2	15.2	24.7	0	13.0	55.0	NA
CDM	Area 4	19	1990	5.7	1.0	25.9	14.8	26.6	0	15.2	44.9	NA
CDM	Area 4	20	1990	5.5	0.8	22.0	10.7	20.7	0	13.0	46.3	NA
CDM		**Mean**	1990	**5.9**	**1.2**	**27.8**	**17.9**	**27.7**	**0.0**	**14.5**	**51.6**	**NA**
CDM		Minimum	1990	4.3	0.7	20.7	10.0	20.4	0.0	10.2	38.7	NA
CDM		Maximum	1990	8.7	2.2	35.4	25.5	35.9	0.1	16.8	67.9	NA
CDM		**Mean**	**1994**	**6.8**	**0.31**	**49.9**	**25.2**	**25.4**	**0.13**	**21.1**	**84.8**	**NA**
CDM		Mean	1990, 94	6.3	0.7	38.9	21.6	26.5	0.09	17.8	68.2	NA
CDM	**Mean(90) Norm to %Fines (42.5)**			**12.4**	**2.5**	**58.8**	**37.8**	**58.5**	**0.08**	**30.7**	**109.1**	**NA**

Appendix E, UDM Pre-dredging Trace Metals Data (Maguire 1995)

Designated Region	Dredging Area	Sample	Year	As	Cd	Cr	Cu	Pb	Hg	Ni	Zn	% Fines
UDM	Area 1	1	1990	7.7	1.1	27.8	22.5	28.3	0.1	13.4	47.3	43.5
UDM	Area 1	2	1990	7.3	1.4	39.1	40.9	58.8	0.1	24.7	83.6	45.0
UDM	Area 1	3	1990	4.3	1.4	37.5	38.7	48.0	0.1	15.7	81.3	41.5
UDM	Area 1	4	1990	8.3	1.2	34.7	34.7	40.0	0.2	14.1	73.9	42.2
UDM	Area 3	8	1990	8.0	1.5	34.9	26.4	41.8	0.1	18.1	77.6	41.8
UDM	Area 3	9	1990	7.4	1.3	29.4	22.4	30.1	0.1	15.5	59.2	46.3
UDM	Area 3	11	1990	5.8	1.2	50.0	36.9	58.1	0.3	13.6	64.1	49.4
UDM	Area 3	12	1990	7.9	1.0	31.6	32.1	41.1	0.2	11.0	62.7	30.5
UDM	Area 3	B	1994	13.1	0.6	72.8	34.9	46.4	0.2	28.9	165.0	NA
UDM		**Mean**	**1990 only**	**7.1**	**1.3**	**35.6**	**31.8**	**43.3**	**0.2**	**15.8**	**68.7**	**42.5**
UDM		**Mean**	**1990, 94**	**7.8**	**1.2**	**39.8**	**32.2**	**43.6**	**0.2**	**17.2**	**79.4**	**NA**
UDM		Minimum		4.3	0.6	27.8	22.4	28.3	0.1	11.0	47.3	30.5
UDM		Maximum		13.1	1.5	72.8	40.9	58.8	0.3	28.9	165.0	49.4
UDM	**Mean(90) Norm to %Fines (42.5)**			**16.7**	**3.0**	**83.8**	**74.9**	**101.8**	**0.35**	**37.1**	**161.7**	**NA**
UDM	Area 1	P1 0-3 ft	1992	16	3.6	120	167	160	0.4	63	295	NA
UDM	Area 1	P1 >3 ft	1992	16	2.4	54	60	47	0.1	50	145	NA
UDM	Area 1	P2 0-3 ft	1992	9.4	3.2	86	139	110	0.3	51	263	NA
UDM	Area 1	P2 >3 ft	1992	9.7	3.3	94	99	120	0.3	71	206	NA
UDM	Area 3	M1 0-3 ft	1992	12	2	150	165	170	0.6	49	189	NA
UDM	Area 3	M1 >3 ft	1992	14	3.3	230	290	250	0.9	59	345	NA
UDM	Area 3	M2 0-3 ft	1992	9.3	3	78	129	100	0.3	102	269	NA
UDM	Area 3	M2 >3 ft	1992	14	2.7	54	59	51	0.1	72	171	NA
UDM		Mean 0-3 ft	1992	11.7	3.0	108.5	150.0	135.0	0.4	66.3	254.0	NA
UDM		Mean >3 ft	1992	13.4	2.9	108.0	127.0	117.0	0.4	63.0	216.8	NA
UDM		**Mean**	**1992**	**12.6**	**2.9**	**108.3**	**138.5**	**126.0**	**0.4**	**64.6**	**235.4**	**NA**
UDM		Minimum	1992	**9.3**	**2.0**	**54.0**	**59.0**	**47.0**	**0.1**	**49.0**	**145.0**	**NA**
UDM		Maximum	1992	**16.0**	**3.6**	**230.0**	**290.0**	**250.0**	**0.9**	**102.0**	**345.0**	**NA**

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